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E-mail: uosman@aydin.edu.tr

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<td>Istanbul University, TR</td>
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From the President

It is our great pleasure to publish seventh issue of international journal, “International Journal of Electronics, Mechanical and Mechatronics Engineering” (IJEMME) of Istanbul Aydin University. Our sustainable strategy is to demonstrate new trends in science and technology subject to high quality standards by ensuring a stringent peer review process.


Manuscripts reporting original theoretical and/or experimental work and tutorial expositions of permanent reference value are highly welcome.

I sincerely wish to thank the editor in chief, members of the editorial board, and authors of this issue who have generously contributed their time and knowledge to the work and the mission of the journal.

Dr. Mustafa AYDIN
President
From Editor

In this issue of “International Journal of Electronics, Mechanical and Mechatronics Engineering (IJEMME)”, we have especially selected the scientific areas which will cover future prospective Engineering titles such as Robotics, Mechanics, Electronics, Telecommunications, Control systems, System Engineering, Biomedical, and renewable Energy Sources.

We have selected only a few of the manuscripts to be published after a peer review process of many submitted studies. Accepted papers are as follows:

An Analysis of Electro-Melting And Hot Element Welding Methods’ Safety Used to Join Pe Natural Gas Pipes
Adnan AKKURT

Evaluation of Private School Location in the Istanbul Metropolitan Area
Mehmet Topcu, Fatih Terzi, N. Ipek Cetin, Vedia Dokmeci

Parameter Tests For Image Segmentation of An Agricultural Region
Z. Damla Uça AVCI

Usage of Pictograms to Introduce Musical Instruments to Educable Mentally Retarded Children as an Alternative Method
Gunsu YILMA, Bahadir UCAN

Evaluation of Computer Algebra Systems Using Fuzzy AHP
Ilham N. HUSEYINOV, Feride S. TABAK

The Determination of Green Areas in City From The View Point of City Furniture in Eminonu
Yıldız AKSOY

Multi Segment Circular Fractal Reflect array Antenna
Bahareh Baghani BAJIRAN

Substrate Integrated Waveguide Band-Pass Filter with CPWG Fed for Radar Application in X-Band
Abbas AYARAN, J. Bagheri K., S. GOLMOHAMMADI

Analysis and Performance Measurement of Existing Solution Methods of Quadratic Assignment Problem
Morteza KARAMI, Sadegh NIROOMAND, Nima MIRZAEI, Bela VIZVARI
Formation of Watersides on The Bosporus And Spatial Development of Bosporus Waterside Gardens
Petek JAWDET ABDULLA

UWB Radar In Hidden Human Detection
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AN ANALYSIS OF ELECTRO-MELTING AND HOT ELEMENT WELDING METHODS’ SAFETY USED TO JOIN PE NATURAL GAS PIPES

Adnan AKKURT
Gazi University, Faculty of Technology, Industrial Design Engineering Dept, Ankara, Turkey

Abstract—Use of natural gas as an eco-friendly and user-friendly fuel increases day by day, in parallel to developments in industry and need for comfort. The common use of natural gas arouses interest about gas transfer and joining of pipes in order to install gas pipe lines. In this study, two methods to join PE plastic pipes are compared: electro-melting welding and hot element (butt) welding methods. Tests are applied in order to measure the leaktightness and strength properties of the joined pipes in ambient conditions similar to actual working conditions. Results of the standardized tests are compared. Consequently, electro-melting welding is found to be the ideal method for pipes of certain diameters. However, for main transfer line pipes (of larger diameters), hot butt welding gave more successful results.

Key Words: Plastic pipe welding, Electro-melting (Electrofusion), Hot butt welding, PE pipe welding, PE pipe welding safety

I. INTRODUCTION

Developments in metallurgical technology increased the demand for easy-to-shape materials resistant to environmental working conditions and having high abrasion resistance. Usage of plastic and composite materials become widespread day by day and these materials replace timber, metal, ceramic etc. However, the widespread usage of plastic materials in industry and everyday life brings along several problems. The leading problem of plastic is its negative effects on human health. Therefore, production of plastic materials is subject to very tight standards, with respect to other types of materials. Products confirming to DIN, ISO, TSE, EN etc. standards and food legislations are long lived, environment friendly and human friendly, so they should be preferred [1, 3]. Various techniques are used to produce plastics materials. However, some parts can not be produced using the existing methods. Also, some other parts can be produced, but taking a longer time and with higher costs. Welding these parts, rather than directly producing, is much more effective and gives high quality results [4].

1.1 Welding Properties of Plastic Materials

In welding process, several parameters must be taken into account. These include material properties, working conditions, time-related changes in material properties, hardening tendency after welding, chemical and heat resistance of welded material, process and post-process security, and economy. Thermoplastic materials are acceptable with respect to each of these properties. Other types of plastic materials can not be welded effectively. To join these materials, bonding and mechanical joining are preferred, rather than welding [5, 6].

During welding of plastic materials, a heat-effected region is formed around the weld beam. As a result of the pressure and polymer flux, various types of crystal occur in the welding region. In semi-crystalline materials like polypropylene, condensed flux and rapid cooling also results in certain amounts of crystallized structure. Like metals, the heat-effected region of the workpiece becomes more fragile than the main body. Due to the excess welding strength in the heat-effective region and the aggressive liquids and dissolvers, corrosion in this region accelerates. Whilst molded metals easily flow into the welding bath and fill the welding bend, viscous fluid plastics needs to be compressed and forced to the welding region. In order to do filling, such an operation is required when working with plastics. However, such pressures make the chain replace in the flow direction, which results in anisotropy. As a result, notch strength, impact strength and tensile strength on joining line level become lower related to the vertical level [4, 6, 7].
1.2 Welding Methods Applied on Plastic Materials and the Effective Parameters

The leading methods applied to thermoplastic materials are the following ones:

- Hot Element (Butt) Welding
- Hot Gas Welding
- Extrusion Welding
- Electrofusion Welding
- Implant Induction Welding
- Infrared and Laser Welding
- Resistive Implant Welding
- Ultrasonic Welding
- Linear and Orbital Vibration Welding
- Spin (Friction) Welding
- Radio frequency Welding
- Microwave Welding

Each of these methods used to weld plastics has advantages and disadvantages. Hot Element (Butt) and Electrofusion (electro-melting) welding methods are widely used pipe melding methods to join polyethylene (PE) natural gas pipes. Reaching to a targeted quality in plastic welding requires an optimum combination of the following parameters:

- **Temperature:** External surfaces of welding components are softened with heat (hot element, hot gas or friction). Direct flame is not preferred because of bad heat conductivity of plastics. If used, the materials would probably start burning before getting deeply hot. Similarly, if heated plastics are cooled suddenly with pressure air or water, sudden tensions occur in the welding region.

- **Pressure:** As melted plastic is viscous, not fluid, the fibres slipping into each other should be supported with pressure.

- **Time:** Because of poor heat conductivity of plastics materials, heating time and cooling time must be determined very carefully. If the melting heat source is not removed from the ambient for a long time, thermal damages emerge. Expansion and contraction degrees in plastic materials during the heating and cooling applications are higher than metals, which must be taken into account [4, 8, 9].

2. JOINING METHODS

2.1 Hot Element (Butt) Welding

Hot element butt welding is a commonly preferred method, because it is more simple, safe, secure and economical. Joining components are heated with a hot element in touch or radiation. When they are softened enough, components are joined under a certain pressure. An additional element can be used to press. The process can be named as direct heating or indirect heating hot element welding, depending on the preferred method. Graphic representation of welding steps is given in Figure 1. As can be seen in this graph, the process includes five steps [11].

**Alignment:** Joining parts are aligned to the heated tool in a parallel fashion to the tool. The parallelism should be controlled with the help of bead height. Alignment should be performed under P1 pressure for T1 time period. T1 is determined according to the bead height. The minimum bead height levels are given in Table 1.

**Heating-Up:** In this step, first the pressure applied for alignment is eliminated rapidly. So, the welding components are in touch with the heated tool under nearly no pressure (interface pressure). Meanwhile, heat moves on in the direction of pipe axis. Heating time T2 is given in Table 1. If this period is adjusted shorter than its optimum, the depth of melted plastic becomes shorter than the required depth. If this period is too long, the butt welding region will melt too much and degenerate.

**Removal of Heated Tool:** After heating-up, joining regions are detached from the heated tool. The joining regions should not be damaged or contaminated during this process. The removal time should be as short as possible. If joining process is not done quickly, cooling and oxidizing will occur in the joining regions and welding quality will deteriorate. The maximum time of removal (T3) is given in Table 1.

**Joining:** When the heated tool is removed, the joining regions are drawn closer to each other, but this must not be a beat. The desired P3 level of pressure (interface pressure) should be reached with linear increment. The required time T4 is given in Table 1.

**Cooling:** The joining (interface) pressure P3 must be kept constant while cooling. After joining process is completed, smooth dual bead forms up [13 – 15].
AN ANALYSIS OF ELECTRO-MELTING AND HOT ELEMENT WELDING METHODS’ SAFETY USED TO JOIN PE NATURAL GAS PIPES
(Adnan AKKURT)

Figure 1. Graphical representation of process steps of hot element welding [10]

Table 1. Welding parameters suggested in hot element welding [10]

<table>
<thead>
<tr>
<th>Nominal Wall Thickness mm</th>
<th>Alignment</th>
<th>Heating - Up 10 X wallthickness (heating-up with ≤ 0.02 N/mm²)</th>
<th>Changeover</th>
<th>Joining pressure build-up time (P=0.15 N/mm² ± 0.01)</th>
<th>Cooling time under joining pressure ± 0.01</th>
</tr>
</thead>
<tbody>
<tr>
<td>4,5</td>
<td>0,5</td>
<td>45</td>
<td>5</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>4,5 – 7</td>
<td>1,0</td>
<td>45 – 70</td>
<td>5 – 6</td>
<td>5 – 6</td>
<td>6 – 10</td>
</tr>
<tr>
<td>7 – 12</td>
<td>1,5</td>
<td>70 – 120</td>
<td>6 – 8</td>
<td>6 – 8</td>
<td>10 – 16</td>
</tr>
<tr>
<td>12 – 19</td>
<td>2,0</td>
<td>120 – 190</td>
<td>8 – 10</td>
<td>8 – 11</td>
<td>16 – 24</td>
</tr>
<tr>
<td>19 – 26</td>
<td>2,5</td>
<td>190 – 260</td>
<td>10 – 12</td>
<td>11 – 14</td>
<td>24 – 32</td>
</tr>
<tr>
<td>26 – 37</td>
<td>3,0</td>
<td>260 – 370</td>
<td>12 – 16</td>
<td>14 – 19</td>
<td>32 – 45</td>
</tr>
<tr>
<td>50 – 70</td>
<td>4,0</td>
<td>500 – 700</td>
<td>20 – 25</td>
<td>25 – 35</td>
<td>60 – 80</td>
</tr>
</tbody>
</table>

Bead dimensions and form reveal the smoothness of the welding. Different types of bead forms can be formed in relation to the melt flow. The bead height must always be bigger than zero. Examples to bead formation defects due to inappropriate parameters and conditions can be seen in Figure 2.

The inappropriate conditions and their possible defects are summarized in Table 2. Figure 3.a shows an example of coin image. Figure 3.b and 6.c shows the results of an appropriate joining with appropriate parameters and application [14, 15].

Figure 2. Bead formations [14, 16, 17]

Table 2. Hot element welding problems and their possible reasons [16]

<table>
<thead>
<tr>
<th>Problem</th>
<th>Reason</th>
</tr>
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<tbody>
<tr>
<td>Excess bead width</td>
<td>Excess heating or excess joining pressure</td>
</tr>
<tr>
<td>Excess space height in the middle of the bead</td>
<td>Excess joining pressure; inadequate heating; Pressure during heating</td>
</tr>
<tr>
<td>Flat bead top</td>
<td>Excess joining pressure; excess heating</td>
</tr>
<tr>
<td>Non-uniform bead around pipe</td>
<td>Incorrect position (centring); defective heating tool; inadequate treatment</td>
</tr>
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</table>
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(Adnan AKKURT)

<table>
<thead>
<tr>
<th>Smaller beads</th>
<th>Inadequate heating; inadequate joining pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not rotating bead to pipe exterior surface</td>
<td>Little space in the middle of bead: Inadequate heating and inadequate joining pressure</td>
</tr>
<tr>
<td></td>
<td>Large space in the middle of bead: Inadequate heating and excess joining pressure</td>
</tr>
<tr>
<td>Bigger beads</td>
<td>Excess heating time</td>
</tr>
<tr>
<td>Square external surface of bead</td>
<td>Pressure applied during heating</td>
</tr>
<tr>
<td>Rough bead surface</td>
<td>Hydrocarbon spread to butt welding region during welding process</td>
</tr>
</tbody>
</table>

Figure 3. a) Inappropriate welding parameters b) Appropriate welding parameters c) Appropriate welding parameters and pipe internal surface appearance [18]

Figure 4. Temperatures with respect to wall thicknesses [19]

Temperature, heating time, cooling time, removal time of heated tool and pressure are among effective parameters of hot element welding. Change in temperatures according to the nominal pipe wall thickness values are given in Figure 4. As seen in the graph, while high temperatures are needed for thin walls, thick walls require low temperatures.

- It is necessary for both properly centring the pipes and preventing them from leaving the heads and giving harm to operator during treatment.
- During butt welding process (including cooling time) welding components should not be exposed to any kind of mechanical force or coercion. Other end of the pipe should be on a sliding ground, so it can move easily. It is necessary for easy feed forward and feedback without applying any force to butt welding region.
- Treatment tool should be sufficiently sharp. The blade must be sharpened or changed at certain intervals.
- There should not be any deep scratches or notches on teflon coat of the heated tool. Surface of the tool must be checked at certain intervals [11, 20].

2.1.1 Important Points about Hot Element Welding Quality

In order to obtain a successful butt weld;
- Welding components should match each other in form. The working area should be protected against moisture, wind and low temperature, which affect the butt welding parameters negatively.
- The butt welding region should be protected against direct sunlight etc. to be sure that faces of welding components are at the same temperature at the end of the heating time.
- Dust, shavings etc. on the faces of welding components should be removed before butt welding process.
- Pipes should be properly bound to heads before starting butt welding process.
2.2 Electrofusion (Electro-Melting) Welding

Resistive implant welding is a simple technique applicable to any kind of thermoplastics and thermoplastic composites. In this method, a direct or low frequency alternating current is drawn into an electric conductor implant material (resistance wire) placed between the welding components; so thermoplastic around this implant melts down. Resistive implant welding is widely used for welding pipes with electro-melting. A specially designed socket with electric resistive cables is used for joining. In our country and in the world, custom-engineered sockets are used in butt welding of polyethylene natural gas and water pipes, for T-branching of pipes and valve assembling to pipes. The common name of the method is electro-melting. Even though the principle of electro-melting method is new, the use of resistance wires for heating dates back to 1900s. In 1956, Mannesman AG improved electro-melting method for the first time to join PE pressure pipes [21]. Electro-melting method is widely used nowadays to join pipes of 20 – 200 mm diameter. Each joining element (fitting, sleeve or socket) in this system is equipped with an integrated heating wire (electric resistance cable), embedded and close to the melting surface (Figure 5, Figure 6). Wire wounds can be single or double wound. Main advantage of single wound to double wound is elimination of a possible short circuit during melting process. When a current generator equipped with a voltage regulator and a timer system is switched on, inner side of the joining element is melted by means of heating elements. Internal diameter of the joining elements should be 1.1% larger than the external diameter of joining pipe. When the joining element is heated, this space between pipe and the element decreases due to thermal expansion (Figure 7).

Melting material creates pressure, which is necessary for adhesion of the joining element and the pipe. Interfacial heat is provided by a current generator. This energy depends on the wound resistance, voltage applied and heating time. Melting time can be controlled automatically via a control box, depending on these parameters. The voltage is about 35 – 40 V; a regulator is needed to optimize this energy and to maintain a decisive voltage. The welding system is shown schematic in figures.

It is determined that performance of an electro-melted welding is much better than the performance of pipes, as long as the joining process is well done. Wire wounds contribute to this performance. Also, slow cooling of the joining region affects positively. Main negative effect on performance is dirty surfaces [23].

In order to eliminate the risk, the pipe is generally shaved before welding process. Various apparatus are developed to mechanically remove chips of certain height and thickness from external diameter of the pipe.

Some space between the joining element and the pipe (Table 3) is crucial for an ideal joining process [24].

<table>
<thead>
<tr>
<th>Pipe External Diameter ØD (mm)</th>
<th>Space Width t (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤355</td>
<td>0.5</td>
</tr>
<tr>
<td>400 &lt; 630</td>
<td>1.0</td>
</tr>
<tr>
<td>630 &lt; 800</td>
<td>1.3</td>
</tr>
<tr>
<td>800 ≤ 1000</td>
<td>1.5</td>
</tr>
<tr>
<td>&gt; 1000</td>
<td>2.0</td>
</tr>
</tbody>
</table>
2.2.1 Conditions and Parameters of Electro-Melting Welding

- Plastic pipes of same raw material can be welded with electro-melting welding.
- Flow rate of melted material for electro-melting welding of YYPE pipes is between 0.3 – 1.7 g/min. Solution flow rate of welding pipes and sleeve should be within these values. Pipes with same solution flow rate can be welded.
- The welding region must be kept safe from adverse weather conditions (snow, rain, wind, effective sun light etc.).
- Ambient temperature should be between 5°C and 50°C.
- Generally there are barcode readers on electro-melting welding machines; and barcodes are on electro-melting additional materials (sockets), indicating necessary welding parameters. The welding parameters can be uploaded to the machine via barcodes but welding parameters written on the additional materials can also be saved to the welding machine manually [25].

3. EXPERIMENTAL STUDIES

3.1 Material

In this study, polyethylene (PE 100) plastic material used in natural gas pipe production is analysed. Polyethylene is one of the most commonly used materials in industry; because this material is elastic, resistant to earthquakes and landslides; it reserves its elasticity at -40°C temperature; it is also resistant to chemicals, abrasion and corrosion. As there is not any molecule changeover between polyethylene pipe and the fluid inside, there is not any carcinogenic effect. Polyethylene is 8 times lighter than metals, because of its lower density.

Some samples are joined with hot butt welding using Taurus Welding Machine, in accordance to the parameters given in Table 4. Then, other samples are joined with MSA 300 electrofusion welding machine. Parameters of this welding process are given in Table 5.

3.2 Method

In this study, polyethylene natural gas pipes of 20 – 315 mm nominal diameters are joined with butt welding methods. These pipes can be used under 4 bar pressure and 60°C temperature at maximum.

<table>
<thead>
<tr>
<th>Table 4. Hot butt welding parameters and properties of welding equipment [28]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process Parameters</td>
</tr>
<tr>
<td>Heating up temperature</td>
</tr>
<tr>
<td>Heating element temperature</td>
</tr>
<tr>
<td>Heating up temperature</td>
</tr>
<tr>
<td>Joining temperature</td>
</tr>
<tr>
<td>Changeover time</td>
</tr>
<tr>
<td>Joining and cooling time</td>
</tr>
<tr>
<td>Working pressure</td>
</tr>
<tr>
<td>Fluid Flow Rate</td>
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</tbody>
</table>

<table>
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<tr>
<th>Taurus Welding Equipment Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conforming TS ISO 12176-1 norms</td>
</tr>
<tr>
<td>380V-2200 Watt Treatment Tool</td>
</tr>
<tr>
<td>5000 Watt Mono Block Heater Iron</td>
</tr>
<tr>
<td>Three-faze Hydraulic System</td>
</tr>
<tr>
<td>380V-2,2 kW (16 li/min -150 Bar)</td>
</tr>
</tbody>
</table>

Welded samples conforming to standardized dimensions are tested in appropriate conditions for each test. Some tests gave numerical values; whereas in some tests, the changes and negativities
in joining regions are evaluated and formation of any damage is questioned. Each test is applied to 4 – 8 samples, depending on nature of test; and the arithmetical means are calculated. In the tests about damage formations, samples are evaluated individually. If none of the samples are damaged, the result is indicated as DAMAGE FREE. In pressure tests, ALC BTC Pressure Test Devices are used. Also, other examinations are carried by hand, tensile strength test device and bending test devices. Outcomes are given in Table 6.

Table 5. Electrofusion welding parameters [21]

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working temperature</td>
<td>-10°C – 45°C</td>
</tr>
<tr>
<td>Mains Voltage</td>
<td>180V – 264V AC</td>
</tr>
<tr>
<td>Input Voltage</td>
<td>380 Volt</td>
</tr>
<tr>
<td>Mains Frequency</td>
<td>45 Hz – 65 Hz</td>
</tr>
<tr>
<td>Fusion Welding Voltage</td>
<td>8 – 42 (48) V AC</td>
</tr>
<tr>
<td>Fusion Welding Power</td>
<td>Max. 80A</td>
</tr>
<tr>
<td>Use of Power</td>
<td>Max. 3780 W</td>
</tr>
<tr>
<td>Protection</td>
<td>1 / IP65</td>
</tr>
<tr>
<td>Power Capacity</td>
<td>3.5 KW</td>
</tr>
<tr>
<td>Welding Time Interval</td>
<td>Min. 20 min. Max. 30 min.</td>
</tr>
</tbody>
</table>

The most important point to remember when carrying a test is that butt welding can only be applied to pipes with same polymer structure. So, polyethylene (PE 100) plastic material is used in the study. Polyethylene is among widely used plastic materials. High density polyethylene (HDPE) pipes are subject to least abrasion in nature. As seen in a small abrasion of 0.09 mm is observed in the internal surface of HDPE pipes after first 100000 test cycles [27]. Methane permeability of samples prepared with natural gas pipes is maximum 0.075m2/bar a day, for at least 2 mm-thick samples. For butt welding, new material should be used because new materials are resistant to crack formation and propagation. If old materials are welded, crack formation is generally seen near the welding region. For this reason, developed countries occasionally withdrew their old materials from markets [28].

4. EXPERIMENTAL DATA AND DEBATE

The most delicate issue in welding in relation to the welding quality and post-process safety of pipes is positioning the pipes in line. Nominal wall thickness difference should not exceed %10. When cooling process is completed, the pipe is removed from machine. Adequacy of welding, bead width, bead height, presence of any dirt on the joining region, space on heat-effected region and presence of cracks, fractures etc. in adhesion region must be controlled visually. If the visual control is satisfactory, tests should be applied according to international standards. If visual control is not satisfactory, joining process should be repeated after the required pre-treatment process is completed (treatment and cleaning of both pipes after removal of beads). Tests are applied to production and quality control of PE pipes, according to the following standards. Pipes can be conveyed after these tests and controls are completed [29, 30].

Determination of Density (ISO 1183)
This test aims to determine material’s weight in unit volume. The material is first weighed in air then in a fluid of a known density with analytical balance. The density of material is calculated using the standardized calculation method.

Determination of MFI (ISO 1133)
This process is carried on in order to evaluate behaviour of materials in relation to temperature changes, before processing the material. Samples are weighed with analytical balance after being tested by MFI device. The weight values are uploaded to the device and results are obtained in g/10 min.

Tensile Strength (ISO 527)
In this test, material’s strength to forces is analysed. The tensile strength and elastic module is determined.

Tensile Elongation (ISO 527)
In this test, elongation amount of the material at break is determined as percentage (%).

Hydrostatic Pres. Test (ISO 9080 EN 921)
In this test, behaviour of pipes under pressure in time is determined under abbreviated ambient conditions. High pressure is applied on the pipes.
and changes in the pipes in a time equivalent to 50 years are observed.

**Homogeneity Test (ISO 13949)**
This test is carried on to analyse homogenous pigment dispersion and possible spaces in material structure. A microtome cross section of 10-15µm is examined with microscope.

**Carbon Black Amount Analysis (ISO 6964)**
This test aims to determine the carbon amount in percentage (%) added to the material homogenously.

<table>
<thead>
<tr>
<th>HYDROSTATIC INTERNAL PRESSURE TEST REPORT (F50)</th>
<th>PE 100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrostatic Strength (80°C,165 h)</td>
<td>Damage Free</td>
</tr>
<tr>
<td>Hydrostatic Strength (80°C,1000 h)</td>
<td>Damage Free</td>
</tr>
<tr>
<td>Hydrostatic Strength (20°C,100 h)</td>
<td>Damage Free</td>
</tr>
<tr>
<td>Determination of Gas Flow Rate/Pressure Decrease Relation UGETAM Test Report</td>
<td>At 0.5 mbar ≥ 0.25 m/sec</td>
</tr>
<tr>
<td>Leaktightness Under Bending and Temperature Conversion Conditions Experiment</td>
<td>Damage Free</td>
</tr>
<tr>
<td>Tensile Test Under Constant Speed and Constant Load at 23°C Test Report (F61)</td>
<td>Damage Free</td>
</tr>
<tr>
<td>Leaktightness After Tensile Test at 80°C Test Report (F60)</td>
<td>Damage Free</td>
</tr>
<tr>
<td>Leaktightness in Temperature Conversion Experiment Report (F62)</td>
<td>Damage Free</td>
</tr>
<tr>
<td>Hydrostatic Strength 80°C, 165 h Hydrostatic Pressure Test Report (F50)</td>
<td>Damage Free</td>
</tr>
<tr>
<td>Density Raw Material Quality Control Report (F39)</td>
<td>959 kg/m³ PE 100</td>
</tr>
<tr>
<td>Hydrostatic Strength 80°C, 1000 h Hydrostatic Pressure Test Report (F50)</td>
<td>944 kg/m³ for PE 80</td>
</tr>
<tr>
<td>Hydrostatic Strength 20°C, 100 h Hydrostatic Pressure Test Report (F50)</td>
<td>Damage Free</td>
</tr>
<tr>
<td>MFR Raw Material Quality Control Report (F39)</td>
<td>0.40 (190°C/5 kg) PE 100</td>
</tr>
<tr>
<td>Splice Strength Report (F 96)</td>
<td>0.88 (190°C/5 kg) PE 80</td>
</tr>
<tr>
<td>Impact Resistance UGETAM Report</td>
<td>%100 Fusion</td>
</tr>
<tr>
<td>Pressure Drop UGETAM Report</td>
<td>Damage Free</td>
</tr>
<tr>
<td>Oxidation Induction Time</td>
<td>At 0.5 mbar ≥0.33 m/sec</td>
</tr>
<tr>
<td>Electrical Properties Process Control Form (F-12)</td>
<td>33 min</td>
</tr>
<tr>
<td>The statement DAMAGE FREE indicates that no leakage or deformation is observed.</td>
<td></td>
</tr>
</tbody>
</table>

4.1. **Comparison of Butt – Fusion and Electrofusion Welding**

When PE pipes are heated up the material properties become weaker at a factor of 0.8. This situation is true only for butt-fusion. For electrofusion welding, it doesn’t occur considerable amount of weakening since wall thickness increases (pipe + fitting) at the same time. For butt fusion, obtaining high quality welding is not possible all the time due to necessity of very high man skill, the use of complicated welding machines for welding process, low resist to the pressure at the welding place and also high possibility of leaking [21, 35]. For electrofusion however, at a minimum level of operator knowledge is necessary and it is easier. Also, the welding process can be done with easily usable welding machines giving high quality all the time (Table 7). If one wants to use SDR 17 pipes, they should at least take away the welding bead. As by the bead the pipe is weakened additionally, especially at the outside by the tensile stresses. This is particularity true for PE 100, where the stress concentration factor (another factor to multiply the original strength with) of the notch will weaken the pipe again and very severely [36]. When it is compared in the aspect of both safety and economical respects using of electrofusion welding technique instead of butt – welding is much more proper. Using of electrofusion welding techniques have been increasing rapidly in many countries even for large diameters [21]. But it can be said in general, that there is a much higher risk of failures because of bad workmanship during welding while applying butt fusion compared to electrofusion. A higher possibility of bad workmanship of the welder can create massive problems in the long-term behavior of pipes.

**Calculation of operating pressure:**

\[
P = \frac{20 \times MRS}{500} \text{ bar} \quad (1)
\]
AN ANALYSIS OF ELECTRO-MELTING AND HOT ELEMENT WELDING METHODS’ SAFETY USED TO JOIN PE NATURAL GAS PIPES
(Adnan AKKURT)

C x (SDR -1)

P : Operating pressure (bar)
MRS : Minimum circumferential strength (10Mpa for PE 100)
C : Safety factor (Cmin = 1.25)
SDR : Standard dimension ratio

Operating pressure for PE 100 SDR 17 pipe:

\[ P = \frac{20 \times 10}{1.25 \times (17 - 1)} = 10 \text{ bar} \quad (2) \]

Operating pressure for PE 100 SDR 11:

\[ P = \frac{20 \times 10}{1.25 \times (11 - 1)} = 16 \text{ bar} \quad (3) \]

For butt-fusion welding:
PE 100 SDR 17 pipe “ 10 x 0.8 = 8 Bar
PE 100 SDR 17 pipe ” 16 x 0.8 = 12.8 Bar

Conclusion:
1 – For the piping system where the pressure is 10 bar, if butt-fusion is used the PE 100 SDR 11 should be used. However, this increases the cost of pipe at a percentage rate of %50.
2 – For the piping system where the pressure is 10 bar, with using PE 100 SDR 17 and electrofusion welding technique it is possible to obtain the strength of 10 bar [21].

Table 7. Comparison of Butt – Fusion and Electrofusion Welding [21, 34]

<table>
<thead>
<tr>
<th>General Criteria</th>
<th>Electrofusion</th>
<th>Butt-fusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating pressure for straight piping system</td>
<td>Same with operating pressure of selected pipe.</td>
<td>Decreases 20 % of operating pressure of selected piping system. (The piping system which is designed for 10 bar can only be operated at 8 bar).</td>
</tr>
<tr>
<td>The effects of components like elbow and tee to the operating pressure of piping system</td>
<td>Same with operating pressure of selected pipe.</td>
<td>Operating pressure of selected piping system: decreases at a rate of; At tee components = % 80 + % 50 At elbows = % 80 + % 80 Example: For the fittings which is manufactured by using 10 bar pipe: Working pressure at tee : 10x0.8x0.5 = 4 bar Working pressure at elbow : 10x0.8x0.8 = 6.4 bar</td>
</tr>
<tr>
<td>Reduction in the inner diameter of the pipe</td>
<td>Reduction doesn’t occur in the inner diameter of the pipe.</td>
<td>Reduction occurs in the inner diameter of the pipe.</td>
</tr>
<tr>
<td>The cost of machine equipment</td>
<td>The cost of standard electrofusion welding machine is 2500€</td>
<td>The cost of standard butt-fusion welding machine is between 5000€ and 30000€</td>
</tr>
<tr>
<td>The usable flexibility of machine equipment</td>
<td>An electrofusion welding machine can be used for all diameters of the pipe</td>
<td>A butt-fusion welding machine cannot be used for all diameters. The machine must be changed for some intervals according to diameters of the pipe.</td>
</tr>
<tr>
<td>The weight of the machine equipment</td>
<td>20 kg</td>
<td>150 – 300 kg</td>
</tr>
<tr>
<td>Welding speed</td>
<td>For d 125 pipe 50 welding operation can done in one day</td>
<td>For d 125 pipe 15 welding operation can done in one day</td>
</tr>
<tr>
<td>Necessity of the fitting material</td>
<td>Additional coupler is necessary for straight piping system</td>
<td>Nothing is necessary for the piping system</td>
</tr>
<tr>
<td>The automation of welding process</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Needed skill for the operator</td>
<td>Little</td>
<td>Middle</td>
</tr>
</tbody>
</table>

Taking all these comparisons into account, it is found out that the ideal welding method for PE pipes up to 250 mm diameter is electrofusion welding method.
The long term tensile test, which the relevant test to show the long term behaviour of plastics in known conditions, will show a long term welding factor of 0.8, which means a reduction of 20% of the strength, compared to unwelded material. Therefore I would like to confirm to you, that altogether form a safety and economic point of view, it is certainly better to use electrofusion rather than butt fusion [36].

If butt welding method is applied with optimum welding parameters, welding quality is generally high and excellent leaktightness is achieved. However, material hardness increases and elasticity declines in and around the joining region.

PE plastic pipes of 250 mm and bigger diameters should be joined with hot butt welding. Methods other than butt welding do not give good results for such big diameters. Also, components welded by hot butt welding gave best results in folding tests, compared to other welding methods. The welding temperature and change in size of weld had negative effects under pressure in both of the different processes. Expansion of welding region narrows the cross section. These shrinkages result in a decrease of natural gas transfer pressure.

5. CONCLUSIONS

Welding of PE pipes used for natural gas transfer is important in relation to its effects on human life, industry and environment. Hot butt welding method is widely preferred as a cheap and easy method. But, internal beam formed during joining process reduces gas flow in small quantities. On the other hand, electrofusion method gives better results in pipes of certain diameters. However, penetration and space formation are its main disadvantages.

In this study, tests are carried in accordance with international standards. It is found out that the most preferable method for joining PE pipes is hot butt welding method, in terms of easiness, safety, durability and economy.

7. REFERENCE


AN ANALYSIS OF ELECTRO-MELTING AND HOT ELEMENT WELDING METHODS’ SAFETY USED TO JOIN PE NATURAL GAS PIPES
(Adnan AKKURT)


EVALUATION OF PRIVATE SCHOOL LOCATION IN THE ISTANBUL METROPOLITAN AREA

1Mehmet TOPÇU 2Fatih TERZİ 3N. İpek ÇETİN 4VEDİA DÖKMÈCİ

1Department of Urban & Regional Planning, Faculty of Architecture, S.U., Konya, Turkey
e-mail: topcu@selcuk.edu.tr
2Department of Urban & Regional Planning, Faculty of Architecture, I.T.U., Istanbul, Turkey
e-mail: terzifati@itu.edu.tr
3Department of Urban & Regional Planning, Faculty of Architecture, I.T.U, Istanbul, Turkey
e-mail: nipekcetin@gyte.edu.tr
4Department of Urban & Regional Planning, Faculty of Architecture, I.T.U, Istanbul, Turkey
e-mail: dokmeciv@itu.edu.tr

Abstract—Investment in education is considered important for economic growth and poverty alleviation. In many developed and developing countries families contribute privately to the education of their children as a result of continuously shrinking public budgets. Also, in Istanbul private primary schools were supported by the government in order to answer to increasing demand due to continuous rural migration and to create a competitive educational market to improve the quality of primary education. This paper, first, analyzes the spatial distribution of private primary schools according to the concentric rings and illustrates the gap between the center and the periphery and among the districts. Then, the relationships between the number of private primary schools and demand and the characteristics of the districts are investigated by a regression analysis. According to the results, the number of public primary schools is the most important factor and GDP per capita is the second factor to affect the number of private primary schools in the districts. Currently, the cluster of private primary schools mainly in high-income districts does not allow developing a competitive educational market at the metropolitan level. It is expected that a more balanced market will be develop as the urban structure of Istanbul adjusted to the neo-liberal economies in the future. The results are useful for urban planners, investors and policy makers. Further research is suggested to investigate the impact of private primary schools on the quality of public primary school education in Istanbul.

Key Words: Primary education, Private education, Location, Urban development, Istanbul.

1. INTRODUCTION

Generally, the role of human capital with a good educational level is taken an indispensable determinant of economic growth [1]. Especially, in developing countries, large amount of school age population increases the dimension of this responsibility. For this purpose, provision of quality and equity of education is very crucial. Recently, globalization put even more pressure on the developing countries governments to increase spending on education to produce a more educated and competitive labor force. On the other hand, global finance capital pressures governments to reduce the growth of public spending on education and to find other sources of finding for the expansion of their education systems. In many countries, public schools face strong pressures to upgrade and expand facilities and deliver better, more advanced, and higher-quality education while tax revenues and therefore budgets are shrinking each year [2]. School districts have few resources to address the pressing space needs especially in developing countries. In this case, private investment becomes inescapable approach to supply educational facility needs in societies with a rapidly growing young population. In addition, a number of studies demonstrate that private participation can encourage the public sector to improve the quality and efficiency of public schools [3, 4]. The present study is concerned with the growth of the number of private primary schools and their spatial distribution with respect to demand and characteristics of districts in Istanbul.

In the developed countries, private investment in primary education facilities has started long before the developing countries. The school finance landscape in the US has changed dramatically in the past forty years. Most states have undertaken major changes to their school finance programs, motivated principally by the notion that the unequal school resources associated with unequal incomes and community sorting lead to unequal educational and labor market outcomes [5]. Apart from recent studies by Hoxby [6] and Dee [7] that show that private primary schools raise the quality of public education, there is very little empirical evidence in the US [8]. Moreover,
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foundings Gibbons, Machin and Silva [9] for English primary schools suggests that competition has no causal effect on the performance of schools. However, Arum [10] illustrated that public school students in US with private school sectors have improved educational outcomes. Bashir [11] reviewed the size of the private sector in 35 countries found that most developing countries in the sample have large private sectors at the secondary level accounting for at least 20% of total enrolment. Problems with public schools are usually more severe in low-income countries, since the quality and integrity of public sector service delivery is highly correlated with income levels [12, 13].

A large number of developing nations are in the process of decentralizing basic education, with the aim of diversifying revenue sources and introducing greater accountability and efficiency. This is especially true in Latin America, where Chile introduced the first significant reform in 1981 [14]. Studies illustrate that there is a remarkable willingness of households to pay for private education in even low-income countries such as Bolivia [12], Other developing countries also illustrate achievements in this trend such as Pal [15] argues that local public infrastructure exerts a significant and positive effect on the presence of private school as well as the quality of schooling in India villages as well as [16]. Glewwe and Patrinos [17] demonstrate that willingness to spend on education is increasing as household incomes rise in Vietnam, which is switching from a centrally planned to a market economy. Xu [18] shows that private education is gaining importance in China as a result of reforms in the China’s education sector over the last two decades that have sought diversity of funding in education as also described by others [19, 20]. The growth of private schools is also observed in other Asian and African developing countries [21] such as in Bangladesh and Pakistan [22, 23], Cote d’Ivoire [24] Nigeria [4, 25] and in Ghana [26].

Moreover, the previous studies illustrate that location of private primary school plays an important role in the enrolment to schooling in developed and especially in developing countries and varies according to the income of people. The study by Downes and Greenstein [27] examines the location choice of California private schools in 1978-79. The results indicate that the character of the population and the public schools influence location decisions. In Brazil, the study by Pizzolato, Barcelos and Nogueira [28] is concerned with the location of primary public schools. It is illustrated that a number of factors, such as questionable educations quality, limited capacity, poor location and social preferences, secure a participation of about 30% to the private school system. In Ghana, Fentiman, Hall and Bundy [26] investigated the impact of location, gender, age, and health on children access to basic schooling. The stark contrast in enrolment between the disadvantaged north and the south of the country is also confirmed.

Although private school law was passed in 1965 in Turkey, the number of private schools was not increased until 1985 in which free economy principles started to be implemented and government subsidy were provided. In other countries also, private primary schools are subsidized by governments [29] The main purpose of Turkish government policy is to provide private participation as an answer to the dramatic growth of demand for primary education, to modernize education system and facilities and to create a competitive market to improve the quality of public schools. Thus, after 1997 on the total, primary schooling increased from 80% to 90%. Private sector provided modern facilities and introduced modern technology into the education system [30]. Despite this achievement, there is still way to go to reach the AB goal for the girls at least 85% primary school education. The ratio of GDP spent for education in Turkey increased from 2.18 in 2006 % to 2.51% in 2009 and the Budget of Education ministry increased from 9.47% in 2006 to 10.64% in 2009 [31] which over passed the AB and OECD countries. Public and private spending all together is not successful to reduce the inequalities among the localities. While traditionally public schooling systems have been neighborhood based, private primary schools have larger market areas by providing transportation services for long distances.

The present paper investigates the spatial distribution of private primary schools in Istanbul. According to previous studies, locational decisions of all types of private schools depend most on characteristics of the community in which a school locates [27]. Therefore, in this study, the relationships between the number of private primary schools and the characteristics (5-14 age group population, GDP per capita, distance to the CBD, land price, population [32] density and number of public schools) of the districts are analyzed by the use of a regression analysis. The organization of the paper is as follows. Background information about the characteristics of the districts and the development and the spatial distribution of private primary schools are given in section two. In the third section, the relationships between the number of private primary schools and the characteristics of the districts are investigated by the use of regression analysis. The final section is devoted to a conclusion and suggestions for further research.

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2. BACKGROUND

Most developing countries provide public education free or at minimal cost to their citizens. But because of recent increasing fiscal constraints, many countries have difficulties to provide free public education especially in the countries where the demand for schooling is projected to increase dramatically during the next decades. In order to solve this problem, some countries started to charge tuition fees, some others depend on private schools to handle at least part of the expansion [33]. In Istanbul, both systems were implemented to some extent. Private schools by attracting higher quality teachers and building higher quality facilities compete for students from upper and middle-income families. On the other hand, in public schools, families share heating expenses in order to contribute to the increasing operational costs of educational buildings.

Private provision and funding at all levels of education is widespread in developing countries. Bashir [11] reviewed the size of the private sector in 35 countries found that most developing countries in the sample have large private sectors at the secondary level accounting for at least 20% of total enrolment. Also, in Turkey, after 1980s, the number of private primary schools was increased with the government subsidy to create a competitive educational environment to improve the quality and quantity of primary education where it is needed. Traditionally, public schooling systems have been neighborhood based, but this tends to tie school quality to the socioeconomic status of local areas and has become usually linked to poor standards. On the other hand, private schools have more freedom to choose their location and have larger market areas by providing transportation services to attract students from middle and upper income families from different parts of Istanbul. However, in Germany, it was necessary to have unsatisfied need for primary education and also demand from the local families [29]. The spatial distribution of private primary schools is investigated with respect to demographic and socio-economic conditions of the city in the following part of this section.

Istanbul is the largest city of Turkey and between 1950 and 2007, its population increased from 1.002.085 to 12.573.836 primarily due to rural migration [34]. It is also the largest socio-economic, cultural and tourism center by being the capital of three empires, with unique natural and historical characteristic which further enhanced its attractiveness. Its tremendous population growth resulted in its expansion and thus increased the need for schools as well as for other social facilities. Provision of schools could not keep up with rapid population increase. Private investment was introduced in order to answer the demand for primary education in Istanbul.

The analysis of schooling for the education year 2007-2008 in Istanbul illustrated the nature and extent of private primary education. Although the number of private primary schools consisted of 15 percent of the total primary schools in Istanbul, only 4.5 percent of primary school children were enrolled in private schools [35]. However, James [36] clams that while the US private schools account for only about 11% of US enrolment (U.S. Dept. of Education, 1998), in the developing world, in contrast, private enrolment as a proportion of total enrolment is 2-3 times higher than in industrialized nations. In Turkey, the aim of the government policies is to increase the ratio of private primary school students to the level of developed countries.

The spatial distribution of characteristics of districts and private schools are investigated according to concentric rings for the year 2007. The core area covers up to 3 km. from the center, which correspond to the old CBD (Figure-1) with 2000 years of history and has since been continuously redeveloped and loosing population to the periphery [37]. This zone has 2.2 percent of population, 2.2 percent of 5-14 age group, 13.75 percent of GDP, 2.4 percent of people with higher education, 2.8 percent of primary schools of which has 984 students per school on the average, and 3.9 percent of private primary schools. 21 percent of the primary schools of this zone are private [34, 35].

The first ring reaches 10 km. from the center (Figure-1), which covers the area occupied by the city in the 1950s before the commencement of mass rural migration [37]. Much of the major development of this zone took place in the late 19th century and early 20th century, and the zone is now linked closely to the core and the periphery by subway, train, buses and ferry. Most of the buildings in this zone experienced renewal due to the changes often in construction density ratios, which caused the population increase. This zone has the 25 percent of population of the city, 44.32 percent of GDP, 44.6 percent of people with higher education which is the highest with respect to its population, 20.5 percent of 5-14 age group which is the highest with respect to its population, 28.8 percent of primary schools of which has 984 students on the average, and 41.1 percent of primary schools. Private schools count for 22 percent of the primary schools of this zone (Table-2) [34, 35]. This zone forms the economic backbone of the city by being the inner ring of the city, and includes mostly upper and middle-income people as well as a small amount of squatters.
The second ring is taken as the peripheral area beyond the first ring (Figure-1). This zone has 72.8 percent of population, 41.93 percent of GDP, 53 percent of people with higher education which is the lowest with respect to its population, 68.4 percent of primary schools of which has 1570 students on the average, and 55 percent of private primary schools. The private primary schools count for 12.4 percent of the primary schools in the zone (Table-2) [34, 35]. This zone consists of large squatter areas as well as a small amount of upper and middle-income neighborhoods.

Table 2- Ratios of population distribution, primary school children, GDP, primary schools, students per school, number of private schools according to the concentric zones

<table>
<thead>
<tr>
<th>Zones</th>
<th>Population (% of Total)</th>
<th>0-4 Age Group (%)</th>
<th>5-14 Age Group (%)</th>
<th>GDP (%)</th>
<th>Education (%)</th>
<th>High School (%)</th>
<th>Primary School (%)</th>
<th>Students/ School (%)</th>
<th>School Distribution (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core</td>
<td>2.2</td>
<td>13.25</td>
<td>2.8</td>
<td>104</td>
<td>3.9</td>
<td>20.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I. Ring</td>
<td>25.0</td>
<td>44.32</td>
<td>28.8</td>
<td>984</td>
<td>41.1</td>
<td>23.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>II. Ring</td>
<td>72.8</td>
<td>41.93</td>
<td>68.4</td>
<td>157</td>
<td>55.0</td>
<td>12.4</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Although the investigation of the spatial distribution of primary schools illustrates that their largest share is located in the periphery, their ratio is still below the ratio school age population in this zone since school construction could not keep up with the rapid population increase due to constant rural migration with large families. As a result, the primary schools of the periphery are overcrowded and associated with low-level accessibility. Similarly, the periphery has the has the highest ratio of private primary schools, but much lower ratio than the ratio of school age population due to existence of high amount of lower income neighborhoods in this zone. For the same reason, the ratio of private primary schools within each zone illustrate that the one in the periphery is much lower as in the other developing countries [26]. Therefore, first of all, there is a need to increase the number of primary schools in the periphery in order to provide equitable accessibility to facilities with respect to other zones. As a second view, in order to provide equitable quality of primary education in this zone, private primary schools can be attracted to the periphery by providing land subsidy by the municipalities with the condition that they should provide tuition for some of the low-income students. Moreover, investigation of the distribution of primary schools according to the districts with respect to 5-14 age group population illustrates that there is a wide gap among the districts. While Besiktas which has the highest density of primary schools with respect to 5-14 age group population due to its central location, the peripheral lower income districts have much lower density of primary schools, such as Esenler, G.O.P. and Bagcilar. Similarly, investigation of the private primary school distribution shows that Besiktas has the highest density and the rest of the private primary schools is mostly clustered in the higher income districts (Sariyer, Kadikoy, Sisli, Uskudar and Bakirkoy) or near the higher income districts (Umranliye, Bahcelievler, B. Cekmec) which have available land (Table-1).

Table 1 - Distribution of population and age groups according to districts and income in Istanbul (2007)
Thus, the analysis reveals that there is a large gap between the density of primary schools central and peripheral districts with respect to the number of school age children. In order to improve equity and quality of primary education, the number of the primary schools should be increased in the peripheral districts and the gap among the districts should be decreased. At the same time, it is expected that with the participation of private sector, it will be possible to improve quality and equity of primary education by providing a competitive educational market.

3. REGRESSION ANALYSIS

Using data from Istanbul metropolitan area, the relationships between the number of private primary schools and characteristics (GDP per capita, 5-14 age group population, distance to the CBD, education level, density of population, the number of public primary schools) of districts are investigated by the use of a regression analysis. The results are given in Table -3. The variables of the study explain only 42 percent of the variation in the number of private primary schools in the districts. According to the results, the number of public primary schools is the most important factor to affect the number of private primary schools in the districts. The results illustrate that the impact of GDP per capita on the number of private primary schools is also an important factor as it is expected and it is also showed by the other studies [17, 38]. On the other hand, some of the private primary schools are obliged to be located in the low income neighborhoods in the periphery by providing transportation services for long distances due to shortage of available land in the higher income neighborhoods. The relationship between the number of private primary schools and the number of children at the 5-14 age groups is not found significant. Thus, one of the aims of private primary schools is to fill the gap between the public primary schools and the capacity need of the districts is not true for the case of Istanbul. Other variables (number of people with high level of education and density of population), which are not significant, are not included in the analysis due to limited number of districts. However, in the previous studies, education level of people and the characteristics of public schools are found significant to affect the number of private schools [38].

<table>
<thead>
<tr>
<th>Table 3- Regression results of private primary school locations analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Beta</strong></td>
</tr>
<tr>
<td>Constant</td>
</tr>
<tr>
<td>5-14 age group</td>
</tr>
<tr>
<td>GDP/capita</td>
</tr>
<tr>
<td>Ln number of public schools</td>
</tr>
</tbody>
</table>

Dependent variable: Ln the number of private primary schools

N=32 districts

<table>
<thead>
<tr>
<th>R</th>
<th>R²</th>
<th>Adj.R²</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>.69</td>
<td>.48</td>
<td>.42</td>
<td>7.74</td>
<td>.001</td>
</tr>
</tbody>
</table>

Moreover, the previous analysis of the relationships between the number of private primary schools and the characteristics of the districts was also repeated according to the concentric rings. However, no variable was found significant at the concentric zone level. This means that the location system of private primary schools has not reached to a stable state at the local level yet.

At the same time, the relationships between the number of public primary schools and the characteristics of the districts are investigated by a regression analysis and the results are given in Table-4. The variables of the study explain only 57 percent of the variation in the number of public primary schools in the districts. The number of 5-14 age groups is the most important factor to affect the number of public primary schools as it is expected. However, this does not mean equity is provided to a great extent. There are great differences among the districts with respect to density of schools. Although officials try to construct new schools as many as possible in order to supply rapidly increasing demand but there are still shortages in some of the newly developed districts. Also, wealthy people contribute to this effort by donating land and buildings. As a result of regression analysis, no relationship is found between the number of public primary schools and the characteristics of the districts such as the education level of people, density of population and GDP per capita.

<table>
<thead>
<tr>
<th>Table 4 - Regression results of public primary school locations analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Beta</strong></td>
</tr>
<tr>
<td>Constant</td>
</tr>
<tr>
<td>5-14 age group</td>
</tr>
<tr>
<td>GDP/capita</td>
</tr>
<tr>
<td>Number of public schools</td>
</tr>
</tbody>
</table>

Dependent variable: Ln the number of public primary schools

N=32 districts

<table>
<thead>
<tr>
<th>R</th>
<th>R²</th>
<th>Adj.R²</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>.78</td>
<td>.61</td>
<td>.57</td>
<td>13.18</td>
<td>.000</td>
</tr>
</tbody>
</table>
Thus, the existing spatial distribution of private and public schools does not yet produce a competitive education market to improve the quality and equity of primary school education. Clustering of private primary schools in the higher income neighborhoods should be overcome by providing locational subsidies in the periphery in order to create a balanced distribution between public and private primary schools to improve education. At the same time, under used capacity of private primary schools (50%) can be used for the qualified lower income students by providing government scholarship [29].

4. CONCLUSION

Primary education continues to be the number one investment priority in developing countries. Primary education systems in many developing countries including Turkey face a number of challenges. A number of studies demonstrate that private participation can encourage the public sector to improve the quality and efficiency of public schools in developing countries. These countries are facing serious financial shortcomings to answer dramatically growing demand for primary education due to their rapid population increase. After 1985s, with the implementations of free economy principles, to rely on private education is adopted in Turkey in order to answer rapidly growing demand, to modernize education system and also to create a competitive environment to improve primary education. Although there is some government subsidy for private primary schools, it was always limited and much below the subsidy made for private hospitals.

In this paper, first, the spatial distribution of private primary schools was analyzed according to the concentric rings with respect to characteristics of these zones such as 5-14 age group population, GDP per capita, ratio of people with high level of education, ratio of primary schools, ratio of private schools and ratio of private schools within each zone. The results of the analysis illustrate that while the ratio of private schools and the GDP are highest in the intermediate zone, demand for primary education is highest in the periphery. Thus, the private primary schools follow higher income neighborhoods rather than high demand for primary education as it is expected and observed in other countries.

Then, the spatial distribution of private primary schools with respect to the characteristics of districts in Istanbul was analyzed by using a regression analysis. The number of private schools is taken as a dependent variable and 5-14 age group population, education level of public, GDP per capita and the number of public schools is taken as independent variables. The results indicate that the number of private schools is the most important factor for the number of private schools in a district. GDP per capita of the district is the second factor to affect the number of private primary schools in a district. Other variables, which are taken into consideration, are not fund significant to affect the number of private primary schools. With respect to public schools, only the 5-14 age group population has an impact on their numbers and the other variables, which are taken into consideration, are not found significant.

Thus, this paper illustrates unequal distribution of private primary schools with respect to 5-14 age group population and investigates the relationship between their numbers and the characteristics of the districts in Istanbul. The unequal private school resources associated with unequal incomes does not allow producing a competitive education market to improve equity and quality for primary school education that is a government policy. This situation leads to unequal educational and labor market outcomes. Therefore, more effort should be spend for a better distribution of public and private primary school distribution and improve the quality of primary education. Dökmeci [39]’s hierarchical model can be used for optimum location of new private primary schools by taking into consideration the distribution of school age children and the location of public primary schools, and the concept of population dynamics can be included into the model by using [40]’s approach.

The results of the study can be useful for education planners, urban planners, investors and policy makers. Further research is suggested to analyze the impact of private participation on public primary education with respect to quality and equity of the educational system. Moreover, the relationship between type of school, public or private, is another important research topic in studies of school attainments, career patterns and especially of social mobility and social inequality.

5. PREferences

EVALUATION OF PRIVATE SCHOOL LOCATION IN THE ISTANBUL METROPOLITAN AREA
(Mehmet TOPÇU, Fatih TERZİ, N. İpek ÇETİN, VEDİA DÖKMECİ)


[23] T. Andrabi, J. Das, and A. Khwaja, "The rise of private schooling in Pakistan: Catering to the urban elite or educating the rural poor?," Harvard University, Pomona College, and World Bank, 2002.


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Figure 1 - Distribution of concentric zones in Istanbul
Figure 2 - Distribution of concentric zones in Istanbul
PARAMETER TESTS FOR IMAGE SEGMENTATION OF AN AGRICULTURAL REGION

Z. Damla Uça AVCI

İstanbul Technical University, Center for Satellite Communications and Remote Sensing
damla@cscrs.itu.edu.tr

Abstract: Segmentation, operation of object extraction from the total image, is the initial and a very important step of object-based image processing since it directly affects the performance of the processing, quality of the product and the accuracy of the results. In this study, the segmentation parameters of Definiens, widely used GEOBIA software, were tested by comparing the segments obtained by various combinations of values. As the study area, an agricultural region was selected and the results were evaluated in scope of extracting the field boundaries. The tests were conducted by producing 27 segmented images of the SPOT 4 data acquired on April 26th, 2007. The performances for the given conditions (combination of criteria) were compared to each other and the criteria of value selection that can be used for different aims were outlined. The results can be used in further studies for estimating the optimum values in accordance with the purpose.

Keywords: image segmentation, segmentation parameters, parameter tests, agricultural remote sensing.

1. INTRODUCTION

Remote sensing can be defined as any process of gathering information about an object, area or phenomenon without being in contact with it. Human seeing and understanding is the best examples of data collection and information extraction procedures of remote sensing operation.

In remote sensing, for a very long time, traditional pixel-based image processing methods have been used. For the recent decade, object-based image processing method, a new way of image analysis have been developed and tested by the researchers worldwide. It can be said that recent studies have proven the superiority of the object-based image processing method over traditional methods.

The new concept is based on a principle close to human seeing and understanding activity. The complex mental process that each human performs depends on extracting the objects from the view first, and then comparing the view of objects and their relationships with the existing knowledge of memory. The decision-making of the procedure makes use of shape, texture and contextual information of objects and their mutual relationships efficiently to produce meaningful information. Similarly, in object-based image processing approach, segmentation is the initial step of the process, which meaningful objects are created. After this step, classification and analysis take place.

Segmentation can be defined as the subdivision of an image into separated regions, mainly for the purpose of extracting the desired objects of interest for a certain task. The segmentation operation is performed to form objects by grouping pixels according to some criterion of homogeneity. [1] In object-based image analysis, image segmentation is a crucial process since it directly influences the accuracy and quality of the result [2].

For many years, procedures for image segmentation have been one of the main research areas in the field of image processing and a variety of algorithms have been developed to generate image objects. Each algorithm has its advantages and disadvantages. Image segmentation methods can be thought to be categorized in two main domains: i) knowledge driven methods (top-down) and ii) data driven methods (bottom-up). In top-down
PARAMETER TESTS FOR IMAGE SEGMENTATION OF AN AGRICULTURAL REGION  
(Z. Damla Uça Avcı)

approaches, the objects desired to be extracted are known, however the extraction is undefined. Therefore, first a model of the desired objects is defined, and then the extraction is performed. In bottom-up approaches the segments are generated based on statistical methods [1]. In top-down methods, difference is an important parameter, in other words it is based on the foreground-background contrast, whereas in bottom-up methods, the work is done based on similarity which pixels with similar intensity are clustered together [3].

As the technique, one of these two processes is followed: i) region-based methods that use some measure of homogeneity criterion, ii) edge-based methods based on separation of objects by finding edges between neighboring pixels, iii) pixel-based methods. Region-based approaches can be operated as ‘region growing’ or ‘region split and merging’. Edge-based methods create image objects based on contours of gray levels. ‘Watershed analysis’ -a popular one- and the ‘connectivity-preserving relaxation-based’ segmentation methods are examples of edge-based methods. In watershed analysis, the aim is to find the “watershed lines” in an image in order to separate the distinct regions [4]. Connectivity-preserving relaxation-based segmentation is usually referred to as an active contour model, starts with some initial boundary shape represented in the form of spline curves, and iteratively modifies it by applying various expansion operations. Pixel-based methods are counted as thresholding and clustering. Histogram thresholding is one of the most popular segmentation techniques, extracting the object from the background by selecting the threshold that separates the image histogram [5]. Clustering is related to grouping and organization due to several key factors, such as similarity, proximity, good continuation. However, still many of the computational issues of perceptual grouping remain unresolved [6].

In this study, the segmentation algorithm implemented in Definiens software was used and segmentation parameters were tested for an agricultural region in scope of extracting field boundaries with the highest accuracy. In the literature, generally the work which referred as “Object Based Image Analysis” originate around the software known as eCognition and/or Definiens ([11], [12], [13], [14]), therefore the segmentation can be defined as a standard one and the definitions, method and algorithms indicated in the article are dependent to the forementioned software.

2. MATERIAL

2.1 Study Area:

Turkgeldi State Production Farm (SPF) is located on E 27.12°, N 41.41°, in the Thrace region of Turkey, 65 kilometers from Kirkiralei, and 9 kilometers from Luleburgaz district [15]. 19.05 square kilometers of the SPF is used for agriculture, gardening and livestock. Mainly wheat and additionally clover, vetch, sunflower and corn are the crop types planted in the region.

2.2 Satellite Data:

As satellite data, a SPOT-4 image acquired on April 26th, 2007 was used. SPOT 4 provides data that involves four bands in multispectral mode: Band 1: 0.5-0.59 µm, Band 2: 0.61-0.68 µm, Band 3: 0.78-0.89 µm, Band 4: 1.58-1.75 µm, all having 20 m spatial resolution [16].
2.3 Field Map:
The crop type map belonging to 2007 was taken from Turkgeldi SPF. The field boundaries were extracted from the map, to use as a reference data for the evaluation of segmentation process.

3. BACKGROUND

Segmentation

In Definiens, three kinds of segmentation algorithms are used for creation of basic image objects (Figure 2) [17]: i) Chessboard segmentation: Entire image is splitted into square objects, ii) Quadtree segmentation: Entire image is splitted into image objects of maximum size as described by the parameters, iii) Multi-resolution segmentation: Entire image is segmented to user defined resolution, meeting the optimized color-shape, smoothness-compactness criteria.

(a) (b) (c)

Figure 2. Segmentation types (a) chessboard, (b) quadtree, (c) multi-resolution. ([17])

The chessboard and quadtree segmentations are mostly used as a first step to divide the image into main parts to make the remaining process easier, and then the multi-resolution segmentation takes place. The patented multi-resolution segmentation algorithm can be defined as the main procedure to create image objects.

Multi-Resolution Segmentation

In Definiens software, a region merging approach to segmentation called “Fractal Net Evolution” was implemented [18], which become one of the most popular approaches in object-based image segmentation [10]. This patented multi-resolution segmentation algorithm which is a bottom-up region-merging technique, is the main procedure to extract image objects. In this process, to achieve adjacent image objects of similar size and comparable quality, the procedure starts at any point in the image with one-pixel objects and the segments are grown in each step till the final result is reached [1], [17]. Zhang et al., 2010 summarizes the process as [2]: i) It starts with determining individual adjacent pixels as initial objects ii) the spectral heterogeneity change $h_{color}$ and the shape heterogeneity change $h_{shape}$ are measured between the two neighbor pixels (objects) to determine whether they need to be merged together, or not, iii) the process continues iteratively until a user defined threshold is reached.

The technique applied is a local optimization procedure, it minimizes the average heterogeneity and maximizes the respective homogeneity. The subdivision operation of segmentation is controlled by the composition of homogeneity, which is composed of color ($h_c$) and shape ($h_s$). Shape is formulated by a composition of smoothness ($h_{ss}$) and compactness ($h_{sc}$) parameters. The relations are defined as in Eqn.1 - Eqn.5:

$$h_c = 1 - h_t \quad (\text{Eqn.1})$$

$$h_s = h_{ss} + h_{sc} \quad (\text{Eqn.2})$$

$$h_c = \sum_b w_b \ast \sigma_b \quad (\text{Eqn.3})$$

$$h_{ss} = \frac{l}{k} \quad (\text{Eqn.4}),$$

$$h_{sc} = \frac{l}{\sqrt{n}} \quad (\text{Eqn.5})$$

In the Equations, $b$ stands for band, $w$ defines weight and $\sigma$ is the standard deviation, $l$ is the actual length of the object’s outline, $k$ represents the shortest length of the bounding box, and $n$ gives the number of pixels of the object.

The change of heterogeneity $S$ is calculated by Eqn.6:

$$S = w_s h_c + (1 - w_s) h_s \quad (\text{Eqn.6})$$

Scale parameter (SP), a threshold that influences the average object size, and layer weights ($w$), a factor value regarding to the importance of the layer, are the other parameters used in segmentation.

All parameters can be combined as illustrated in Figure 3, namely ‘composition of homogeneity criterion’.

![Figure 3. The composition of homogeneity criterion [17]](image-url)
Some of previously made suggestions for parameter selection of segmentation step in Definiens software are given as below:

In eCognition manuals it is mentioned that [17]:

Scale: It should be as large as possible, but small enough to ensure the separation between different land cover classes. Color: It should be weighted as high as possible, while the shape parameter should be weighted only as high as necessary. Compactness: The importance given to compactness has to depend on the properties of objects of interest.

Baatz et al., 2004 suggest emphasizing the spectral information as much as possible, and keeping the shape information as much as necessary [23].

These kinds of guidance are useful for the analysts. But they are general. In this study it is aimed to output similar kind of advices for a specific application area. First a parameter test was applied and then the results are evaluated.

4. PARAMETER TESTS

Segmentation algorithms may either be applied to the original images, or after the application of transformations and image enhancement such as filters [25]. In this study, it is preferred to conduct the application on original images.

The input of a single band was preferred to perform the parameter tests. Band 3 was used, since vegetation has high reflectance on infrared portion of the electromagnetic spectrum and the performance will be measured by accuracy of field boundary extraction which is directly related with the discrimination of vegetation and other land surfaces.

As segmentation scale, three different values were tested: i) 100, ii) 50 and iii) 20. Visualizing segmented images at different scales, different levels of abstraction can be observed.

For color-shape, and compactness-smoothness parameters, value combinations (for high: 0.8, average: 0.5 and low: 0.2) were tested. In Table 1, the parameter values are given for each condition named as A, B, C, D, E, F, G, H and I. The segmented images of each condition are given by Table 2, 3 and 4 for scales 100, 50 and 20, respectively.

<table>
<thead>
<tr>
<th>Segment Parameters</th>
<th>Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td>Color</td>
<td>0.</td>
</tr>
<tr>
<td></td>
<td>8</td>
</tr>
<tr>
<td>Shape</td>
<td>0.</td>
</tr>
<tr>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Compactness</td>
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</tr>
<tr>
<td></td>
<td>8</td>
</tr>
<tr>
<td>Smoothness</td>
<td>0.</td>
</tr>
<tr>
<td></td>
<td>2</td>
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</table>
### Table 2. Segmented images for SP 100.

<table>
<thead>
<tr>
<th>Condition A</th>
<th>Condition B</th>
<th>Condition C</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Image" /></td>
<td><img src="image2.png" alt="Image" /></td>
<td><img src="image3.png" alt="Image" /></td>
</tr>
<tr>
<td>Condition D</td>
<td>Condition E</td>
<td>Condition F</td>
</tr>
<tr>
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<td><img src="image5.png" alt="Image" /></td>
<td><img src="image6.png" alt="Image" /></td>
</tr>
<tr>
<td>Condition G</td>
<td>Condition H</td>
<td>Condition I</td>
</tr>
<tr>
<td><img src="image7.png" alt="Image" /></td>
<td><img src="image8.png" alt="Image" /></td>
<td><img src="image9.png" alt="Image" /></td>
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</tbody>
</table>
### Table 3. Segmented images for SP 50.

<table>
<thead>
<tr>
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<th>Condition C</th>
</tr>
</thead>
<tbody>
<tr>
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<td><img src="image3.png" alt="Image" /></td>
</tr>
<tr>
<td>Condition D</td>
<td>Condition E</td>
<td>Condition F</td>
</tr>
<tr>
<td><img src="image4.png" alt="Image" /></td>
<td><img src="image5.png" alt="Image" /></td>
<td><img src="image6.png" alt="Image" /></td>
</tr>
<tr>
<td>Condition G</td>
<td>Condition H</td>
<td>Condition I</td>
</tr>
<tr>
<td><img src="image7.png" alt="Image" /></td>
<td><img src="image8.png" alt="Image" /></td>
<td><img src="image9.png" alt="Image" /></td>
</tr>
</tbody>
</table>
Table 4. Segmented images for SP 20

<table>
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<th>Condition A</th>
<th>Condition B</th>
<th>Condition C</th>
</tr>
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<tbody>
<tr>
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<td><img src="image3.png" alt="Image" /></td>
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<tr>
<td>Condition D</td>
<td>Condition E</td>
<td>Condition F</td>
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<td><img src="image6.png" alt="Image" /></td>
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<tr>
<td>Condition G</td>
<td>Condition H</td>
<td>Condition I</td>
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<tr>
<td><img src="image7.png" alt="Image" /></td>
<td><img src="image8.png" alt="Image" /></td>
<td><img src="image9.png" alt="Image" /></td>
</tr>
</tbody>
</table>
5. FINDINGS

Segmentation evaluation can be applied by direct and/or indirect methods. As one of the direct methods, visual analysis can be executed. Another method may be using a measure to quantify the goodness of the segmentation as Tian and Chen, (2007) developed. In their study the measure, termed \( G_s \), takes into account both the overlapping areas and the mismatching areas to compare the reality and the produced image objects [10]. As an alternative it is possible to proceed with the classification of the segmented image, and then indirectly assess the segmentation results through the classification accuracies [9].

It is suggested by Definiens Imaging that “a strong and experienced source for the evaluation of segmentation techniques is the human eye”, mentioning that even a result is sufficient by a quantitative assessment, it still has to seem visually correct for the human eye [17]. For this study, visual analysis is chosen.

By visual analysis it is obviously seen that the objects produced in each case are different. Observing the 27 different segmented images and comparing the parameter values, the findings given below were reached:

**Segmentation Scale:**

Segmentation scale is a measure of object abstraction. Although there are some studies for automated methods, segmentation scale parameter is often selected depending on subjective trial-and-error methods [19], [20].

In this study, three different segmentation scale values (100, 50, 20) were tested and visually analyzed. The best fitting object size for segmenting the agricultural fields was obtained in scale 50. In scale 100, some of the fields were merged and couldn’t be discriminated whereas in scale 20 over segmentation occur. This value cannot be generalized since it depends on the specific parameters such as field sizes of the region, satellite resolution etc. The most important factor for the scale selection is the purpose of the study. As can be observed from the views of segmented images, each scale seems to be appropriate for different feature extraction purposes. If the study area is extended to a wider frame, many fields that are relatively smaller in size would also be involved in. In such a case, as each task requires its specific scale, a multi-level segmentation may be preferred. Different scales could be used for different sized objects while the features of comparable sizes (such as forest, crop fields and urban) can be segmented in the same level. It has to be mentioned here that in a multi-level system, each segmentation other than the first one, will be operated using the parent segmentation boundaries as the basis. So, every image object will separately have child image objects that form the whole when pieced together.

**Color, Shape, Compactness, Smoothness Parameters:**

When the value of ‘shape’ factor is increased, fields with different characteristics can easily be distinguished well such as neighboring fields having different crop types, vegetation covered fields and harvested fields. However, the neighboring fields with the same crop type and belonging to the same planting term are not extracted successfully although there is road lying between them, because the algorithm searches for a line that is suitable to split the area into parts having sufficient difference in characteristic. However, a field boundary or track line of a road can be eliminated if the two sides have similar color values.

On the contrary, increasing the value of ‘color’ factor has an effect in discriminating the fields having same or similar kind of crops even with little dissimilarities, depending on efficient recognition of the roads between the fields.

Increase in ‘compactness’ value causes a well discrimination of sharp boundaries or clear urban structures, but it can also merge regions having very different characteristics since it ignores reflectance. It has a tendency to follow round closed polygons since it searches for compact regions. Therefore the results mostly do not give good results for legged shapes, such as passing over roads, railways, rivers. Although for some situations it can provide advantages, it has to be kept in minimum weight. The other disadvantage of giving weight more than needed is causing over-partitioning inside the same fields even for little variations. The variations in vegetation color can arise from the variations in reflectance of crops planted in different topographies, which is highly relational with the sunshine duration, or irrigation may have effects on reflectance as the same way.
Increasing the ‘smoothness’ value can cause formation of segments consisting of mixed features such as crop fields including man-made structures.

6. CONCLUSION

Segmentation is an essential process for most subsequent image-analysis tasks [21], because, using the object-based approach, only a successfully segmented image will lead to convincing outputs.

The most common approach to determine the segmentation parameters is trial-and-error method until reached to a satisfactory result. The two problems that have to be clearly solved is to understand what is ‘satisfactory’ and how to ‘measure’ it [24]. The trial-and-error method is conceptually simple, however without an approach it’s time consuming to establish the parameter value selection. Therefore the analyst should have the clear definition of what the expected and acceptable results are, considering the main aim. To provide meaningful objects by segmentation, the process should be conducted and evaluated according to the feature classes of interest. Value selection for segmentation parameters may be good for one feature class but poor for another. Hence, the to evaluate the outputs the optimal information for further processing and data analyzing operations have to be searched [22]. In this study agricultural purposes was the main concept, therefore field boundaries were used as the test measure in segmentation operation and evaluation process.

In scope of outlining a view that summarizes the effects of increase/decrease in parameter values, the results were interpreted and a general guide for segmentation process mostly usable for agricultural purposes were provided. To perform a comprehensive assessment of segmentations depending on different parameter values 27 conditions were tested and the results were illustrated. Convincing results were described with the parameter value effects. Although it cannot be claimed that the projected values can be generalized, a guidance of segmentation for field extraction was offered.

REFERENCES


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USAGE OF PICTOGRAMS TO INTRODUCE MUSICAL INSTRUMENTS TO EDUCABLE MENTALLY RETARDED CHILDREN AS AN ALTERNATIVE METHOD*

Gunsu YILMA¹, Bahadir UCAN²

¹ Yildiz Technical University, Faculty of Art & Design, Department of Music and Performing Arts, B 1036, Davutpasa Campus, Istanbul
² Yildiz Technical University, Faculty of Art & Design, Department of Art, B 1031, Davutpasa Campus, Istanbul

E-mail: gunsuy@yildiz.edu.tr, bucan@yildiz.edu.tr

Abstract: The purpose of this research is to examine and investigate the perception ability of musical instruments of educable mentally retarded children with the support of visual elements. The research is conducted for every children individually in a special education and rehabilitation centre. The problematic of this research is the level of perception ability of musical instruments with visual support on mild mentally retarded children. In this research, perception ability of defining pictograms by music is introduced as an alternative method. It is researched that how educable mentally retarded children perceive pictograms by music tools. In this case, it is aimed to introduce musical instruments to educable mentally retarded children by pictograms with music. The research is applied with a qualitative approach. Data were obtained with the recorder, then they were turned into texts and analyzed with content analysis method.

Key words: Mentally retarded children, pictogram, 2d character design, computer aided drawing, auditory perception, visual perception, music.

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1. INTRODUCTION

In our country, various methods via materials are used for educable mentally retarded children’s special education and rehabilitation services. Also in the academic sense, there has been several research conducted and researchers still have to develop new methods and approaches for mentally retarded children to increase their potentials. In this research area, specially, the emergence of specific data gains importance to comment and conclude on such students and children. It is said to be beneficial to the development process of educable mentally retarded children to improve their life skills they need and in these studies music and musical elements are necessarily useful. Perception is an interpretation process which is the interpretation of sensory information. When we pay attention to certain stimuli from sensory detection, there begins the recording process. The working memory (short term memory) to entering information from the sensory record of environmental stimuli, the learner is not only able to detect information. Therefore, perception has special importance in learning [1].

Researchers conducted thus far have revealed that there is not just one specific “music center” in the brain, but on the contrary that music perception, performance and creativity is spread across many areas of the brain and that these areas, when compared to other areas, undergo structural development with music training. The area of the brain at the same time comprises to contraptions of perception. In recent years scientists have begun to have a firmer understanding of where and how music is processed in the brain [2].

<table>
<thead>
<tr>
<th>Brain Sections</th>
<th>Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensory Cortex</td>
<td>Controls tactile feedback while playing and instrument or dancing</td>
</tr>
<tr>
<td>Auditory Cortex</td>
<td>Listens to sounds. Perceives and analyzes tones.</td>
</tr>
<tr>
<td>Hippocampus</td>
<td>Involved in music memories, experiences and context</td>
</tr>
</tbody>
</table>
** USAGE OF PICTOGRAMS TO INTRODUCE MUSICAL INSTRUMENTS TO EDUCABLE MENTALLY RETARDED CHILDREN AS AN ALTERNATIVE METHOD**

(Gunsu YILMA, Bahadir UCAN)

<table>
<thead>
<tr>
<th>Brain Section</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual Cortex</td>
<td>Involved in reading music or looking at your own dance moves</td>
</tr>
<tr>
<td>Cerebellum</td>
<td>Involved in movement while dancing or playing an instrument, as well as emotional reactions.</td>
</tr>
<tr>
<td>Nucleus Accumbens &amp; Amygdala</td>
<td>Involved with the emotional reactions to music.</td>
</tr>
<tr>
<td>Prefrontal Cortex</td>
<td>Controls behavior, expression and decision making.</td>
</tr>
<tr>
<td>Motor Cortex</td>
<td>Involved in movement while dancing or playing an instrument.</td>
</tr>
<tr>
<td>Corpus Callosum</td>
<td>Connects both sides of the brain.</td>
</tr>
</tbody>
</table>

**Table 1. Music and Brain Sections [3]**

This is clearly indicated brain sections and musical perception.

Musical perception, musical sensations of sound frequencies that as a result of the interpretation is to be meaningfully processed by the brain. In the musical perception, the perception takes place in the sensation of the brain and there is a process with the result of bundling treatment and interpretation [4].

We need to use visual symbols to express our feelings. Through all our lives, we have conditioned emotional response with humans, evidences and their relations. Artistic experiences be interested of directly with the subjective and intuitive one and it offers greater [5]. Occasionally, it is important to reveal that keep thoughts and feelings in. Therefore, artistic experiences helps to improve people’s level of cognitive and emotional perception.

As a symbol language, pictogram, is a shape of pictorial-writing which use symbols to convert visualize a concept or idea [6]. In other words, pictograms are stated to be clearly explained to understanding.

According to British Joint Committee on Mental Deficiency, the term mental retarded child is used in broader sense to include all those whose educational progress, from whatever cause, has been slower than that of an average child of the same chronological age [7]. American Assosation Mental Retardation (AAMR) was classified the individuals on mentally retarded in 1983 [8].

**Table 2. Classification of Mentally Retarded Individuals.**

The process of perception for specially educable mentally children works on slower than normal children. Because of this, it is hard to difficult to transfer data from short term memory to long term memory. Consequently, it can be difficult to remember to transmitted the information. The same situation applies to musical perception.

Ozsoy says that one of the difficulties of mentally retarded children is learning and recalling the attention of one of the main condition that is intensifying and sustaining. It has been stated that mentally retarded children, who has distractibility and lack of attention, generally, have various problems to transfer data from short term memory to long term memory. Besides, he states that mentally retarded children have no problem on their long term memory and he also says that these children may remember for a long time thoroughly learned information [9].

---

AAMR 1983 Classification | IQ Range | Educational Classification |
--------------------------|----------|-----------------------------|
Mild Mentally Retardation | 50-55 to 70 | Educable Mental Retardation |
Moderate Mental Retardation | 35-40 to 50-55 | Trainable Mental Retardation |
Severe Mental Retardation | 20-25 to 35-40 | Severely/MultiplyHandicapped |
Profound Mental Retardation | Below 20 or 25 | Severely/MultiplyHandicapped |
Generally, mentally retarded children have problems to take environmental data which they transfer data from short term memory to long term memory. Forgetting is occurred when they can not transfer to coming information or sensory stimulus. In addition, after learning, they have difficulties to remember data, recalling information from memory compared with normal children [10].

Mentally retarded children can be classified as three different groups which are educable, trainable, severe mentally disability.

Educable mentally retarded children have variant of 45-75 IQ range. They are also calling mild mentally retarded children. These children needn’t to take rehabilitation or special education needs all their life. But they can participate in the inclusive education. They can also take formal education with rehabilitation services or special education – assisted learning. They have 8-12 age range mentality and they can academic study level of sixth grade.

Trainable mentally retarded children have variant of 25-44 IQ range. They are in the group of mentally retarded children which children collaborate with area health institution, rehabilitation services and special education. In academic study, their performance lower than educable mentally retarded children. In addition, these individuals can make limited and do monotonous work.

Severe mentally retarded children have variant of 0-25 IQ range. They can also calling intensely mentally retarded children. They have significant problems about self-care, adaptation, social and lots of skill and acquired to these skills. They need clinical services and clinical health care. Their development of intelligence level of 0-2 age range [11].

If mentally disabled child’s perceptions compared with their own level in itself, it can be different from educable mentally retarded children to trainable mentally retarded children and severe retarded children. It is said that their learning situation show deficiency to differ from each other. Retardation in learning, which attest to educable mentally retarded children, lower than to show severely mentally retarded children. It is also the same to auditory and visual perception. Besides, mentally retarded child’s auditory and visual perception is lower than normal children [12].

These classifications with the educable mentally retarded child’s perception, auditory and visual perception on the level accordingly musical perception can be said to establish a relationship. For example, educable mentally retarded child’s musical perception level can be higher than trainable mentally and severely mentally retarded child’s musical perception. In other words, severe mentally handicapped children depending on their intelligence scores may display less performance compared with trainable and educable mentally retarded children on auditory and visual perception related with the music.

Music therapy is a profession which has emerged over the last fifty years from a variety of professional disciplines in different countries. Therefore, the process of defining music therapy can depend under various situations. In order to establish a more generic and all-embracing definition of music therapy, in 1996, the World Federation of Music Therapy (WFMT) produced the following definition:

Music therapy is the use of music and/or musical elements (sound, rhythm, melody and harmony) by a qualified music therapist to facilitate and promote communication, learning, relationships, expression and other relevant objectives [13].

It is also important to use music therapy methods for educable mentally retarded children. Because these methods can contribute to their mental, emotional and social development. In view of the usefulness, it can be expressed that music therapy and its aims have under five main headings. These aims, respectively, are fixing the social and emotional behavior, develop the skills motional, fix the communication, teaching skills pre-school and school-age and provide with leisure time activities [14].

2. METHOD OF THE RESEARCH

Many researches are conducted to obtain the relationship between music and perception. Two methods are mainly used in these researches: collecting psychological data by brain imaging techniques (fMRI, PET, EEG) and observing attitudes and behaviors of test subject to indicate the relationship between music and perception [15].

As Wigram noted, the second method observation and data collection techniques- are used in this research. Research is based on natural observation with the dimension of practice. In this study, musical instruments with related music and pictograms are used in a special education and rehabilitation center in Istanbul Sancaktepe. Test subject is composed of three girls, three boys with a total of six educable mentally retarded students with the ages of 7 to 10. Through pictograms their ability to recognize musical instruments are studied1.

1 Students have no additional disability except educable mental disability.
In this study, educable mentally retarded children are observed one by one in their working environment. Research is programmed as two months involving an hour's work of two days a week and pictograms are used as the images of drum, snare drum, tambourine, harmonica, clarinet, trumpet, xylophone, piano and the guitar. In the first four weeks of the research, drum, snare and cymbals are played with students. School songs are singed together and students accompany rhythmically with related instruments. In the last four weeks, pictograms are introduced to students. During the introduction of pictograms, music of these instruments are listened to students by audio media.

<table>
<thead>
<tr>
<th>No</th>
<th>Music</th>
<th>Composer</th>
<th>Pictograms</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Clarinet Concerto, K.622 Part 1</td>
<td>W.A. Mozart</td>
<td>Child Playing Clarinet</td>
</tr>
<tr>
<td>2</td>
<td>Vals, op.64</td>
<td>F. Chopin</td>
<td>Child Playing Piano</td>
</tr>
<tr>
<td>3</td>
<td>Trumpet Concerto, Part 1</td>
<td>J. N. Hummel</td>
<td>Child Playing Trumpet</td>
</tr>
<tr>
<td>4</td>
<td>Concertino for Xylophone, Part 1</td>
<td>T. Mayuzumi</td>
<td>Child Playing Xylophone</td>
</tr>
<tr>
<td>5</td>
<td>Harmonica-Working on The Railroad</td>
<td>Anonymus</td>
<td>Child Playing Harmonica</td>
</tr>
<tr>
<td>6</td>
<td>Overture of Baglama</td>
<td>C. Akdeniz</td>
<td>Child Playing Baglama</td>
</tr>
<tr>
<td>7</td>
<td>Vals a Rosenthal</td>
<td>G. Reinhardt</td>
<td>Child Playing Guitar</td>
</tr>
<tr>
<td>8</td>
<td>Snare Drum Etude, Heigh Hoo Drumroll</td>
<td>Anonymus</td>
<td>Drums, Snare and Tambourine</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Playing Children</td>
</tr>
</tbody>
</table>

Table 2. Music and Related Pictograms of the Research

Musical instruments that take place in the research has played an important role for selecting useful music. Music is used for educable mentally retarded children with related pictograms to facilitate detection, auditory and visual perception, and depending on the pictograms to facilitate musical perception in order to establish a relationship between pictograms and musical instruments.

Figure 1. Pictograms of some percussion instruments
During the process of drawing the pictograms, a child figure is created that educable mentally retarded students can internalize. Child figure is genial, curly hair, wearing eye-catching phosphoric green color long-sleeved shirt and dark blue trousers, playing different musical instruments. Musical instruments and tools in the pictograms are played in their suitable usage. Pictograms are designed to appeal students’ visual perception and to provide musical instruments to be directed to the relevant.

Figure 1. Pictograms of the other percussion instruments

Figure 2. Pictograms of wind instruments.

Pictograms are prepared on 2D virtual environment of computer and printed as digital images on A4 (21 cm x 29.7 cm) papers. Photoshop CS4 is used for digital drawing and coloring. Sketch of the pictograms are drawn by hand.

3. CONCLUSION

In the first four weeks of the research, drums, tambourine and snare drum has been practiced with educable mentally retarded children as an accompaniment. During the studies with mentally retarded children such as singing together, playing musical instruments, playing-singing practices, it is observed that children obey the given commands. In addition to playing at the same time, finishing the songs together under the leadership of the educator, positive feelings and behaviors of children as a result of mutual verbal dialogue, being in a safe and confident environment, being a part of the activity are observed.

In the last four weeks of the research, only pictograms and musics of musical instruments drawn in pictograms are used. Pictograms are layed on a flat floor to be noticed easily and for every right choice of students, related music is played.
For each process, names of the music instruments are memorized and repeated frequently. Names of musical instruments are asked to students and it is examined that students have the capability to remember the musical instruments (drums, snare drums and cymbals) that are practiced together in the first four weeks and to select correct pictogram.

Throughout the researching period on six educable mentally retarded children, two boys and one girl make the right choices without hesitation. The other three children found the right pictograms after making two wrong pictogram selections. Selecting and identifying the musical instrument from various pictograms is an important sign of mentally retarded children’s or students’ visual and musical perception ability. Moreover, after the first four weeks of application process with instruments in the last four weeks which is the process of working with pictograms, mentally retarded children’s or students’ ability to select desired pictogram and recognize the desired musical instrument shows their educable capacity.

To analyze the research over the past four weeks, the process of right pictogram selection out of multiple choices is to be considered. The process is contributed to students’ permanent perception in visual and aurally by practising one by one based on identifying the musical instruments through pictograms.

Visual aided musical activities on educable mentally retarded children can be useful in children’s education and it can increase their learning abilities. Nelson, Cummings and Boltman (1991) noted that disable students are incapable in learning as normal students and children if they are not systematically educated [16, 17]. The increase in such researches with systematic and repeatable methods, can contribute to improvement of disable students’ aural perception by visual support. These musical experiences are important on improving the learning abilities of educable mentally retarded children and can develop their motivation, auditory, visual, cognitive and emotional perception.

In addition, it is so important the accurate answers without hesitation. Because, when educable mentally retarded children correctly give answers, they feel sense of achievement. It is clearly indicated that they are environmentally-conscious. There is another indication that when they listen to music, they relate musical instruments to pictograms resolutely.

During study, educable mentally retarded children have chosen some of musical instruments, which used within the first four weeks as drum, snare, tambourine. They have chosen pictograms to say the instrument’s names. Thus, with these kind of studies, it can be learn musical instruments with visual elements to educable mentally retarded children. Present study, in the same time, it may contribute to their motor skills, ability to imitate, social skills and enunciative linguistic skill which are located within special education services.

It is an important role that these kind of investigations can prompt educable mentally retarded child’s auditory perception stimulators with music, musical activities and methods. To identify a musical instrument with pictograms and to sense aurally with music by visual elements can accelerate this process.

In this research, it has been conducted various disciplines such as art education, music education, special education and mentally retarded child’s special needs and music therapy. With these multidisciplinary investigations, it can be constituted various musical activities. Educable mentally retarded children can recognize music and several musical instruments with pictograms.

Accompanied by appropriate music, with this alternative method which is adopted with regular repetition can be contributed to positive learnability of students due to their auditory perception and visual perception improvements.

4. REFERENCES

EVALUATION OF COMPUTER ALGEBRA SYSTEMS USING FUZZY AHP

Ilham N. HUSEYINOV,1 Feride S.TABAK2

1Department of Software Engineering, Faculty of Engineering, Istanbul Aydin University, Florya, Istanbul/ Turkey,
2Department of Computer Engineering, Faculty of Engineering, European University of Lefke, Lefke/ North Cyprus

E-mail: ilamhuseynov@aydin.edu.tr , savaroglu@hotmail.com

Abstract. The paper proposes an evaluation model based on fuzzy AHP to help users select CAS that best matches their requirements. The subjectiveness and imprecision of the evaluation process are modeled using linguistic terms. The evaluation criteria framework based on the usability and problem solving capability of CAS is developed. Fuzzy (AHP) is employed to determine the relative importance weights of criteria and the preference order of alternatives. The applicability and effectiveness of the proposed methodology is illustrated.

Keywords: CAS, fuzzy AHP, usability, problem solving capability, linguistic evaluation.

1 INTRODUCTION

It has been appreciated that the goal of promoting mathematical exploration (through symbolic, numerical and graphical experimentation) is well served by computer algebra system (CAS) [1]. CAS(s) are computer based software packages for performing mathematical symbolic computations [2].

However, there are dozens of CAS available for users: Derive, Maple, Mathematica, Maxima, and etc. Hence, users are faced with the challenge to select the most appropriate CAS that meets s/he requirements. From the human computer interaction perspective the usability dimension and from the functional perspective the problem solving capability dimension are the most wanted requirements for a software package [3,4]. Thus, evaluation (or selection) of CAS can be viewed as a complex multicriteria decision making (MCDM) problem [5]. Recent research studies have demonstrated the applicability and flexibility of MCDM approach to evaluation of educational software [6,7]. They employed the analytical hierarchy process (AHP) method of MCDM, which was developed by T.L.Saaty [8]. However,
HP does not give reliable results under fuzzy environment.

This paper proposes an evaluation model based on fuzzy AHP to help users select CAS that best matches their requirements. The subjectiveness and imprecision of the evaluation process are modeled using linguistic terms. The evaluation criteria framework based on the usability and problem solving capability of CAS is developed. Fuzzy (AHP) is employed to determine the relative importance weights of criteria and the preference order of alternatives. The applicability and effectiveness of the proposed methodology is illustrated.

The paper is organized as follows. The description of fuzzy AHP and evaluation model is given in Section 2. A case study of evaluation of CAS is presented in Section 3. Finally, in Section 4 we present results and conclusion.

DESCRIPTION OF FUZZY AHP AND EVALUATION ALGORITHM

In this section, we present an overview of the literature on FAHP and describe the proposed evaluation algorithm. AHP is a powerful decision making tool of multi-criteria decision making methods. Its aim is to select the best alternative among different criteria. The main idea of AHP is to decompose a complex problem into several small problems by means of a systematic hierarchy structure [9]. A decision maker makes a reciprocal comparison for each element and layer of the structure using ratio scales. A reciprocal matrix is constructed. Then, using matrix algebra, the relevance weights of elements are calculated. However, AHP is not able to make decision under the environment of uncertain, vague, incomplete, fuzzy information. Hence, there is a need to modify AHP for fuzzy environment. It is presented in [10, 11], where fuzzy comparison ratios were introduced. The work [12] proposed an extent analysis method to handle fuzzy reciprocal matrix. Using this method we propose the following evaluation algorithm.

Step 1. Identify the goal.
Step 2. Identify a set of alternatives: $A_j, (j = 1, 2, ..., n)$
Step 3. Identify a set of evaluation criteria (or sub criteria): $C_i, (i = 1, 2, ..., m)$ and construct a tree type hierarchy structure of criteria and sub-criteria.
Step 4. Get decision makers’ evaluation judgments in the form of comparison scores $a_{ij}$ in pairs of criteria $C_j, (i = 1, 2, ..., m)$ . Each comparison score should show how much important one criterion is than the other. The comparison scores form the matrix of pairwise comparisons $A = \begin{bmatrix} a_{ij} \end{bmatrix}$ that should satisfy the conditions: $a_{ij} = 1/a_{ji}$ and $a_{ii} = (1, 1, 1)$ for $i = 1, 2, ..., m$. The comparison scores $a_{ij}$ represent linguistic terms [13] expressed by triangular fuzzy numbers $k = (k_1, k_2, k_3)$, where $-\infty < k_1 \leq k_2 \leq k_3 < \infty$, and described in Table 1.
Table 1. Linguistic scores for comparison and ratings

<table>
<thead>
<tr>
<th>Linguistic scores</th>
<th>Fuzzy number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Just equal</td>
<td>(1, 1, 1)</td>
</tr>
<tr>
<td>Equally important</td>
<td>(1, 1, 3)</td>
</tr>
<tr>
<td>Moderate important</td>
<td>(1, 3, 5)</td>
</tr>
<tr>
<td>Strong important</td>
<td>(3, 5, 7)</td>
</tr>
<tr>
<td>Very strong important</td>
<td>(5, 7, 9)</td>
</tr>
<tr>
<td>Extremely important</td>
<td>(7, 9, 9)</td>
</tr>
</tbody>
</table>

Step 5. Calculate the relative importance weight \( w_i \) for each criterion \( C_i \), \((i = 1, 2, ..., m)\) using the equation:

\[
w_i = \sum_{j=1}^{m} a_{ij} \otimes \left[ \sum_{j=1}^{m} \sum_{j=1}^{m} a_{ij} \right]^{-1},
\]

where addition, multiplication, and division operations for two fuzzy triangular numbers \( a = (a_1, a_2, a_3) \), and \( b = (b_1, b_2, b_3) \) are defined as [14]:

\[
a \oplus b = (a_1 + b_1, a_2 + b_2, a_3 + b_3),
\]

\[
a \otimes b = (a_1 b_1, a_2 b_2, a_3 b_3), \text{ and}
\]

\[
a / b \cong (a_1 / b_1, a_2 / b_2, a_3 / b_3),
\]

respectively [13].

Step 6. Similar to Step 4, we obtain decision maker’s preferences, \( d_{ij}, (i = 1, 2, ..., m, j = 1, 2, ..., n) \), about the performance of each alternative \( A_j \) within each criterion \( C_i \) using Table 1. These values form the decision matrix \( D = [d_{ij}] \). Then, it is normalized as follows:

\[
\hat{d}_{ij} = \frac{d_{ij}}{\sum_{j=1}^{n} d_{ij}},
\]

\( i = 1, 2, ..., m, j = 1, 2, ..., n \). (2)

Step 7. Calculate the fuzzy score of each alternative:

\[
X_i = \hat{d}_{ij} \otimes w_j.
\]

Step 8. Calculate the ranking score of each alternative using the graded mean integration representation of the fuzzy number \( a \) [15]

\[
R(a) = \frac{a_1 + 4a_2 + a_3}{6},
\]

where \( a > (\preceq, \prec) b \iff R(a) > (\preceq, \prec) R(b) \).

Step 9. Choose the alternative whose ranking score is maximum as the best alternative.
2 EVALUATION OF CAS.

In this section, we present an empirical study concerning the application of the proposed algorithm. It is carried out through a survey among students. Three alternatives of CAS are identified: A1- Maple, A2- Mathematica, A3- Maxima. They are open source and easily available. Students are given a questionnaire about the user interface and problem solving capability of CAS. The user interface is closely related to the concept of usability that is central dimension in human computer interaction [3]. The usability is considered to be inherent in human computer interface, because it implies the interaction of users with the software product [16,17]. The guidelines for the mathematical problem solving software design proposed in [4] are adopted in our case study. The results of the survey, is analyzed and the following criteria set hierarchy is derived.

We give a short description of each criterion [3,4]. Ease of use - C11 - use of an interface with a minimum effort; Visibility - C12 - how interface looks indicates how it can be used; Aesthetics - C13 - the ‘look and feel’ of the user interface intended to make the interface attractive and appealing; Consistency - C14 - makes the interface familiar and predictable by providing a sense of stability; Problem tasks – C21 - refers to a situation in which a person wants something and does not know immediately what sorts of action he/she can perform to get it; Problem solving process – C22 - means understanding, planning, solving, reviewing the problem and the solution; Strategies – C23 - refers to the ways to proceed that are planned and carried out; Problem structuring – C24 - enables students to recognize problems by their structure rather than their contextual setting. After obtaining criteria structure, we follow the algorithm described in section two.

Step 4. Matrices of pairwise comparisons obtained from the survey analysis are shown in Tables 2 and 3.

Table 2. The pairwise comparison matrix of the dimensions

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>C1</th>
<th>C2</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>(1,1,1)</td>
<td>(1,3,5)</td>
</tr>
<tr>
<td>C2</td>
<td>1/(1,3,5)</td>
<td>(1,1,1)</td>
</tr>
</tbody>
</table>

Fig. 1. Hierarchical structure of criteria set.
Table 3. The pairwise comparison matrix of the usability criterions

<table>
<thead>
<tr>
<th>Criteria</th>
<th>$C_{11}$</th>
<th>$C_{12}$</th>
<th>$C_{13}$</th>
<th>$C_{14}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$C_1$</td>
<td>(1,1,1)</td>
<td>(1,3,5)</td>
<td>(1,3,5)</td>
<td>1/(1,3,5)</td>
</tr>
<tr>
<td>$C_2$</td>
<td>1/(1,3,5)</td>
<td>(1,1,1)</td>
<td>(1,1,3)</td>
<td>(1,1,3)</td>
</tr>
<tr>
<td>$C_3$</td>
<td>1/(1,3,5)</td>
<td>1/(1,1,1)</td>
<td>(1,1,1)</td>
<td>(1,1,3)</td>
</tr>
<tr>
<td>$C_4$</td>
<td>(1,3,5)</td>
<td>1/(1,1,1)</td>
<td>(1,1,1)</td>
<td>(1,1,3)</td>
</tr>
</tbody>
</table>

Step 5. Based on Eq. (1) the relative importance weights of dimensions and criteria are computed and presented in Table 4.

Table 4. Priority weights of dimensions and criteria in the AHP decision tree

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Weight between dimensions</th>
<th>Weight within the criteria(s)</th>
<th>Weight among the sub-criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>$C_1$</td>
<td>(0.25,0.76,1.86)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$C_{11}$</td>
<td>(0.11,0.42,1.12)</td>
<td>(0.027,0.32)</td>
<td></td>
</tr>
<tr>
<td>$C_{12}$</td>
<td>(0.11,0.19,0.74)</td>
<td>(0.027,0.14)</td>
<td>1.37</td>
</tr>
<tr>
<td>$C_{13}$</td>
<td>(0.082,0.1,9,0.56)</td>
<td>(0.02,0.14)</td>
<td>1.41</td>
</tr>
<tr>
<td>$C_{14}$</td>
<td>(0.061,0.1,9,0.37)</td>
<td>(0.015,0.14)</td>
<td>0.69</td>
</tr>
<tr>
<td>$C_2$</td>
<td>(0.15,0.25,0.62)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$C_{21}$</td>
<td>(0.13,0.35,1.04)</td>
<td>(0.02,0.086)</td>
<td>0.64</td>
</tr>
<tr>
<td>$C_{22}$</td>
<td>(0.11,0.19,0.7)</td>
<td>(0.016,0.04)</td>
<td>7.04</td>
</tr>
<tr>
<td>$C_{23}$</td>
<td>(0.077,0.2,3,0,52)</td>
<td>(0.01,0.57)</td>
<td>0.32</td>
</tr>
</tbody>
</table>

Step 6. Based on Eq. (2) the normalized decision matrix is computed and given in Table 5.

Table 5. Normalized decision matrix

<table>
<thead>
<tr>
<th>Criteria</th>
<th>$A_1$</th>
<th>$A_2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$C_{11}$</td>
<td>(0.27,0.33,0.43)</td>
<td>(0.21,0.37,0.71)</td>
</tr>
<tr>
<td></td>
<td>(0.15,0.37,0.43)</td>
<td></td>
</tr>
<tr>
<td>$C_{12}$</td>
<td>(0.24,0.57,1.023)</td>
<td>(0.08,0.18,0.27)</td>
</tr>
<tr>
<td></td>
<td>(0.16,0.25,0.8)</td>
<td></td>
</tr>
<tr>
<td>$C_{13}$</td>
<td>(0.14,0.43,1)</td>
<td>(0.12,0.37,1)</td>
</tr>
<tr>
<td></td>
<td>(0.12,0.2,0.71)</td>
<td></td>
</tr>
<tr>
<td>$C_{14}$</td>
<td>(0.27,0.33,0.43)</td>
<td>(0.21,0.37,0.71)</td>
</tr>
<tr>
<td></td>
<td>(0.15,0.37,0.43)</td>
<td></td>
</tr>
<tr>
<td>$C_{21}$</td>
<td>(0.19,0.33,1.14)</td>
<td>(0.15,0.33,0.71)</td>
</tr>
<tr>
<td></td>
<td>(0.11,0.33,0.43)</td>
<td></td>
</tr>
<tr>
<td>$C_{22}$</td>
<td>(0.25,0.23,0.56)</td>
<td>(0.18,0.48,1.1)</td>
</tr>
<tr>
<td></td>
<td>(0.1,0.3,0.34)</td>
<td></td>
</tr>
<tr>
<td>$C_{23}$</td>
<td>(0.06,0.11,0.3)</td>
<td>(0.25,0.6,1.3)</td>
</tr>
<tr>
<td></td>
<td>(0.12,0.38,0.12)</td>
<td></td>
</tr>
<tr>
<td>$C_{24}$</td>
<td>(0.19,0.33,1.14)</td>
<td>(0.15,0.33,0.71)</td>
</tr>
<tr>
<td></td>
<td>(0.11,0.33,0.43)</td>
<td></td>
</tr>
</tbody>
</table>

Step 7. The scores and ranking of alternatives are computed using Eq. (3) and Eq. (4) and presented in Table 6.

Table 6. Scores and ranks of alternatives

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Scores $X_j$</th>
<th>graded mean integration $R_j$</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>$C_{24}$</td>
<td>(0.07,0.23,0.35)</td>
<td>(0.01,0.57,0.28)</td>
<td></td>
</tr>
</tbody>
</table>
EVALUATION OF COMPUTER ALGEBRA SYSTEMS USING FUZZY AHP

Ilham N. Huseyinov, Feride S. Tabak

<table>
<thead>
<tr>
<th></th>
<th>A1</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.3</td>
<td>(0.028, 0.59, 5.4)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A2</td>
<td>(0.021, 0.83, 5.3)</td>
<td>1.44</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A3</td>
<td>(0.017, 0.77, 3.25)</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The chart representation of Table 6 is shown in Fig. 2.

Fig. 2. Ranking of alternatives

4 RESULTS AND CONCLUSIONS

This study proposed a fuzzy AHP framework based on the combination of the extent analysis and the graded mean integration methods to effectively solve the problem of evaluation of CAS under fuzzy environment. Vague, incomplete, fuzzy preferences of decision makers are represented in linguistic terms by triangular fuzzy numbers. This enabled to have a more accurate, reliable and convincing evaluation process. As a result of evaluation of CAS alternatives, Mathematica is ranked first, Maple is ranked second and Maxima is ranked third. Of course, any evaluation process is context dependent. The proposed framework can be used for evaluation of any kind software product. The future work will be devoted to the research on integration of other MCDM into the proposed decision making methodology.

REFERENCES


THE DETERMINATION OF GREEN AREAS IN CITY FROM THE VIEW POINT OF CITY FURNITURE IN EMINONU

Yıldız AKSOY
Istanbul Aydin University Engineering Architecture Faculty Architecture Department
yildizaksoy@aydin.edu.tr

Abstract In this paper, Eminönü district is selected; for being found in Historical Peninsula, being the most important center in the Metropolitan and for having historical, natural and available to tourists properties. Paper is formed by third chapter. In the first part; concept of urban green areas and its importance was mentioned and urban green areas were classified. In the second part; design of city furnitures, properties of users were determined in Eminönü district. Also problems of the existing city furnitures were found which are deficiency of material and workmanship, functional and ecological usage and problems due to human. In the third part; general evaluation of the subject and recommendations were done.

Key Words: Eminönü, green areas, city furniture.

1.INTRODUCTION

1.1. Concept of Urban Green Area and Importance
A city is not only formed by the building and human motions. Such conditions must be created that, life will not be only for living but also to enjoy the life. This, requires many riggings. Green areas are one of these riggings. For long time, green areas were understood as simple decorations covering unseemly sides of the buildings. But today green areas are realized as an important element for human life in intensive urban condition.

Green areas make positive effects on city climate. It decreases the heat which artificial Mosses absorb. Green areas decrease the noise. Green areas with all open areas which was included in physical structure of city, between different land use sections do the job as a tampon; separate their each other the most form positive. A balanced and planned green area distribution can be arrange construction number and density for what all constructions take place of air up to their volume in city. At the same time, it controls the city development which are green braces. It gives the city an esthetic worth. It responds the active and passive recreational needs of users. Green areas are helper development of a strong society. Green areas are helper development of nature consciousness.

Increase speed of green areas which is the most important for life, is not keep in step with increase speed of population in cities and per person green area is on the decrease every day. Improvement and application efforts being amount, dispersion and use of green areas in cities are on the increase.

Green areas of cities and nearby place are very important for healthy life people of city. Being natural Industrialism and nevertheless Urbanization are acquiring artificiality our life. Extreme populational and structural density of country cities in last years, developing new functions are causing slowly exhausting of open and green areas. Depressions which gradually increasing population is extracted in city, psychic wearinesses and decreasing relation between person and natura with extreme dirtiness are causing increase of necessities of green area. Our cities don't reply this increasing necessities whether area or equipment.

1.2. Classification of Urban Green Areas.
When the settlement plans of cities are examined, differences in green tissue system in city can be seen. The reason of appearance of these differences are topography, morphology, climate of city, characteristic structure of the city, that is to say being or not being agriculture, trade, industries or available to tourists city and the policy of the city is important. In cities, the differences of needs of green area are occur according to age, culture, occupation, social and economical situation of person. Different types at green areas appeared due to these differences in cities. Green area types can be classified in to four groups such as, for their functions and influence area, building level, primary school level, neighborliness level and city level.

- **Green Area In Building Level:** In this level, the green and private garden that is inside the building causes a wholeness to the building. Green areas of front, back and side gardens of the building.

- **Green Area In Primary School Level:** This unit includes gardens of single dwelling place and apartment, street afforestation, refüjs and playgrounds between residence groups.

- **Green Area In Neighborliness Level:** In this level, playground and sport area and neighborhood park offered as an outfit type.

- **Green Area In City Level:** They are city parks, sport institution areas, zoos, botany gardens, visual green areas, refüjes and squares, afforested areas, pasture, nursery and forests, grove areas, and areas to be added in grove and cemeteries.

Child playgrounds, park areas, sport areas, pasture, nursery and forests, visual green areas, refüje and squares are green areas in Eminönü which are shown in zoning and construction plans under the header green areas.

When the current position of green areas is examined 10,5 m² active green area and 3,2 m² passive green area per person usage can be seen in the district. When this position is evaluated with the green areas of standarts of Ministry of public improvements, there isn’t norm absence of active green area in Eminönü district.

Although, existing active green areas are enough, from dispersions, accessibility and content of city furnitures of green areas, such as Sarayburnu park, Saraçhane park, Kadırga park and Sultanahmet Horsesquare park quality of green areas are find, but generally negative examples can be observe. Thus, subject of negativitess in question is detached importance of green areas’ relations with settlement areas, insufficient and monotony of content of city furnitures, not furnished with modern element, detached importance of green tissue functions with esthetic quality.

2. THE DETERMINATION OF CITY FURNITURES IN EMINONU DISTRICT

2.1. The Determination of Furnitures From the View Point of Design.

Design is a very dimension period which inclusion art, science, history and philosophy. The definition of city furniture includes structures from communication board, trashcan, stairway, statue to public fountain and telephone cabin, which may be designed for functional or aesthetic purposes. City furniture, as well as functionally carrying two or all of the abovementioned definitions, may also serve for a different purpose from that of its original.
The functional using is also very important for the city furniture as one of the basic principles of landscape architecture. Choosing the right place is the most important functional usage of a furniture. If the furniture is placed well, it can be used effectively and unbroken less (Photograph 1).

**Figure 1. Kadırga Park**
When look at example of Kadırga Park; such as see; if the sitting banks are placed well, they can be used effectively according to other corners of park.

There are problems which defects of place and position of city furnitures, in green areas of Eminönü. (Photograph 2-3-4-5-6-7-8)

**Photograph 2. Sultanahmet Horsesquare Park**

**Photograph 3. Sultanahmet Horsesquare Park**

**Photograph 4. Sultanahmet Horsesquare Park**

**Photograph 5. Sultanahmet Horsesquare Park**

**Photograph 6: Mehmet Akif Ersoy Park**

**Photograph 7. Şehzadebaşı Park**

**Photograph 8. Şehzadebaşı Park**
Such as see at photograph 2,3,4,5,6,7 and 8; point of view place and position; if sitting banks are not
placed well, they can be used more little. Users prefer bottoms of tree and lawn areas. The design of city furnitures is not take into consideration peripheral factors. City furnitures which harmony of historical and natural environments are not selected (Photograph 9-10).

Photograph 9. Türkiyat Park

Photograph 10. Mehmet Akif Ersoy Park

There are various aesthetic flaws in the colour, texture, shape and dimensions as regards the design of city furniture (Photograph 11).

Photograph 11. Mehmet Akif Ersoy Park

Sitting banks are commonly designed and placed in dependently in Mehmet Akif Ersoy Park. Eventually, a confused aspect is exposed instead of aesthetic.

In the production of city furnitures the selection of incorrect material and the use of low-quality, non-durable, frail and defective materials can be observed. City furnitures are being processed from design to application. One step of them is related with labour. It can be given some examples such as litters broken cover, felling down lighting, broken concrete sitting units, broken child play tools, e.t.c. in the parks (Photograph 12-13-14-15-16).

Photograph 12. Mehmet Akif Ersoy Park

Photograph 13. Sultanahmet Furnished With a Pond Park.

Photograph 14. Kadırga Park
Example of lighting and garbage can which using in ordering of Yenikapı and Kumkapı coast; is seen at photograph 17. This examples are exposed to vandalism actions made by various reasons and eventually resulted in the non-usable condition due to bad usage. Vandalism and ill use must be prevented, allowing the urban setting to remain in its initial designed form.

Garbage cans in Kadırga park, are exposed to vandalism actions made by various reasons. Generally, the furniture is being made by the cheap and worthless material and lost the quality in short time and so caused a wicked city esthetic if they leave unrenewed (Photograph 21-22).
Photograph 22. Yenikapı-Kumkapı

There is incompatibility of individual elements with each other and incorrect selection of elements when combined during construction (Photograph 23).

Photograph 23. Şehzadebaşı Park

The same banks again being phantoms in parks, are stopped also boring, the single manner and their integrity in with environment is not be achieved.

There is monotony how using the city furnitures being a single type.

2.2. The determination of City Furnitures From the View point of Properties of Users.

City furnitures are specially designed to meet users requirements.

Collection of the social and the cultural data related to the attitudes and behaviors of the users with respect to the city furniture is the important step to identify problems.

There are user defects which apathy, lack of education, cultural discrepancy, selfish, indifferent attitudes in a large-city psychology, insensibility towards nature, degeneration of art, beauty and aesthetic emotions, ignorance, incorrect use, vandalism. City furnitures are occasionally exposed to vandalism actions made by various reasons and eventually resulted in the non-usable condition due to bad usage.

When look at in the relation of city furniture user, primarily the users must be educated and trained, the citizen conscious and the thought of city-possession must be inculcated. The necessary education must be given both by family and educational institutions and the sensitiveness of our Public must be achieved.

There are some problems which economic (material and labour), functional, ecological and human beings problems (vandalism); with existing using city furnitures in green areas of Eminönü district.

3. CONCLUSIONS:

During the arrangement of urban areas, random placement of city furniture will not meet the real and functional requirements of the community. In this respect any single element must be separately taken into consideration and located in the manner most suitable to its individual function.

In city furnitures, the single manner application shall be avoided in order to abstain from environmental incompatibility and monotony caused by the standardisation. The authentic city furniture designs shall be allowed. Only then can urban areas become enjoyable and pleasant living environments.

City furnitures must be resistant hard environmental conditions as well as user’s damage.

In an urban setting, in order to achieve the compatibility of the place by itself and the environment thereof, the compatibility of all individual equipment used in that place and the functional particularities of the place.

City furnitures are specially designed to meet human requirements. Therefore the relations of human between the perception and attitude particularities and requirements must be well studied, and the
products, which are compatible to the physiological and psychological structure of humans must be manufactured.

The visual effect of city furniture upon urban places is rather important. City furnitures must be considered in whole, not separately but jointly taken into consideration and placed into a settlement. Both individual and group design of elements and their integrity in an urban landscape must be achieved.

City furnitures also reflects the environmental characteristics other than responding to modern day requirements.

The city furniture, which is located in the historical districts, and principal squares, where people rest and have leisure times, must match to the identity of the city and surroundings. The new street furniture, which does not adapt to a historical environment not only creates a visual disturbance but damages the identity of the historical district.

Ecological usage can be described as to analyse all ecological data (climate, soil, altitute, latitute, e.t.c.) Of the area before placing landscape elements and choose suitable elements to the area known all ecological values.

The maintenance of city furniture also bears great importance to encourage their use. Because it has been revealed that the unkempt, dirty and old elements courage the persons inclined to vandalise public property, and that nobody prefers to use such elements. Therefore all city furnitures must bear aesthetic and functional aspects and be maintained regularly.

REFERENCES:


MULTI SEGMENT CIRCULAR FRACTRAL REFLECT ARRAY ANTENNA
Bahareh Baghani BAJGIRAN

Abstract - In this paper with using novel fractal structure which is composed of multi segment circular fractal, a unit cell and then reflectarray antenna have been designed. The unit cell of reflect array has been designed in 4.4 GHz with 24*24*1 mm^3 dimension. The reflectarray is consist of 400 (20*20) elements that even element is placed in the locus has been calculated. Maximum gain of antenna is 12.9 dBi.

Introduction
Since the revolutionary breakthrough of printed circuit technology in the 1980’s, microstrip reflectarrays have emerged as the new generation of high-gain antennas for long distance communications. They are similar in principal to parabolic reflectors, while the bulky curved surface of the parabolic reflector is replaced with a planar antenna array, which results in a low-profile, low-mass, and low-cost antenna. The concept of the reflectarray was initially introduced using waveguide technology in the 60’s [1]. Later in the 70’s the spiral phase reflectarray was developed [2], but the reflectarray didn’t receive much attention until the development of microstrip reflectarrays in the late 80’s [3]. The elements of the reflectarray are designed to reflect the EM wave with a certain phase to compensate for the phase delay caused by the spatial feed. The phase shift of the elements is realized using various methods such as variable size elements, phase-delay lines, and element rotation techniques. The infinite array approach is used to calibrate the element phase versus element change [4]. Due to the very large number of elements involved in a reflectarray, full-wave simulation of the entire reflectarray antenna is still challenging. On the other hand, different theoretical models have been developed for the analysis of reflectarrays, such as the array theory formulation and the aperture field analysis technique, which show a good agreement with measured results. Moreover, implementing the spectral transform in these calculations allows for fast calculation of the radiation characteristics of the antenna, which is a considerable advantage for synthesis design problems using iterative procedures. Single and multi-layer reflectarrays have been designed to achieve broad band and multi-band performance from microwave frequencies up to the THz range [5]. Considerable improvements have been made to these designs over the years and many practical designs have been demonstrated. One of the main challenges in reflectarray designs is improving the bandwidth of the antenna, which is the major drawback of all printed structures [6]. Different bandwidth improvement techniques such as using multi-layer designs [7], true time-delay lines [8], and sub-wavelength elements [9] have been studied and bandwidths of more than 20% have been reported. On the other hand, the direct control of the phase of every element in the array allows multi-beam performance with single or multiple feeds [10]. The design of contoured beam reflectarrays is also a challenging field [11]. A phase-only synthesis process is used to obtain the required element phase shift from any given mask. Multi-feed multi-beam contoured beam designs have been demonstrated [12]; however, the performances of these designs are slightly inferior to the shaped beam parabolic reflectors. Another advantage of reflectarrays is the ability of the antenna to scan the main beam to large angles off broadside. Beam scanning reflectarrays are designed by using low-loss phase shifters in every element of the array [13]. These beam scanning reflectarrays require a switch board to control the main beam direction and are well suited for radar applications and some models have been demonstrated; however, considerable challenges lie in improving the performance of these beam scanning antennas. In addition to the numerous capabilities and potentials reflectarray antennas have demonstrated, a great deal of interest now is the practical implementation of reflectarray antennas for space applications. Since the common considerations for space antennas are size, weight, and power, because of limitations imposed by the satellite launch

Multi-segment circular fractral configuration, result and discussion
The proposed circular fractral is a two dimensional (2D) fractral constructed from multi-segment circles. The construction of the proposed fractral begins with an iterative process at odd numbered iterations km, m=1, 3... 2M+1, where M is a positive
integer number. As shown in Fig.1, the proposed fractal initiator is partitioned into three non-overlapping segments with different radius. The same procedure is then applied recursively to the other remaining layer with iterated function transformations, ad infinitum. In the proposed fractal, all the segments angle have M=2π/n constant value and different radius r=R, 2R… nR. Fig.1 shows illustration of the first four iterations in the construction process. As seen in fig 2, R1, R2 and R3 are fixed in 4, 8 and 12 mm, respectively and φ3 is fixed at 120°.

The techniques presented in this section are applied to C-band reflectarrays for comparison of these methods. We consider a C-band reflectarray with a circular aperture and a diameter of 678.8mm. The phasing elements, used in this study, are variable size of φ1 with R2 fixed at 8 mm. The unit-cell periodicity of 0.35λ at the design frequency of 4.4 GHz and are fabricated on a 1 mm FR4 epoxy substrate. The reflection phase response (S-curve) of the phasing elements obtained using the infinite array approach, is generated using High Frequency Structure Simulation (Ansoft HFSS v.15) [15], and is given in Fig. 3.

The variable size of φ1 are selected from the S-curve in Fig. 3 to match the required phase distribution on the aperture. The mask of the reflectarray antenna and the obtained reflection phase of the elements are given in Fig. 4(a) and 4(b).

It can be seen the phase distribution obtained from the variable size of φ1 shows a close agreement with the ideal phase, i.e. Fig. 2-15 (b). The principal plane radiation patterns of the reflectarray antenna, is given in Fig. 5 at 4.4 GHz. It should be noted that with this design the cross-polarized pattern obtained using the aperture field formulation is almost zero in the principal planes. The maximum cross-polarization level for this system is -18.5 dB.

Using the FR4 substrate with high loss tan0=0.02 is caused increasing the side lobe level and X-polarization.

![Image](image_url)

**Fig. 4.** The mask of the reflectarray antenna and the obtained reflection phase of the elements

**Reflectarray antenna result and discussion**

In this design, the reflectarray phasing elements are designed to generate a beam in the broadside direction. The reflectarray aperture is circular and has a diameter of 678.8mm. The x-polarized prime-focus feed horn is positioned with an F/D ratio of 0.9, in the array theory calculations, the polarization of the feed horn is not modeled. For the horn model used in this study, the gain of the horn is 6.5dBi at 4.4 GHz, the ideal phase requirement for the reflectarray elements is given in Fig. 4.

**Conclusion**

In this paper the design of reflectarray with 400 elements each of the elements by changing the angle of the circular fractal parameters were placed in selected locations. All structures on FR4 substrate with loss tangent of 0.02 and permittivity of 4.4 were designed. The unit cell of reflectarray was consist of Multi-segment circular fractal. Reflection phase of unit cell of reflectarray that designed with infinite array approach has 380
degree that suitable for broadside application. F/D ratio was 0.9 and gain of antenna at 4.4GHz (center frequency) was equal with 12.9dBi.

Reference

SUBSTRATE INTEGRATED WAVEGUIDE BAND-PASS FILTER WITH CPWG FED FOR RADAR APPLICATION IN X-BAND

Abbas AYARAN1, J. Bagheri K.2, S. GOLMOHAMMADI3
1. Department of electrical engineering, East Azarbaijan Science and Research Branch, Islamic Azad University, Tabriz, Iran.(ayaran.ieee@yahoo.com)
2. Department of electrical engineering, East Azarbaijan Science and Research Branch, Islamic Azad University, Tabriz, Iran. (moghaddas74@yahoo.com)
3. Department of electrical engineering, East Azarbaijan Science and Research Branch, Islamic Azad University, Tabriz, Iran.(sgolmohmmadi@tabrizu.ac.ir)

Abstract: Filter described in this paper is composed of two cavity resonator that formed by substrate integrated waveguide (SIW). The filter is fed by coplanar waveguide with ground (CPWG) that provide 50 ohm input impedance in proposed filter. The proposed filter bandwidth is from 8.6 to 9.2 GHz that this region of frequency have S21>-3dB and S11<-10dB.

INTRODUCTION:
Radio Frequency (RF) filters possess the properties of frequency-selective transmission allowing energy to transmit desirable bandwidths (passbands) and attenuate undesirable bandwidths (stopbands). These microwave filters are essential components for the front-end of today’s communication systems. The current progression of wireless communication technologies demand RF front-end designs to have better performance, lower power, and a more compact size. Conventional non-planar structures such as the rectangular waveguide possess the advantage of producing higher performing filters compared to planar configurations due to their lower loss characteristics. However, advantages of planar structures such as microstrip and coplanar waveguide (CPW) filters relate to a more compact size and lower manufacturing cost. The substrate integrated waveguide (SIW) has recently been developed to fill this performance gap by possessing the advantages of both types of structures [1]. The basic concept of the SIW merges waveguide cavities with planar structures on a single dielectric high frequency material. This is accomplished through rows of vias in a substrate dielectric acting as the walls of a waveguide cavity. The top and bottom metal layers of the high frequency PCB material next form the upper and lower cavity walls, while planar transmission lines are then placed between the planar transmission lines and the top metal layer of each cavity, completing the SIW structure [3]. Many applications are attributed to the use of SIW structures. Depending on the configuration, the SIW has been utilized for antenna arrays [5]-[8] and slot antennas [9]-[11]. For RF circuit applications, proper adjustment to the dimensions of SIW transmission waveguides enable the development of various linear phase shifters [12]-[13]. Additionally, directional couplers [14]-[16], power divider/combiners [17]-[19], and mixers/oscillators [20]-[22], all have been realized through the use of different configurations of multiple SIW cavities. The most researched application of the SIW involves filter design. Various designs have been implemented to help reduce the size of SIW filters even further including folded substrate integrated waveguide (FSIW) [23]-[24], half-mode substrate integrated waveguide (HSIW) [25], and evanescent-mode SIW filters [26]-[27]. In addition, SIW cavities have been employed to produce higher quality filters compared to planar configurations such as dual-mode SIW filters [29]-[30], compact super-wide bandpass filters [31], and multilayered substrate integrated waveguide (MSIW) filters [32]. Lastly, complete front-end systems regarded as system-in/on-package (SiP/SoP) designs have recently been developed with SIW structures such as an X-band receiver with embedded MSIW filters [33] or a 60 GHz multi-chip module module receiver Chaving both an SIW antenna and an SIW filter all on one substrate [34].

In this paper with using tow cavity resonator that made by substrate integrated waveguide with ground. The cavity resonators are placed in over together and coupling between to resonator is helped with a slot.

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(a)
Substrate Integrated Waveguide Band-Pass Filter with CPWG Fed for Radar Application in X-Band
Abbas Ayaran, J. Bagheri K., S. Golmohammadi

Filter Parameters & Structure:

The filter has been designed on Rogers 4003 with electrical permittivity \( \varepsilon_r = 3.55 \) and loss tangent \( \tan \sigma = 0.002 \), the thickness of substrate is \( h = 0.524 \text{mm} \).

The Filter is composed of two layers, one of layer over another layer is placed. Each layer is composed of a coplanar waveguide with ground (CPWG). In order to achieve 50 ohm impedance feed line use from CPWG with \( W = 1 \text{mm} \) and \( g = 0.3 \text{mm} \). Each layer have a cavity resonator with \( 12 \times 12 \text{ mm}^2 \). Between two layers of substrate in metal of between two layers a slot with length of \( \lambda_g / 2 \cong 9 \text{ mm} \) and width of \( \lambda_g / 20 \cong .8 \text{ mm} \) is embedded. Other parameters are shown in figure 1.

Result and Discussion:

Substrate Integrated Waveguide (SIW) cavities follow the same basic principles compared to conventional air-cavity rectangular waveguides. Some key differences relate to the dissimilar dielectrics of air versus a substrate material. More care must be taken in order to design SIW cavities for microwave applications. This is due to higher frequencies being more sensitive to substrate losses versus a very low loss air dielectric. Additionally, compared to conventional 3-D rectangular waveguides, thinner substrate dielectrics prevent Transverse Magnetic (TM) modes to resonate. Therefore, only Transverse Electric (TE) modes can effectively propagate through SIW cavities [28].

Given the above distinctions, two primary design rules for SIW cavities are next presented in order to exploit the same modeling and design procedures for conventional waveguides. These rules pertain to the diameter (\( d \)) of the metal via posts emulating the waveguide side walls and the via post spacing (\( s \)) [22-23]:

\[
\begin{align*}
\text{Equation 1(a):} & \quad d < \frac{\lambda_d}{5} \\
\text{Equation 1(b):} & \quad s \leq 4d
\end{align*}
\]

Disregarding these expressions creates too much leakage loss for the via post SIW cavity side walls to perform as conventional rectangular waveguide side walls. Figure 1(b) depicts a single SIW cavity resonator with appropriately labeled dimensions. Metal layers 1 and 2 create the top and bottom terminations of the waveguide with via posts generating the side wall terminations of the waveguide. The following expressions provide the first resonant frequency mode for the SIW cavity [11]:

\[
\begin{align*}
\text{Equation 2(a):} & \quad f = \frac{c}{2\alpha\sqrt{\varepsilon_{\text{eff}}}} \left( \frac{\pi}{w_{\text{eff}}} \right)^2 + \left( \frac{\pi}{l_{\text{eff}}} \right)^2 \\
\text{Equation 2(b):} & \quad l_{\text{eff}} = l - \frac{d^2}{0.95b} w_{\text{eff}} = w - \frac{d^2}{0.95b}
\end{align*}
\]

where \( f \) is the first resonant mode of the cavity, \( w \) and \( l \) are the width and length of a single SIW cavity, \( d \) is the diameter of the vias, and \( s \) is the via spacing (depicted in Figure 1(b)). The expressions are only valid when equations 2(a) and 2(b) are upheld, enabling the via posts to function as conventional rectangular waveguide side walls. These single SIW cavity resonator dimensions are the basis for the two-pole fixed filter design. Adjusting the dimensions of these coupling window openings in the SIW cavities provides the tuning needed to match coupling coefficients and external quality factors extracted from full-wave simulation to the calculated parameters.

Figure 2 depicts the return loss and insertion loss of the bandpass filter, shown in Figures 1(a) and 1(b), developed in this article. As shown in figure 2 the pass band of proposed filter is from 8.6 GHz to 9.2 GHz and minimum point of \( S_{11} \) is placed in 8.8 GHz with -30dB depth. Figure 3 shows the contour map for the electric field distribution in the two cavities. The polarization of the electric field drawn in this figure is along the \( z \)-direction. In Figure 3, the operation frequency is 8.8 GHz. From this figure, we may clearly see that the resonant mode in both cavities is \( TM_{110} \); the maximum field strength takes place around the middle of the cavity. Since the aperture is opened at the position near the maximum electric field, the energy can be significantly coupled from the first cavity to the second one.
CONCLUSION:
On Roger 4003 was designed a bandpass filter with tow cavity resonator. The cavity of resonator was consisted of substrate integrated waveguide that the side walls of SIW has been evoked the waveguide with high quality factor. The input of cavity resonator is fed by 50 ohm input impedance with CPWG feed line. Coupling between two cavity resonators have been occurred by a slot with length of $\lambda_0/2$ which this slot was matched with resonator frequency and defined bandwidth of proposed filter. The filter has bandwidth frequency from 8.6 to 9.2 GHz.

Reference


ANALYSIS AND PERFORMANCE MEASUREMENT OF EXISTING SOLUTION METHODS OF QUADRATIC ASSIGNMENT PROBLEM

Morteza KARAMI¹, Sadegh NIROOMAND², Nima MIRZAEI², Bela VIZVARI¹

¹ Department of Industrial Engineering, Eastern Mediterranean University, North Cyprus, Turkey
Email: m.morteza01@yahoo.com
Email: bela.vizvari@emu.edu.tr

² Department of Industrial Engineering, Istanbul Aydin University, Istanbul, Turkey
Email: sadeghnroomand@aydin.edu.tr
Email: nimamirzaei@aydin.edu.tr

Abstract- Quadratic Assignment Problem (QAP) is known as one of the most difficult combinatorial optimization problems that is classified in the category of NP-hard problems. Quadratic Assignment Problem Library (QAPLIB) is a full database of QAPs which contains several problems from different authors and different sizes. Many exact and meta-heuristic solution methods have been introduced to solve QAP. In this study we focus on previously introduced solution methods of QAP e.g. Branch and Bound (B&B), Simulated Annealing (SA) Algorithm, Greedy Randomized Adaptive Search Procedure (GRASP) for dense and sparse QAPs. The codes of FORTRAN for these methods were downloaded from QAPLIB. All problems of QAPLIB were solved by the above-mentioned methods. Several results were obtained from the computational experiments part. The results show that the Branch and Bound method is able to introduce a feasible solution for all problems while Simulated Annealing Algorithm and GRASP methods are not able to find any solution for some problems. On the other hand, Simulated Annealing and GRASP methods have shorter run time comparing to the Branch and Bound method. In addition, the performance of the methods on the objective function value is discussed.

Keywords: Quadratic Assignment Problem, Quadratic Assignment Problem Library, Branch and Bound, Simulated Annealing, Greedy Randomized Adaptive Search Procedure

1. INTRODUCTION

The aim of Quadratic Assignment Problem (QAP) is to assign a set of given tasks (say set 1) to another set of given tasks (say set 2) with a given assignment cost/benefit matrix in order to minimize/maximize total cost/benefit of the assignments. This problem is restricted to assign each task of set 1 to only one task of set 2 and also only one task of set 1 can be assigned to each task of set 2 by the use of binary variables. QAP has many applications in the real world where, the aim is to assign a set of jobs (set 1) to a set of machines/workers (set 2) with a given matrix including cost of assignment of each job to each machine/worker in order to decrease the total assignment cost. The aim is to assign a set of facilities (set 1) to a set of given and fixed locations (set 2) with given flow matrix of facilities and distance matrix of locations in order to decrease the cost of assignment that is calculated by multiplying the distance of a pair of location and the flow between their related facilities for all possible pairs of locations. In addition to the above-mentioned assignment problems, QAP may be used as a mathematical formulation for the placement problem of interconnected electronic components onto an integrated circuit board or on an electronic microchip, which is a part of computer aided design in the electronics industry. QAP is an NP-hard problem. The Branch and Bound (B&B) method is a well-known exact method for solving QAPs. The method is used in most of optimization software e.g. Lingo, Xpress, Cplex, etc. This method can be more effective for solving QAPs where some linearization techniques are used to linearize the quadratic terms of objective function. The methods were effective to reduce the running time of the problem (see He et al. (2012))

1.1 QAP applications
Koopmans and Beckmann in 1975 were the first proposers of quadratic assignment problems as a mathematical model connected to the location of economic activities. After that it was shown in difference practical application: (Steinberg, 1961) used the QAP to show the optimal placement of computer element on the backboard wiring; (Dickey & Hopkins, 1972) done the Campus building arrangement by using QAP. (Francis & White, 1974) used QAP for assign some facilities (police posts, supermarkets, schools and so on) to best location in order to have the best service. The QAP is used to find the best place for typewriter keyboard and control panel by (Pollatschek, Gershoni, & Radday, 1976). Quadratic assignment, as a general data analysis strategy, is defined by (Hubert & Schulz, 1976). (Elshafei, 1977) utilized the quadratic assignment problem for the Hospital planning. (Krarup & Prazan, 1978) applied computer aided layout design to archeology. also (Rabak & Sichman, 2003) and (Miranda et al. 2005) studied the best place of electronic elements. (Wess & Zeithofer, 2004) studied the phase coupling problem between data memory layout generation and address pointer assignment. Generally, because of more benefit and importance of QAP in different industry and place, a lot of papers have pressed and new techniques for these problems created until now and will be continue in future.

1.2 Resolution algorithms for solving QAP

Two general algorithms usually are used for solving optimization problems and specially QAP. The first one is exact algorithm and the second algorithm is heuristic. The most important strategies of these two methods can be explained in a short way as follows. The rest of the algorithms were not used in this project and mentioned only in order to show the vast application of QAP. The following are some exact algorithm that is used for solving QAP in optimization problem.

- **Branch-and-Bound algorithm (B&B):** The B&B is one of the well-known and most frequently used methods for solving this kind of optimization problems.

- **Dynamic programming algorithm:** This algorithm is used for some special instances that the flow matrix (matrix B) is the adjacency matrix of a tree. (Christofides & Benavent, 1989) were the first introducers that studied and used this algorithm to the relaxed instances. After that this algorithm was improved and (Urban, 1998) used the framework of dynamic programming to obtain an optimal solution procedure.

- **Cutting plane algorithm:** Bazaraa and Sherali in 1979 were the first introducer of this algorithm that at the beginning did not give a good result. This algorithm only used to small size of problems by (Kaufman & Broeckx, 1978) and (Burkard & Bonniger, 1983). In two decades later for solving on computer motherboard design problem used Bender decomposition method by (Miranda, Luna, Mateus, & Ferreira, 2005).

- **Branch-and-cut algorithm:** It is a modified version of the B&B idea. First it was applied by (Padberg & Rinaldi, 1991) for solving symmetric matrices. (Junger & Kaibel, 2000, 2001a,b) and (Blanchard, Elloumi, Faye, & Wicker, 2003) were some of the researchers that improved and applied this algorithm.

1.3 Heuristic and metaheuristics algorithms

The heuristic method does not assure that the best solution achieved is optimal or not. This algorithm is classified in three parts: The first one is a constructive method that first time proposed by (Gilmore, 1962) and in the future developed and used by some other researchers as (Arkin, Hassin, & Sviridenko, 2001) (Gutin & Yeo, 2002). The second class is a limited enumeration that assures the obtain solution value is optimum if that obtain value go to the end of the enumerative procedure. The third and last class of heuristic algorithms that includes most of the Quadratic Assignment Problems is improvement methods. The procedure of this method is parallel with the local search method, and it starts with a feasible solution and attempt to make it better (Mills, Tsang, & Ford, 2003). The heuristic algorithms were just used for particular numerical problem before 1990s. However, at the end of 1990s some general algorithms were introduced and it is named metaheuristics. Several of most important techniques that were used in assignment problem field are as follow:

- **Simulated Annealing algorithms(SA):** This is one of the good and useful methods for solving NP hard problems, like as QAP. The SA method is a metaheuristic optimization method to solve combinatorial optimization problems. This method was introduced by (Kirkpatrick et al. 1983).

- **Genetic Algorithms:** for QAP classified in two phases, the first phase is finding the starting population by saving the best solution of each iteration. And the second phase is using Genetic Algorithms to achieve the optimal solution. For more information about
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the genetic procedure can see the published paper about this algorithm.

- **Scatter search**: Glover in 1977 was the first introducer of this method for integer programming instances. This method also contains two phases, the first phase is investigate a pleasant solution and called initial phase and the evolutionary phase (the second phase) is continue and repeat this process until achieve to a stop criterion. (Cung, Mautor, Michelon, & Tavares, 1997) studied and applied this method for the QAP instances.

- **Tabu search algorithm**: This algorithm is used to integer programming problems. Glover in (1989 a,b) was the researcher who introduced this algorithm.

- **Greedy Randomized Adaptive Search Procedure (GRASP)**: It is a good method that mixes lot of favorable properties of other heuristics. In GRASP can select number of iterations as each iteration includes two steps, a first one is construction and the second is local search. Each iteration gives a special solution and the best solution from all iterations is selected for the final solution of the main problem (Pardalos & Crouse, 1989).

2. SELECTED METHOD FOR SOLVING QAP

2.1 Branch and bound

In this method the solution status at any point is described by an unexplored subset and the best solution which founded so far. Only one subset exist initially (say complete solution space) and the best solution value obtained so far is infinity. The nodes in search tree represent unexplored subspaces and they contain the root initially. Three main step of iteration can be classified as: Choosing the node, computing the bound and final branching. Figure 1; represent the first step and initial condition (Clausen, 1999). The procedure continues with choosing the next node. The first action will be branching if sub-problem selected according to the bound value. For each subspace which had single solution we keep this solution and then make comparison with the current solution and save the best one. If it does not contain any single solution, bounding function calculation and comparison with current best solution should be made. The subspace can be discarded completely if it is founded that the optimal solution cannot be reached through the subspace, otherwise it must be saved (Clausen, 1999). When the solution space explored completely the procedure ends and what saved in “current best” will be the optimal solution.

Branch and Bound method for QAP classified in three steps:

- Single assignment problem (Gilmore, 1962), (Lawler, 1963))
- Pair assignment algorithms (Gavett & Plyter, 1994), (Land, 1963), (Nugent, Vollmann, & Ruml, 1969))
- Relative positioning algorithm (Mirchandani & Obata, 1979)

Roucairol in 1987 and Pardalos were the first researchers who introduced B&B algorithms for quadratic assignment problem, but they just worked on instances of size \( n \leq 15 \). This algorithm was developed further on in one decade later by many researchers, such as (Gendronu & Grainic, 1994), (Feo & Resende, 1995) and (Pardalos, Resende and Ramakrishnan, 1995).

2.2 Simulated annealing (SA)

This algorithm has been applied to many layout problems e.g. Peng, Huanchen, & Dongme, (1996) and Jingwei, Ting, Husheng, Jinlin, & Ming, (2012), etc. The SA algorithm is based on randomization techniques and works as a probabilistic local search method. Generally the SA applies an iterative improvement algorithm to a predetermined initial solution and its objective function value. The SA with continues stage can be used to find and improve the local optimization algorithm. Also we can achieve to the local optimization algorithm by generating of all solutions in the neighborhood of the current solution. Local Search evaluates the neighbor according to the optimization criterion and selects it if it is better than the current solution, otherwise rejects the neighbor. This procedure continues until that the all or maximum number of the trials was checked and is not able to improve the solution. The SA is differ from local
optimization, in SA we can accept solution \( \hat{A} \) if it is better than solution \( A \) or worse than \( A \). It depends on Boltzmann’s law that uses to determine this acceptance probability that is shown as follow (Singh & Sharma, 2006):

\[
p(\text{accept}) = e^{-\Delta z / bt}
\]

The objective function value of the solutions obtained by SA algorithm usually is close to optimal value. The Simulated Annealing algorithm consists of the following steps:

Step 1: For first solution of SA we choose initial solution ‘i’ randomly.
Step 2: An initial temperature should be chosen \( (T_i > 0) \).
Step 3: Then we should select the temperature updating function i.e. cooling (or annealing) schedule.
Step 4: The epoch length function should be selected.
Step 5: Put temperature change counter \( (t) \) and epoch length counter \( (l) \) equal zero.
Step 6: By replacing two facilities compute solution \( \hat{A} \) in the neighborhood of \( A \).
Step 7: Compute \( \Delta z = z(\hat{A}) - z(A) \).
Step 8: If \( \Delta z \geq 0 \) go to step 9, otherwise replace a with \( \hat{A} \) and go to step 10.
Step 9: If random \( (0,1) \) < \( \exp(-\Delta z / bt) \) then \( \hat{A} = \hat{A} \), otherwise replace a with \( \hat{A} \) and go to step 10.
Step 10: 3 last step (7 to 9) repeat until \( l=Q \) (the maximum \( Q \) (the number of trial) for which the temperature is ‘t’).
Step 11: Generate and find the next temperature according to step 3 so that the function will be change and again repeat step 6 till 9 for the new temperature.
Step 12: We should do all of steps again until the stopping criteria becomes true.

In SA procedure b is a Boltzmann’s constant and parameter, \( t \) is called temperatures that can change according to some annealing schedule and also \( T_i < t < T_F \) \( (T_i) \) is the initial and \( T_F \) is final temperatures respectively). For using SA method four factors must be selected: Initial temperature, Epoch length, Annealing (Cooling) schedule and finally termination criterion. (Singh & Sharma, 2006)

### 2.2.2 Epoch length

If we assume \( N_k \) be the epoch length parameter (i.e. the amount of trials ‘o’ be done with the same temperature value). Some functions that refer to them are as follows:

- **Constant function:** \( N_k = \text{constant} \ (k = 0,1,2,\ldots,Q) \)
- **Arithmetic function:** \( N_k = N_{k-1} + \text{constant} \ (k = 0,1,2,\ldots,Q) \)
- **Geometric function:** \( N_k = \frac{N_{k-1}}{a} \ (a<1 \text{ and constant}, k = 0,1,2,\ldots,Q) \)
- **Exponential function:** \( N_k = \text{constant} \ \exp(-\kappa t_k) \ (\kappa = 0,1,2,\ldots,Q) \)
- **Logarithmic function:** \( N_k = \text{constant} \ \log(N_{k+1}) \ (\kappa = 0,1,2,\ldots,Q) \)

### 2.2.3 Cooling schedule

A lot of functions for updating temperature are available in literature, but sum of the most important ones are as follows:

- **Arithmetic function:** \( t_{k+1} = t_k - \text{constant} \ (k = 0,1,2,\ldots,Q) \)
- **Geometric function:** \( t_{k+1} = at_0 \ (a<1 \text{ and constant}, t_0 \text{ is initial temperature}, k = 0,1,2,\ldots,Q) \)
- **Inverse function:** \( t_{k+1} = \frac{t_k}{a \cdot t_0} \ (a < t_0 \cdot t_0 = T_i \text{ (constant)}, t_k \text{ is initial temperature}, k = 0,1,2,\ldots,Q) \)
- **Logarithmic function:** \( t_k = \frac{\text{constant}}{\log(N_{k+1})} \ (k = 0,1,2,\ldots,Q) \)

### 2.2.4 Termination criterion

In the literature lot of tests available and explained that some of them are as follows:

If we can’t find any improvement in a certain amount of iterations;
If all of the iterations have been done;
If the previously defined number of acceptance for a given number of trials has not been obtained;
If we reached the target temperature.

### 2.3 GRASP method

The GRASP procedure is shown on Figure 2: (Pardalos & Crouse, 1989)

```plaintext
procedure graspl()
  1) InputInstance();
  2) do stopping criterion not satisfied —
  3) ConstructGreedyRandomizedSolution(solution);
  4) LocalSearch(solution);
  5) SaveSolution(solution,bestsolution);
  6) od;
  7) return(bestsolution)
end graspl;
```

Figure 2: General case for GRASP pseudo-code
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In row number one we have inputs that consists two matrices, the flow matrix \( F \) and distance matrix \( D \). The stopping criterion in line 2 is a maximum number of iteration that we select or a solution value that we are satisfied or anything else. Line 3 is the construction step (shown in Figure 3) and line 4 is the local search step of GRASP procedure. In line 5 records the best solution until now and continue (Pardalos & Crouse, 1989). Figure 3 illustrate the summary of construction step. In this figure line 1 means that the construction step start with empty solution. In line 3 create a Restricted Candidate list (RCL). RCL means a list of best components, from that a selection will be created. The selecting random elements from RCL list is done in line 4. In line 5 the new solution is considered as the last solutions set with added s. The last elements (without added s) are computed in the greedy function, where the loop starting with a new RCL will be constructed.

**Figure 3:** GRASP construction step pseudo-code

The construction step can be implemented in two ways, one of them is sparse procedure and another one is dense procedure. Both of these procedures have similar function, but the most important thing is that the sparse procedure is considerably faster rather than dense procedure. This fasting is perceptible in our computations.

### 2.3.1 Initial construction phase for QAP

Each QAP instance consists of two matrices which are the flow matrix \( F = (f_{ij}) \) and the distance matrix \( D = (d_{ij}) \). \( f_{ij} \) is the transportation cost between facilities \( i \) and \( j \) if they are assigned to locations \( k \) and \( l \). \( \alpha \) and \( \beta \) are assumed the candidate list restriction parameters. Then the distance matrix elements classified in increasing order and flow matrix element classified in decreasing order that shown as follow:

\[
d_{k_1l_1} \leq d_{k_2l_2} \leq \ldots \leq d_{k_{n,m}}
\]

\[
f_{i_1j_1} \geq f_{i_2j_2} \geq \ldots \geq f_{i_{m,l}j_{m,l}}
\]

If \( \beta_m \) is the minimum of \( d_{kl} \) elements and also \( \beta_m \) is the maximum of \( f_{ij} \) elements, the corresponding cost is as follows:

\[
f_{i_1j_1} d_{k_{1,l_1}} + f_{i_2j_2} d_{k_{2,l_2}} + \ldots + f_{i_{m,l}j_{m,l}} d_{k_{m,l}l_{m}}
\]

These costs are classified in increasing order and the cost corresponding to some couple assignment shown with each element. In this phase according to two couple assignment, two selection elements take from the previous cost set. For complete implementation details about this phase can refer to (Li, Pardalos, & Resende, 1994).

### 2.3.2 Local search for QAP

In this step the current solution (s) is improved by investigating the neighborhood \( N(s) \) of that solution. QAP include \( n! \) permutation. First of all assume \( \delta(p,q) = \{ i | p(i) \neq q(i) \} \) is the difference between permutation \( p \) and permutation \( q \) and \( d(p,q) = |\delta(p,q)| \) is the distance of this two permutations. For different problems, many different ways are available to construct \( N(s) \). Some of the general ones are as follows (Li (1992)):

The reasonable neighborhood size: could be possible to investigate in the rational number of calculation. Large variance in the neighborhood: show that the maximum distance of all of the permutations is large if a special neighborhood conclude all of the permutations \( p_1 , p_2 , \ldots , p_n \). Connectivity in the neighborhood: it means that the sequential of permutation \( \{p_k\} \) with small \( \delta(p_k,p_{k+1}) \) are available while we moving from permutation \( p_i \) to \( p_j \) \( (k = i,i+1,...,j-1) \).

The \( k \)-exchange neighborhood is used for GRASP local search, which is as follows:

\[
N_k(n) = \{q | d(p,q) \leq k, 2 \leq k \leq n\}
\]

The initial permutation \( p \) is used to start the \( k \)-exchange local search, and then all of the permutations generated by exchanging of \( k \) between each other. The local optimum recorded according to the best permutation. The size of this neighborhood is \( \pi_k(n) \). If \( k = 2 \) then the neighbors are as follows:

\[
m = 1 \quad q = (2,1,3,\ldots,n-2,n-1,n)
m = 2 \quad q = (3,2,1,\ldots,n-2,n-1,n)
m = \pi_2(n-1) \quad q = (1,2,3,\ldots,n-1,n-2,r)
m = \pi_2(n) \quad q = (1,2,3,\ldots,n-2,n,n-1)
\]

In looking for the neighborhood, the \( k \)-exchange local search processing mentioned above ceases when a better solution is achieved, and starts penetrating in the neighborhood until the most valued solution is found at the same manner. The First Decrement search is comparing to Complete Enumeration search, but
Complete Enumeration checks all of the solution in neighborhood, and this procedure continues for the best outcome is suggested as before. However in both case a neighborhood completely search (according to \(p_k\) solution). But in GRASP procedure generally the initial permutation is in the good condition and the local search just search in few percent of the neighborhood (Pardalos & Crouse, 1989).

3. EXPERIMENTATION

3.1 Quadratic assignment problem library

In order to create a standard test set for QAP, in 1991 QAPLIB was established which is accessible for all researchers and all QAP instances that were available to the authors at that time, are included in it. Following the huge positive feedback and continuing demands from scientific community in 1994 Bukard, Karisch and Rendl provided a major update which was even accessible through anonymous ftp as well. Many new problem instances which were generated by researchers for their own testing purpose, were included in that update. In April 1996 QAPLIB was updated again. On one hand this update reflected on the big changes in electronic communication, which means, QAPLIB became a World Wide Web site, the QAPLIB Home Page. On the other hand, research activities around QAP were increased so much that another update was necessary and some recent (at that time) dissertations were added to the library. Some of the test instances were not solved optimally before, so another update released in June 2000 which contained new test instances and the optimal solutions for non-optimally solved old problems. The next update was in January 2002 that again consists of new test instances and improvements on the best known feasible solutions, especially test the instances did not achieve to the optimal solution yet.

3.2 Problem instances

In this part we discuss the problem instances that are available in the QAPLIB. The size of instances are \(12 \leq n \leq 256\), and four largest ones of size 128, 150(two instances) and 256. Instances of size \(n < 12\) are not considered in the QAPLIB, because this size of problems can be solved so easily even without using any software. The problems that solved in the QAPLIB consists different parts:

- \(n\): the size of the instance
- \(A\) and \(B\): are distance and flow matrices
- \(P\): is a corresponding permutation
- \(\text{Sol}\): is an objective function value

Also the solution of the problems classified to two groups:

1) The problem instances where optimality is. Their optimal permutation is also provided.
2) The problem instances where optimality is not achieved. Their best known feasible solution and the gap relative to the best known lower bound are also provided.

This section presents certain numerical results for all of the instances in the QAPLIB (134 instances) were calculated with 4 different algorithms which have been explained in the previous section extensively. The calculations were made by FORTRAN software which is available in QAPLIB home page and FORTRAN codes were modified because the original codes was not appropriate for solving general sizes in the instances so the new codes supported different input size of the matrices. Maximum number of iterations for GRASP method was set to 100 times and the parameters \(\alpha = 0.25\) and \(\beta = 0.5\) were initialized. 12 desktop computers with processors with Pentium® D 3.00 GHz and 960 Mb RAM with windows XP 32 bit as the operating system, were connected to a network and all runtimes correspond to the parallelized processors. Summary of all the experiments with 4 mentioned methods and the existing results in the literature are shown and compared in Table 1 in Appendix.

This table’s columns, contains five parts. The data from first part was taken form QAPLIB home page and the other parts are the results obtained from the algorithms. The first part contains 3 columns. First column is the name of instances, which is abbreviation of author and size of the instance. The second column shows the feasible solution for all the instances and the one that reached to the optimal solution were marked with (Opt) in gap column and the rest are the best known solution. The gaps in between best known solution and the currently known best lower bound were shown in column number 3. The other 4 parts of this table contain 3 columns each. The first one is the obtained feasible solution and the second column shows the runtime of the solution and the third column shows the Performance ratio. The best value among these four algorithms is bolded. The maximum runtime was set to 1 week and if during this 1 week the solution algorithm did not stop, it will drop the process and record the best known solution obtained by the algorithm( if there was not any solution, the square of the feasible solution marked by (—)) and the runtime of these processes are shown by (1w). The value of performance ratio is obtained by dividing the obtained value with mentioned method by the best known value in the QAPLIB web page. If this value is less than one, it means that the obtained value found is better than the value in the QAPLIB web page. Otherwise, the values
which are closer to one are more reliable. In some of the instances (for example all part b of the Taillard instances), the volume and amount of data matrices and the solution were overclocked and in these cases, the compiler was not able to solve the instance. This problem mostly happens in a few of instances that were solved by GRASP algorithm. For example all of the Burkard instances, the Simulated Annealing method and both of GRASP algorithms can’t find any solutions. The reason of this case is that the flow and distance matrices of Burkard instances are not symmetric and solving this kind of problem is difficult. The instances that faced this situation are marked with (N) and also for this kind of problem there is not any runtime and performance ratio. According to the results obtained in this research, about 63% of the solutions in Branch and Bound Algorithm (B&B) were equal or closest to QAPLIB solutions which compared to the other algorithms is the highest percentage. It shows that the accuracy and efficiency of Branch and Bound algorithm is at least twice compared to the other algorithms. The instances which were solved by B&B method reached the objective function value.

The reason for this is that unlike the other methods, B&B method is an exact algorithm and although it takes more time to solve the instances, it will give the objective function value. Based on the average runtimes of each algorithm that led to a feasible solution without taking the instances that did not attain a feasible solution in one week and stopped into the consideration, although the best solutions were obtained by Branch and Bound algorithm, but this algorithm is dependent to a long runtime and has the longest runtime for solving the instances among the other algorithms. The average runtime for this algorithm is more than 265 minutes per instance. This amount of runtime can effect to decision for select the method for QAP. Although the fastest solutions for instances are obtained by Simulated Annealing (with the average run time 0.3 second, but only 20% of the instances reach to best feasible solution by this algorithm. Both types of Grasp algorithms (Dense and Sparse) with the average runtime of 3.60 and 3.53 seconds and 35% and 33% of best feasible solutions, are of the most efficient methods for solving these problems. However, for all Bur and Lipa instances, because of the high volume of data, they do not have a good performance.

4. DISCUSSION OF THE RESULT AND CONCLUSION

The purpose of this research is to illustrate which of these four algorithms mentioned in the previous parts are more suitable for analyzing QABLIB’s instances with respect to runtime. According to the feasible solution that recorded in table 1, it can be concluded that, if the runtime is not a priority, the Branch and Bound algorithm is still one of the best algorithms for solving these kinds of optimization problems, but there is no guarantee when is the optimal solution achieve. And if the classification of these algorithms is made with respect to runtimes, the best method is Simulated Annealing with the average runtime of 0.3 seconds, but because this method is a heuristic method, there is no guarantee to reach the objective value. The solution time can be extremely long for large problem instances. Therefore it is possible that within a week the optimal solution is not achieved. Thus the B&B algorithm can be understood not only exact but heuristic method as well. Obviously if a more powerful processor and greater volume of Ram is used for this research, it will lead to a better runtimes.

5. REFERENCES


## Analysis and Performance Measurement of Existing Solution Methods of Quadratic Assignment Problem
(Morteza KARAMI, Sadegh NIROOMAND, Nima MIRZAEI, Bela VIZVARI)

### Appendix

#### Table 1: Final results

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Analysis and Performance Measurement of Existing Solution Methods of Quadratic Assignment Problem
(Morteza KARAMI, Sadegh NIROOMAND, Nima MIRZAEI, Bela VIZVARI)

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## Analysis and Performance Measurement of Existing Solution Methods of Quadratic Assignment Problem

(Morteza KARAMI, Sadegh NIROOMAND, Nina MIRZAEI, Bela VIZVARI)

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Note: The table above shows the performance of different solution methods on various instances of the Quadratic Assignment Problem (QAP) from the QAPLIB benchmark set. The columns represent the problem instance, feasibility, solution gap, time, and performance ratio for different solution methods: B&B, Simulated annealing, GRASP (dense), and GRASP (sparse).
## Analysis and Performance Measurement of Existing Solution Methods of Quadratic Assignment Problem

(Morteza KARAMI, Sadegh NIROOMAND, Nima MIRZAEI, Bela VIZVARI)

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### Analysis and Performance Measurement of Existing Solution Methods of Quadratic Assignment Problem

(Morteza KARAMI, Sadegh NIROOMAND, Nima MIRZAEI, Bela VIZVARI)

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Analysis and Performance Measurement of Existing Solution Methods of Quadratic Assignment Problem
(Morteza KARAMI, Sadegh NIROOMAND, Nima MIRZAEI, Bela VIZVARI)

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Abstract - As one of the unique beauties of Bosporus, Bosporus watersides have been composed and formed through long ages along the Bosporus. Not only an architectural form and a residential type, the Bosporus watersides also were a part of the culture in which they were built. They project the life traditions of the ages in which they were built. Their users were using those buildings as summer resorts, comprised of a hall, wide rooms, kitchen and other components. The gardens of the watersides also have had their own characteristics, and they were setting out unique beauties. The gardens of the watersides in Bosporus were beyond comparison by their organizational schemes and landscape designs. The watersides were designed with a garden within the bounds of spatial possibilities. The gardens were decorated with colorful flowery plants. Many watersides, which were built in Bosporus, have reached until today. As a type of residences, these buildings are among the most important buildings of Bosporus. The Bosporus watersides have unique architectural samples and features and they need to be well preserved. However, it has been identified that some of those structures have disappeared in time. There are many causes for such a removal. By analyzing these causes, we need to preserve these buildings better nowadays. Bosporus watersides and their gardens today need a better protection by effective policies to be produced. Having unique architectural features and styles, those buildings also are a part of our culture. We must better protect our historical and cultural patterns. This is a must to respect our history and culture too.

Keywords: Bosporus watersides, Bosporus, Architectural form, Residence, Culture, Gardens of watersides.

1. FORMATION OF WATERSIDES ON THE BOSPORUS AND FEATURES OF WATERSIDE GARDENS

Bosporus watersides are one of the unique beauties of Istanbul. Waterside structuring on the Bosporus dates back to the depths of history. After the conquest of Istanbul, many watersides in various sizes were built along both sides of the Strait. These watersides built on both sides of the Strait have national characteristics and quite attracted foreigners [1]. In the fifteenth century, Bosporus watersides were the dense residential area outside of Beşiktas walls. In the Ottoman, watersides were usually places where pashas and sirs resided in summer. These gave an appearance disconnected from the city and the public. The watersides leading the original Bosporus life were the ones owned by dignitaries, officers and merchants along the Strait. With the construction activities carried out over time, many settlements were formed on the Bosporus. Baltalimanı, Emirgan, Tarabya, Rumeli Kavağı, Anadolu Kavağı and Vaniköy settlements were established in this way [17]. While new settlement areas along the Strait were forming and their populations were increasing, Bosporus became a preferred location for the Sultans and leading statesmen. Summer places, watersides and mansions on the Bosporus had become resort areas of senior officers of the government. The wooden ones located on the shores on the Bosporus were called watersides, while the wooden ones in gardens in the resort areas of Istanbul and the masonry constructions with harem and selamlık (the portion of a house reserved for men) were called pavilion and mansion, respectively [1]. From the Bosporus watersides, the Strait could be watched with all its glory. Istanbul had gone through many periods in history. At the beginning of the seventeenth century, it was influenced by westernization efforts. At that time, Istanbul met with the “beautiful city” concept. In this process, the Tulip Era was experienced and construction of fountains, open public spaces and gardens were intensified [10]. On the Bosporus, while waterside structuring towards the Black Sea was intensifying, also waterside structuring in Beşiktas, Tophane and Findikli was observed. Navy and trade had influenced the waterside structuring in these regions. In the middle of the seventeenth century, important watersides began to be built. In the
coastal area of Beşiktaş, watersides of important statesmen, kazasker (judge of the army) and muftis have been found [4]. The Bosporus watersides have their own unique architectural form. The Bosporus watersides are wooden structures. The Bosporus watersides, which can be defined as a type of residence used as resort area by their residents, also transfer us the living traditions of their time. Watersides located in the coastal area of İstanbul are one of the housing types resulting from the socio-economic structure in the historical process. These structures describe life style of an era and the community.

Until mid-way through the eighteenth century, the Bosporus watersides were built in the classical style. Construction of Rococo style and the Empire-style watersides had begun by the end of this period and during the reign of Mahmud II, respectively. The Tanzimat reform era, on the other hand, has brought a new understanding of architecture. Tanzimat dignitaries had large wooden watersides to be constructed on the shores of the Bosporus. Foreign architects, who were brought for the first time in the seventeenth century, have led to a new architecture in the construction of the watersides and other buildings. In this era, Italian Fossati, English Smith, French Gerner, Bourgeois, German Bernramodi and Zaranko were among the famous architects who came to Istanbul. With this new understanding of architecture, palaces and watersides of the statesmen started to be built according to the European taste [7].

City’s trend of development along the Strait beginning in the seventeenth century has made progress towards integration of the area with the city in the eighteenth century. Residential areas, where waterside structuring was developed on the Bosporus, have been differentiated from other residential areas with the urban character created by its socio-economic structure [2]. Westernization movement that has begun in architecture in general in the seventeenth century continued in the eighteenth century.

In the eighteenth and nineteenth centuries, spatial changes occurred on the Bosporus. On the other hand, this area gained importance. Throughout the nineteenth century, eclectic-style and large-size palaces, mansions and watersides were built on the Bosporus. The architectural character of the Bosporus has changed and gained prestige. On the other hand, it has entered into the process of urban integration and living in these places during the entire year [13][14].

Watersides built on the Bosporus were very adversely affected by the First World War and the War of Independence. Watersides that have been abandoned and left to decay were seen. Thus, continuity of the spatial texture of the Bosporus began to be damaged. Until 1950s, the Bosporus has deprived of the nature of urban structure [9]. However, residential structures kept their old forms and watersides continued to exist dominantly in the area. Spatial changes in the Bosporus have been influenced by the economic and social changes. In the periods when the Bosporus was far away from the city, watersides of the upper income group were located along the shores of the Strait. Today, interactions among the spatial, economic and social facts have changed the social and cultural structure in the Bosporus. Bosporus had been detached from the city for a long time and kept its nature of being an area of small village settlements. Different ethnic communities in the Strait also had an impact on shaping the area. Other than Turks, Jews, Armenians and Greeks were also living here [11].

Bosporus watersides have unique architectural and functional characteristics. Watersides on the Bosporus are composed of several units. Bosporus watersides are built with large halls and rooms within the bounds of spatial possibilities. Kitchen was another important part in the waterside. Meals were cooked and served here. It is observed that all units and functions required to be in an average residence were included in the watersides. Gardens of the Bosporus watersides also have their own characteristics. These were adorned with diverse and rich plant varieties offering a unique beauty to the beholders. Gardens of the Bosporus watersides were areas where functionality was brought to the forefront with the organizational schemes. Landscaping was remarkable. The gardens were decorated with colorful flowering plants. Watersides were designed to have a garden. Spatial possibilities were decisive on the size of the gardens.

2. CURRENT NEED OF BETTER PROTECTION OF THE BOSPORUS WATERSIDES

Watersides are the pearls and the most important structures of the Bosporus. Many of the watersides built on the Bosporus have survived until today. However, some of them have disappeared. There are samples detached
from their functions by changing their functionality. These watersides are currently used for other purposes. Such samples bring the requirement of better protection of the Bosporus watersides on the agenda. Because of the changing life style and desires over time, some of the Bosporus watersides lost their original functions and began to serve for other purposes. Some of them began to become nonfunctional and entered in the process of vanishing [1].

In the development of structuring on the Bosporus, enforced laws are determinant. Structuring of the Bosporus is directed by these laws. Watersides, mansions and village settlements in the course of history were developed by this way. However, recent laws are found to be serving more to improve the building stock in the region. Criticisms in this respect have increased and consequently, a protection approach in the Bosporus has begun to be adopted in 1970s. Protection understanding that began on a structure basis has started to gain a spatial nature by the formation of a new protection approach in the 1970s. With the adoption of protection approach by the decision taken in 1970 for preservation of the remaining ones in the destroyed Bosporus, the Bosporus Coastline Protection plan at 1/5000 scale has been the first study on July 15, 1971. This plan has been important for protection of coastal watersides but insufficient for the Bosporus in general. An important decision affecting the silhouette was taken in the plan. To provide continuity of the coastline on the vacant lands between the watersides, construction of new buildings on the empty spots so as not to exceed 9.50 meters height has been permitted [16].

Due to structuring limitations on the Bosporus by the Bosporus Law No. 2960, rent increase brought by the constraints has created an intensive pressure on the historical structures located in the area and caused failure of retaining most of them with their original features. In this regard, it is expressed that, for preservation of the significant historical watersides and other civil architectural examples on the coastline within the area, a protectionist planning approach must be supported by holistic decisions and sub-scales also need to be addressed [16].

The first study conducted to protect the historical integrity of the Bosporus was regarding registration of the watersides in the coastline of Istanbul Bosporus by the Supreme Council of Real Estate Antiquities and Monuments (GEEAYK) in 1970. In this context, it has been renewed on May 13, 1972 and 89 pieces of first degree, 209 pieces of second degree and 67 pieces of third degree historical artifact structures have been identified [6].

In 1971, first planning was made on protection of the Bosporus and 1/5000 scaled Bosporus Coastline Protection plan was created. In this plan aiming protection of the current watersides on the Bosporus, for the vacant plots in the coastline, construction of new buildings consistent with the registered buildings and maximum at the height of 9.5 meters was proposed. However, this decision was widely criticized for its consequences on the watersides. Conservation planning efforts for the Bosporus region has started in 1990s. The first study on protection of the watersides constituting the identity of the Bosporus was carried out with the Registration of Istanbul Bosporus Coastline Watersides by GEEAYK [6].

Bosporus watersides have unique architectural samples and features, and need to be well preserved. However, it has been identified in the study that some of those structures have disappeared in time. There are many causes for such a removal. By analyzing these causes, today, we need to preserve these buildings better. Rapid urbanization is one of the main reasons. Rapid urbanization has been observed in Istanbul, particularly since 1950s. There have been massive migrations from the rural areas to Istanbul. Unplanned urbanization has revealed itself by destroying green areas and building non-zoned structures. Green spaces in the city have rapidly turned into built-up areas. Bosporus watersides have been very adversely affected by these developments [12]. With the failure of effective enforcement of the relevant laws, unplanned structuring in the Bosporus has been overlooked for many years and Bosporus watersides have been adversely affected by this. Some social and cultural factors, legislation and laws, the development of road and sea transportation have been effective on the changes in terms of spatial use of the gardens and watersides on the Bosporus. As a result, watersides and gardens in the Bosporus are being subject to changes in use. Some watersides have disappeared due to reasons such as fire etc., and some have been destroyed by changing their functions. As the Bosporus watersides cannot be protected, it is not possible to see their unmatched landscape. Yet, the Bosporus watersides were magnificent also with their
gards. Gardens were adorned with diverse and rich plant varieties. We can still see the richness in the samples being able to survive until today.

Gardens of the Bosporus watersides have undergone spatial changes in the history due to some factors. In this respect, development of road and sea transportation constitutes a significant factor. When road transportation was undeveloped, the Bosporus was a resort area and sea transportation was in the forefront [8]. With the development of road transportation, traffic congestion began to be faced in the region; one of the precautions to relieve traffic was construction of causeways along the coastline, which affected the Bosporus watersides very adversely. Gardens of many watersides have been destroyed. In 1971, when 1/5000 scaled structural plan studies of the Bosporus were carried out, together with the Bosporus villages, planning of the watersides and the coastline was also addressed. An important decision affecting the silhouette was taken in the plan. To provide continuity of the coastline on the vacant lands between the watersides, construction of new buildings on the empty spots so as not to exceed 9.50 meters height has been permitted [5]. Constructed causeways cut off the sea connection of the watersides and led to loss of their originality. Examples to these changes can be seen from picture 1,2,3.

Today, there are watersides with damaged and detached connections with the sea because of the causeways. Many examples of damaged watersides and gardens in this way are available in the history. For instance, the main axle connecting Hidiv ismail Paşa (Khedive Ismail Pasha) Yalısı to the garden and parts of the garden up to the main entrance have disappeared and its connection with the sea has been lost. The part of the main axle within the boundaries of Emirgan Woods and the part other than interferences with paving were preserved [3].

Analyzing the gardens of the Bosporus watersides, it is seen that these gardens were designed as large as possible, and that a wide variety of garden flowers and tree species is included. Thus, a unique beauty is demonstrated to the beholders. Organization schemes are also remarkable. The presence of a pool in the garden is noticeable in the first
place. Thus, connection of the gardens with water is established. The pools have fountains so that an aesthetic view is provided as well as an element that relaxes people. As the Bosporus watersides were built adjacent to the Strait, one of their fronts is facing the sea. The garden establishes the connection of the waterside with the sea. Boathouses can be seen in the coast section of the garden. In the history, each of the watersides located on the Bosporus had its own boathouse. Gardens of the Bosporus watersides dazzle people with their colorful flowers and these gardens have a unique beauty. Gardens of the Bosporus watersides are decorated with colorful flowering plants offering an incomparable beauty.

3. CONCLUSION

Bosporus watersides are the pearls and the unique beauties of the Istanbul Strait. They have been formed and shaped on the Bosporus for many years. Watersides are the most important structures of the Bosporus. They have unique examples of architecture and features. However, in the historical process, some of these watersides were destroyed. Architectural influence of different eras can be seen on the Bosporus watersides. The influence of Turkish civil architecture continued until the middle of the eighteenth century. After this date, the Western influence has started. Bosporus watersides have taken its fair share from reform decisions of the Ottoman due to various reasons. After this, similar to other buildings the Western influence has begun to be seen on the Bosporus watersides. Bosporus watersides are not only an architectural form or a housing type but also a part of the culture in which they were built. Besides their unique architecture and decoration, they reflect the living tradition of their times. People were using these locations as places of resort. They had components such as Turkish baths, pools and kitchens, etc. Mostly, they were built of wood on a stone floor and had one or 2 floors. Windows were positioned to face the Strait. Watersides were offering the pleasure of viewing the Bosporus to their users. For this purpose and making more use of the daylight in the interior spaces, windows were kept large. Watersides were designed integrated with nature. Their contact with the water on the one hand and with the greens on the other hand was ensured. Thus, they were designed and made eco-friendly. Their interiors had also their own unique features. They had large halls and rooms. They also drew attention with the interior decorations. Gardens of the Bosporus watersides had a unique beauty with their organization schemes and landscaping. Mostly water was used in the side and rear gardens of the watersides. Benefiting from the aesthetic and visual potential of the water in the gardens was intended. Islam religion also has an influence on this. In Islam, water makes connotations of cleanliness and therefore stands out as an indispensable element of garden arrangements. Water, at the same time, is a relaxing factor. It psychologically relaxes people. For such reasons, water was heavily used in the gardens. Ponds were built in the gardens of the watersides and movements were given to the water with fountains. Thus, aesthetic appearances were obtained. There were pergolas and sitting places in the back yards. Garden could also be used as a separator. By this way, a function was added to it. Harem section of the watersides was sometimes separated from the Selamlık by the garden and courtyards. The watersides were designed with a garden within the bounds of spatial possibilities. Large watersides were built in a garden. Around these watersides, starting from the seafront, sets of gardens were rising after flowerbeds, wisterias, lilacs and roses. Since the lands of watersides were sloping, there were watersides having many sets of gardens. These sets were built in the backyards of the watersides. There were garden pavilion (sitting area) and pines at their peaks. These set gardens seen in the watersides constitute a garden type. Some examples of such watersides are located on the Bosporus. By taking the shape of a half circle, retaining walls in the gardens of the watersides were ensured to become more resistant to static load and have a better grip of the garden in front of them. This kind of garden example is also included in the thesis study. There were also boathouses in the front yards of the watersides. They were in a nature that allows entrance of the water inside the waterside. Gardens of the Bosporus watersides were being designed with colorful flowering plants so that they were giving a great pleasure of viewing. Tree species used for garden arrangements were various. There were those built in woods consisting of oaks, sycamores and laurel trees.
Due to various factors, gardens of the Bosporus watersides have been changed over long years. Social and cultural factors had influences on these changes. Development of road and sea transportation along the Strait also had an impact on spatial changes of the Bosporus waterside gardens. Other than these, effects of legal regulations and laws on the spatial changes of the Bosporus waterside gardens can be discussed.

There are samples of the Bosporus watersides that have disappeared today. The list of watersides, which are not present today or undergone functional changes, is given in table 1. In the presence of all these examples, today, there is a need for better preservation of the Bosporus watersides. Conversions of the watersides have been examined and the watersides that have been changed and do no exist today are listed in table 1.

<table>
<thead>
<tr>
<th>NAME</th>
<th>DISAPPEARANCE REASON - STATUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>THE MÜNİRE SULTAN WATERSIDE</td>
<td>It is used as Mimar Sinan Fine Arts University. Certain parts of the garden have been destroyed and utilized for university’s canteen.</td>
</tr>
<tr>
<td>THE CEMİLE SULTAN WATERSIDE</td>
<td>It is used as Mimar Sinan Fine Arts University. Certain parts of the garden have been destroyed and utilized for university’s canteen.</td>
</tr>
<tr>
<td>THE ESMA SULTAN WATERSIDE</td>
<td>It is used as a hall for meetings, parties and events. The garden has disappeared.</td>
</tr>
<tr>
<td>THE NAİME SULTAN WATERSIDE</td>
<td>It burned during a fire. It is not used today.</td>
</tr>
<tr>
<td>THE HATİCE SULTAN WATERSIDE</td>
<td>Due to construction of the Bosporus bridge, certain parts of the waterside have disappeared. Restoration works for a hotel are in progress.</td>
</tr>
<tr>
<td>THE MUHSINIZADE MEHMED PASHA WATERSIDE</td>
<td>It is used as Hotel Les Ottomans. The side garden has disappeared.</td>
</tr>
<tr>
<td>THE EMİNE VALİDE PASHA WATERSIDE</td>
<td>It is used as the Embassy of Egypt. Its garden has undergone restoration and refurbishment.</td>
</tr>
<tr>
<td>THE ŞERİFLER WATERSIDE</td>
<td>It is used as the Museum of Turkish and Islamic Arts.</td>
</tr>
<tr>
<td>THE SAİD HALİM PASHA WATERSIDE</td>
<td>It is used as a hotel and restaurant. Certain parts of the garden have been renovated. The woods at the backside have disappeared.</td>
</tr>
<tr>
<td>THE FUAT PAŞA WATERSIDE</td>
<td>It is used as a hotel and restaurant.</td>
</tr>
<tr>
<td>THE İHMALYAN WATERSIDE</td>
<td>Its restoration by a private institution continues.</td>
</tr>
<tr>
<td>THE EGYPTIAN YUSUF ZİYA PASHA WATERSIDE</td>
<td>It is used as the head office of a private company.</td>
</tr>
<tr>
<td>THE MEDIHA SULTAN-GROOMFERİD PASHA WATERSIDE</td>
<td>Harem section is used as Baltalimanı Osteopathic Hospital; Selamlık section is used as social facilities of İstanbul University.</td>
</tr>
<tr>
<td>THE HUBER WATERSIDE</td>
<td>Its garden has been renovated. It is used as the presidential summer mansion.</td>
</tr>
</tbody>
</table>
FORMATION OF WATERSIDES ON THE BOSPORUS AND SPATIAL DEVELOPMENT OF BOSPORUS WATERSIDE GARDENS
(Petek JAWDET ABDULLA)

4. REFERENCES


FORMATION OF WATERSIDES ON THE BOSPORUS AND SPATIAL DEVELOPMENT OF BOSPORUS WATERSIDE GARDENS
(Petek JAWDET ABDULLA)
UWB RADAR IN HIDDEN HUMAN DETECTION

Saeid KARAMZADEH¹, Mesut KARTAL², Osman N. UCAN³
¹Istanbul Aydin University Engineer Faculty Florya, Istanbul TURKEY
²Department of communication systems, Satellite Communication & Remote Sensing, Istanbul Technical University, Maslak, 34469, Istanbul TURKEY
⁴karamzadehsaeid@itu.edu.tr kartalme@itu.edu.tr

Abstract- Hidden human detection and tracing have many civil and police security application. In this study, The UWB radars as the best system for human detection is discussed. For acquire the optimal result, proper antenna as a transmitter and receiver is presented. Gaussian signal as a suitable transmitter signal in UWB is presented. In the signal processing part two methods are debated and appropriate wavelet transforms for background subtraction is chosen.

Keywords: UWB radar, Gaussian signal, wavelet transforms, background subtraction.

1. INTRODUCTION

Because of high resolution and appropriate penetrating factors, ultra wideband (UWB) radars have got more attention in the hidden human detection. UWB radars in hidden human detection have many civil and police service applications. For instance, the determination of the position of a human behind a barrier in earthquakes is one of them. The other one is the detection of supervising heartbeats and respiration of patients, children and old people at the hospital. In police service, tracking a hidden person inside a building is an application of this system. In this study, we used UWB radar to detect respiratory signal of hidden humans behind a wall. The general system of UWB for detection is discussed. Types of antenna that could be used in UWB systems are discussed. Gaussian signal and some derivatives of Gaussian signal as a transmitter signal is presented. Background subtraction as a big challenge in signal processing is discussed and some wavelet transforms in different environment for obtain the best result are presented [1], [2], [3].

2. UWB SYSTEMS

Ultra wideband (UWB) has advanced and consolidated as a new technology.

The advantages and possibilities of UWB could be summarized by Shannon’s famous capacity equation.

\[ C = W \log(1 + \frac{S}{N}) \]  

Where C is the maximum channel capacity (b/s), W is the channel bandwidth (Hz), S is the signal power (watts), and N is the noise power also in watts [4].

According to equation for improving the channel capacity there are three parameters. Decrease the noise, increase the signal power or bandwidth could improve the channel capacity.

There is a linear relation between capacity of channel and bandwidth. Although, the logarithmic correlation can be observed between channel capacity and signal power. Then could be a bandwidth tradeoff for signal power reduction.

UWB systems defined by Federal Communications Commission (FCC) in United States of America (USA) as systems with bandwidth larger than 500MHz or relative
bandwidth $B/\omega_c$ ($\omega_c$ is the carrier frequency) larger than 20%. Therefore, UWB systems have a great potential for high-capacity communication systems.

The interference of UWB systems with the other existing systems that working in the same frequency could be ignored because of the low power spectral density of UWB. This property enables the unlicensed operation of UWB devices. High resolution property of UWB systems, because of its short pulse, could be helpful in sensitive systems like human respiratory detection [5].

In this work, we used the very large bandwidth advantage of UWB systems like, high time resolution, high date rate, obstacle penetration, low power consumption resistance to interference, for human respiratory detection behind a wall.

3. SYSTEM SCHEME

The basic model of detection system shown in figure 1. Transmitted signal changes due to transmitter antenna characteristic, passing different layers (air, wall) and hitting the target. Rotating back signal, after crossing the channel again, reaches to the receiver antenna.

![Figure 1. System model, $S_i(t)$ is transmitted signal, $h(t)$ is channel function and is $\tau$ time delay.](image)

Transmitted signal is the important challenge in this system. This signal should have some properties as better penetration and ability to analysis in frequency and time domain. Then in the next step this subject will be discussed. Choosing proper antenna is another important parameter. Last but not least, for getting a better information about the target and background subtraction appropriate signal processing methods will be discussed. CST microwave studio (computer simulation technology) software is used to simulate the antenna-target model and getting the received signal. MATLAB software is used to create a transmitted signals and for processing on received signals.

4. ANTENNA

Due to literature, the most popular antennas are Vivaldi and Horn antennas in the UWB radar applications. Both antennas have important advantages like, high gain, simple shape, wide band and easy fabricate [6].

In present of a wall, we have to decrease the antenna working frequency for passing the signal through the obstacle, because of this rationale, the horn antenna could be a better choice.

In this work the horn antenna is used as transmitter/receiver antenna. Figure 2 shows a horn antenna that used for human respiratory detection behind a wall. Figure 3, show a pattern of this antenna in 1 GHz frequency.

![Figure 2. A horn antenna in present of a human behind a wall](image)

![Figure 3. The pattern of horn antenna](image)

5. TRANSMITTED SIGNAL
Another important parameter in the detection is the proper transmitted signal. In this study, a signal with the property of localization in both time and frequency domain is needed. The Gaussian signal and some derivatives of this signal are the best candidate. Figure 4 shows the Gaussian signal and seven derivatives of this signal that used as a transmitted signal in this work. The equation of Gaussian signal and four derivatives of it is presented as below [7].

\[
\begin{align*}
    f(x) &= \frac{1}{\sqrt{2\pi}\sigma^2} e^{-\frac{x^2}{2\sigma^2}}, \\
    f'(x) &= \frac{x}{\sqrt{2\pi}\sigma^2} e^{-\frac{x^2}{2\sigma^2}}, \\
    f''(x) &= \frac{x^2 - 6\sigma^2}{\sqrt{2\pi}\sigma^4} e^{-\frac{x^2}{2\sigma^2}}, \\
    f'''(x) &= \frac{x^3 - 6x^2\sigma^2 + 3\sigma^4}{\sqrt{2\pi}\sigma^6} e^{-\frac{x^2}{2\sigma^2}}.
\end{align*}
\]  

Figure 5. The Gaussian signal and seven derivatives of this signal.

6. SIGNAL PROCESSING METHODS

Transmitted signal’s waveform and bandwidth will be changed after crossing the channel and hitting the target. In the receiver part, after catching the received signal by antenna, appropriate signal processing method will be applied for obtain the desired information about target.

There are two main methods for background subtraction and acquiring the information related to the chest and respiration of human in literature. In the shorter distance, using Matched filter is one of the most common methods [8]. When there is no barrier between the human and the antenna, this method could be helpful for getting the better result. Another method is wavelet transforms. This method is suitable in more complicated environments [9]. In this work, because of obstacle (wall) and different dielectric constant wavelet transform is chosen. Wavelet transform can work with non-stationary signals and this is so important property in this type of works. Wavelet transforms also provide multi resolution analysis with dilated windows which makes it possible to check different resolutions in various frequencies [10]. Some of wavelet transforms that used as a proper signal processing method for background subtraction is presented in figure 5.

Figure 5.a Meyer wavelet

Figure 5.b Mexican hat wavelet

Figure 7.c Morlet wavelet

6. RESULT AND DISCUSSION

In this work, Gaussian signal and some derivatives of Gaussian signal are used as transmitter signal. For background subtraction and obtaining the desired signal some wavelet transforms are operated. The result is presented for different environment presented as below. Figure 6 show the received signal in the receiver antenna. By sending the first order Gaussian signal, Mayer and Morlet wavelet is the best wavelet for extract the target’s information from received signal. The Mexican
wavelet gives better result in present of second derivative of Gaussian signal as a transmitter signal. During simulation process with CST and MATLAB software, could be observed that in the longer distance and in present of an obstacle with high dielectric constant the Morlet wavelet transform would give the best results for extract the target specifications [11]. Figure7 shows the sample result of simulation and figure8 shows the incorrect result with using the wrong signal processing method.

Figure6. One sample of received signal by receiver antenna.

Figure7. The result signal

Figure8. Incorrect result with using wrong wavelet transforms.

6. CONCLUSION

In this paper, hidden human respiration detection is considered. First of all, UWB systems and properties of systems is discussed. The general form of detection systems was in the next step. Proper antenna, transmitted signal and signal processing methods is discussed separately. The wavelet transforms selected as the best background subtraction method and the results of simulation are presented.

REFERENCES


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CORRESPONDENCE ADDRESS:

Editor in Chief
Prof. Dr. Osman N. UCAN
Engineering Faculty

Electrical and Electronics Eng. Dept.
Inonu Caddesi, No.38, Florya, Istanbul, TURKEY

E-mail : uosman@aydin.edu.tr
Web : www.aydin.edu.tr/eng/ijemme

Prepared By

Instructor. Saeid KARAMZADEH
Engineering Faculty,
Electrical and Electronics Eng. Dept.
Inonu Caddesi, No.38, Florya, Istanbul, Turkey

saeidkaramzadeh@aydin.edu.tr