SVEUČILIŠTE J. J. STROSSMAYERA U OSIJEKU
UNIVERSITY OF J. J. STROSSMAYER IN OSIJEK

EKONOMSKI FAKULTET
FACULTY OF ECONOMICS

KORIDOR Vc
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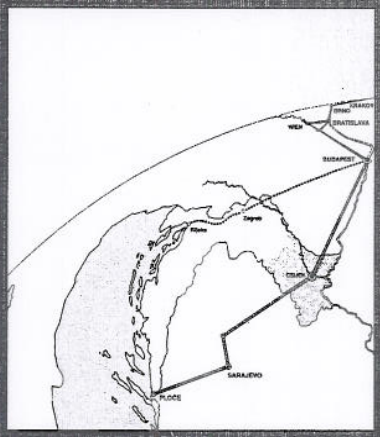

CORRIDOR Vc
AS EURO-REGIONAL CONNECTION ON THE TRAFFIC ROUTE BALTIC SEA - CENTRAL EUROPE - ADRIATIC SEA

1. MEĐUNARODNI ZNANSTVENI SIMPOZIJ
1st INTERNATIONAL SCIENTIFIC SYMPOSIUM

Osijek, 2004.

SVEUČILIŠTE JOSIPA JURJA STROSSMAYERA U OSIJEKU

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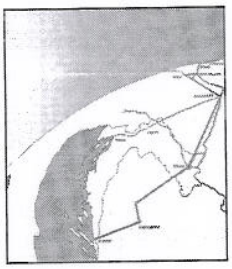

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BIS MACHINE

Integral system of new technologies development and use in production, reproduction and protection of culture and nature monuments as well as in development of other replicates of natural and artificial objects

Summary

These projects brought about completely new field of geo-informatics i.e. micro-geo-informatics as a new research and practical option for applied geodesy, ancient monuments profession, computer sciences and all integrated technologies and knowledge.

In the domain of geoinformatics, computer sciences and integrated technologies, this cooperation contributed to the authors' solution creation being defined as a new method of culture monuments restoration entitled "BIS Machine".

"BIS Machine" is a new system used at developing parts or the whole of stationary and mobile culture and nature monuments as well as other objects from nature , human body structure and productive and research environment.

Today, due to coincidences and friendship, we are in situation to present in detail the new method conception of culture monuments restoration "BIS Machine" as well as two projects known for integrated existing knowledge and associated technologies. First example, originated from Saint Mary church restoration project from Voćin destroyed during the 1991 war, is characterized by already prepared 3D model and a part of the main machine-designed portal in 1:2 scale.

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That project showed us basic dilemmas and problems that should be solved in a broader application of the new restoration system.

Second example is far more complicated. It is about antique sculpture entitled "Apoxiomenos", i.e. "il Bronzo della Croazia" excavated from the sea in 1999 near Losinj island, in the northern Adriatic. The sculpture of 192 cm height originated from the period between Classical Greece and Helenism in the 4th century BC and represents one of the masterpieces of world cultural heritage.

Having been restored and preserved, the sculpture was presented in public whereas the author's team of the method "BIS Machine" had chance to verify the offered abilities of the new method on a very complex sculpture.

These projects brought about completely new field of geo-informatics i.e. micro-geo-informatics as a new research and practical option for applied geodesy, ancient monuments profession, computer sciences and all integrated technologies and knowledge.

Aiming to illustrate multidisciplinary being a basis of this new method, we merge experiences and knowledge of the professions and activities as follows.

Introduction

Quality monuments heritage management is the question of maintaining the spiritual substance of a nation and climate. However, it is, at the same time, concerned with numerous space elements being in the focus of interest, i.e. being the aims of sightseeing, visits and researches of experts, guests, tourists and ordinary citizens. Modern and profitable tourism is today developed in countries, cities and regions characterized by large and numerous objects of ancient times, the Middle Ages, Renaissance and other periods. Centres of artistic creation, museums, galleries, castles, shrines, treasuries of artistic property and many other facilities preserving artistic heritage became generators of millions of tourist migrations and visits. Some cities, apart from significant tourism incomes, have problems with mass visits paid to various centres and sights of interests for domestic and foreign visitors.
New cultural property demands and new pleasure visions are incorporated in reconstruction problems as composite and very important elements.

This paper is the result of cooperation and research of numerous experts from the domain of cultural monuments restoration and protection from Poland, Croatia, Great Britain and many other countries. Acknowledgements go to all subjects for their cooperation, especially to the universities Polytechnika from Cracow, AGH from Cracow and Polytechnika

from Warsaw, Warsaw institutions, Biblioteka Narodowaj and to faculties and institutions from Poland.

Owing to this cooperation, some important aid campaigns were launched aiming to save Croatian cultural heritage in Dubrovnik, Trogir, Pakrac and other cities and centres throughout the Republic of Croatia.

BIS

A New Field of Geoinformatics - Micro Geoinformatics

These projects brought about a completely new field of geo-informatics, i.e. micro-geo-informatics as a new research and practical option for applied geodesy, ancient monuments protection, computer sciences and all integrated technologies and knowledge.

In the domain of geoinformatics, computer sciences and integrated technologies, this cooperation contributed to the authors' solution creation being defined as a new method of culture monuments restoration entitled "BIS Machine".

"BIS Machine" is a new system used in developing parts of or whole stationary and mobile culture and nature monuments and other objects from nature, human body structure, and productive and research environment.

Today, due to coincidences and friendship, we are in the position to present in detail "BIS Machine" - the new method of culture monuments restoration, as well as two projects integrating existing knowledge and associated technologies. The first example of the restoration project of the Saint Mary church in Voćin, destroyed during the war in 1991, is characterized by the already prepared 3D model and a part of the main machine-designed portal in 1:2 scale.

That project showed us basic dilemmas and problems that should be solved in a broader application of the new restoration system.

Second example is far more complicated. It is about an antique sculpture named "Apoxiomenos", i.e. "il Bronzo della Croazia" excavated from the sea in 1999 near the island of Losinj in northern Adriatic. The 192 cm high sculpture originated from the period between Classical Greece and Hellenism in the 4th century BC, and represents one of the masterpieces of the world's cultural heritage.

Having been restored and preserved, the sculpture was presented to the public, while the authors of the "BIS Machine" method and a team of experts had the chance to verify the suggested possibilities of the new method on a very complex sculpture.

After the experiment with the head of Apoxiomenos, in which we processed points and graphic data in precision of 0.10 mm and higher, it was possible to suggest a new solution in the geoinformatics environment – Microgeoinformatics!

Please note that only for Apoxiomenos head we used „clouds of points" – more than1 million captured points x, y and z.

With the intention to illustrate the multidisciplinary basis of this new method, we have merged experiences and knowledge of the following professions and activities:

Ancient monuments protection, culture monuments restoration
Production of cars, ships and airplanes
Metal industry in general
Blacksmith crafts
Stonemasonry
Carpenter's crafts
Computer modelling
Materials science
Applied geodesy
Photogrammetry
Digital methods of data processing
Digital photo-taking
Machine-building industry
Robotics
Tool industry
Art history
Architecture
Etc.

It should be pointed out once again that important roles in this method were played by common people, hard-working craftsmen - masters of their profession who had not been familiar with culture monuments restoration before. We are thankful to all of them!

Our Apoxyomenos, the Greek masterpiece of fascinating beauty, represents a real challenge for the application of our new method. How successful we were will be shown by our colleagues and co-authors.

The care of the society and of individuals for monuments and cultural property heritage is, today more than ever before, a reflection of the attitude towards our own and the world's cultural identity. Inherited traditional material values, managed by us on behalf of our and forthcoming generations represent the stamina of the national, artistic and other creative formation being a composite of a nation's spirit and time.

Specific Problems of Monument Protection

Monumental heritage and culture monuments restoration are long-term, outstandingly complex, demanding and expensive processes. Very often there are situations in which, in spite of our strong desire and quality of design, we are not able to realize some restoration designs of especially important objects, priority constructions and sculptural heritage.

Shortage of time and money, and lack of various profiles of specialists – from craftsmen to top quality specialists in ancient monuments preservation and restoration work – limit broader and faster operations on some objects. We are witnesses that some designs cannot be incorporated in the given frames of profession, time, money and other aggravating circumstances. The last few decades have been characterized by the emergence of some centres in which specialists for monument restoration are educated. Professional workshops for renewal of tapestry, architectural plastics, wood, paper documents etc. organized by specialized centres are essential for quality renewal and restoration of monumental heritage.

Some valuable objects can not be improved or renewed due to lack of either experts, craftsmen or some unfamiliar technology of developing the material that the object is made of or due to lack of knowledge about this material's application procedure. The reconstruction problems were especially recognized after the Second World War, when many cities had suffered a lot and when numerous valuable mobile and stationary monuments of culture i.e. heritage were completely or partially destroyed. Some towns were destroyed to the ground.

Based on these terrible experiences, specialized preservationist disciplines for some monumental heritage types were developed.

In the period 1991 – 1995, the Republic of Croatia suffered heavy destruction, leaving unsolved the problem of many valuable monumental heritage objects.

War destructions, natural disasters, vandalism and aging are the main reasons requiring permanent and quality conservationist's care for culture monuments. Croatia, being rich in artefacts and works of art from pre-history via ancient time, the Middle Ages, Romanesque and Renaissance period to XX century, requires modern methods of preservation,

improvement of financial conditions and objects reconstruction methods such as the BIS Machine system.

BIS Machine

Area to Which the Authors' Solution Refers

This complex method is applied in developing and reconstructing parts of or whole culture monuments, works of art and other required objects.

All mentioned elements, their parts and the like will be referred to as "objects" in further text.

Technical Problems

Culture monument reconstruction or development of the parts or of whole works of art, i.e. of objects made of stone, synthetic materials, wood, salt, metal, natural materials and the like demands very time-consuming, basically manual work, special creativity and the required work precision. The developing of some objects is often impossible due to lack of artists, stone-masons, craftsmen and the like. The problems of lacking knowledge and of long development terms as well as the need for additional funds appear to be the limiting factors of the objects reconstruction development.

Specialists such as sculptors, stone-masons, model constructors, craftsmen and others are getting fewer and, as a consequence, the processes of reconstruction, restoration or designing of objects are taking longer time and become expensive, often even impossible to be done.

Present Situation

Reconstruction and development of the objects in terms of culture monuments reconstruction processes are today based on manual work with minimum aid of simple hand-operated tools. Shaping of stone, metal, wood or synthetic mass objects is limited by the manufacturing speed, precision and work price.

Description of the System and Work Process Flow Diagram

Phase I

1. Object selection
2. Object imaging harmonized with requirements and possibilities (boundaries) of measuring, scanning, photogrammetrical, digital, analogical or combined data entry methods
3. Processing of the imaged (quantified) data
4. Developing of imaging (quantifying) reports
5. Formation of the virtual object, i.e. of the digital file etalon-pattern
6. Data direction and harmonization

Phase II

7. CAD preparation
8. CAD model design
9. Validation and pattern (etalon) calibration
10. Re-design, if necessary
11. Prototyped model design (rapid prototyping – 3 D printing and the like)

Phase III

12. Material selection
13. Machines and tools selection
14. CAM program development
15. Computer development simulation
16. Machine or device-developed production
17. Validation of the developed object
18. CAM program redesign, if needed
19. Sorting and saving of all data systematized in data bases
20. Object delivery and fitting.

Advantages of BIS Machine

1. Precision
2. Significantly shorter design times
3. Simplicity
4. Transparency in all project design phases
5. Lower design prices
6. Possibility of quality objects design in the case of not existing object parts
7. Data base formation and infinite replication possibility
8. Data capture without direct contact with the object.

Former Experiences

So far, the BIS machine method has been applied in the Saint Mary Church restoration in Voćin, which was completely destroyed in the war. In cooperation with the "Končar Alati" company, the Faculty of Architecture in Zagreb and upon consultation with numerous experts in the field of ancient monuments protection, a portal part, made of reddish marble-like synthetic mass, was created.

The complete pilot project was presented on the enclosed CD containing images of some results of the desired object development. The method itself was presented on 27th September 2003 in Cracow in the organization of the Institute for Architecture History at the Cracow Polytechnic and of the Section for Photogrammetry of the AGH in Cracow as well as in the exhibition "European Cities on the Maps" held in Zagreb from 27th October to 5th November 2003.

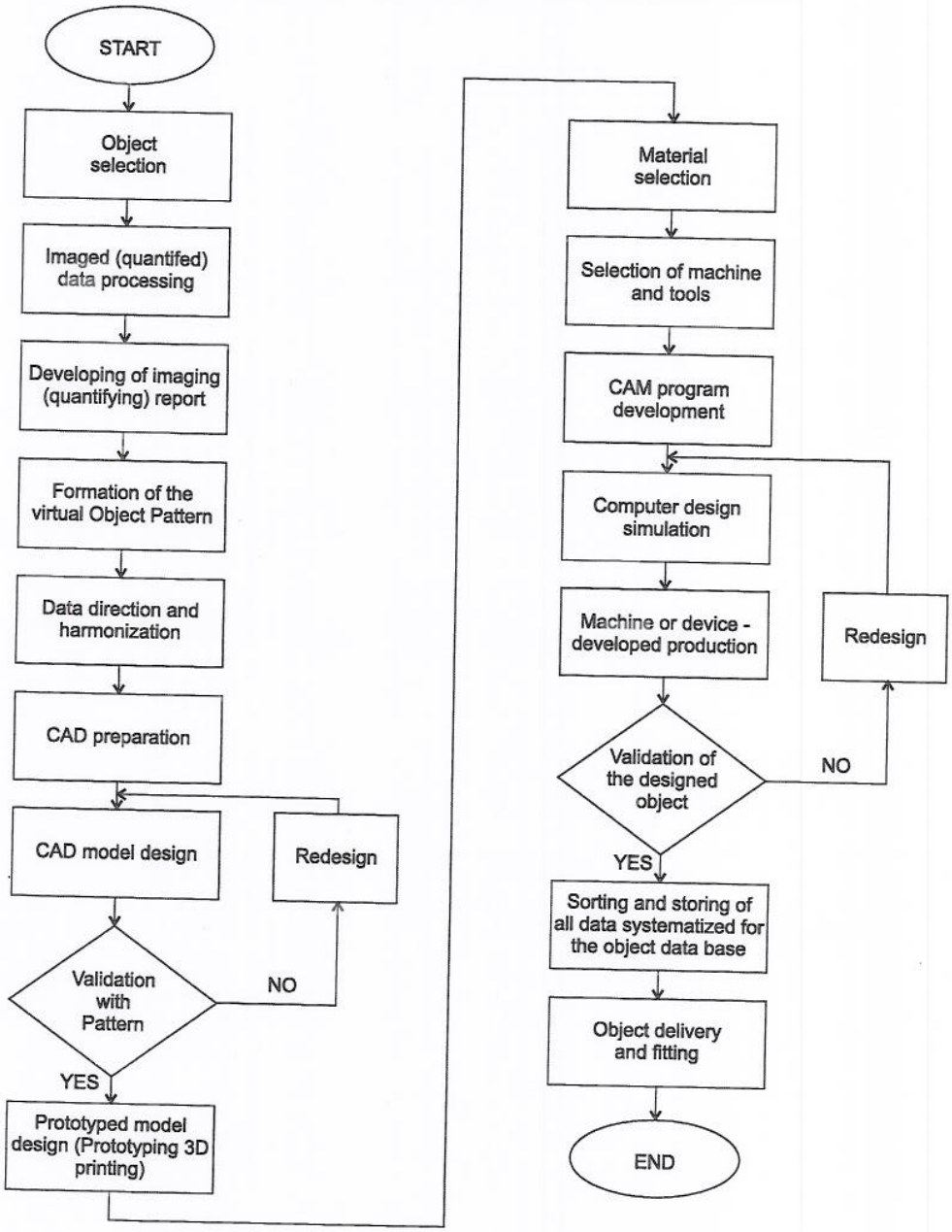
An important presentation of the method was given in Warsaw, in May 2004, where it was invited for presentation at the UNESCO conference devoted to the 50th anniversary of the Hague Convention and to 2nd Protocol. The Apoxiomenos' head, prepeared by means of the "BIS Machine" method, had the high-lighted position during this conference.

Having seen our results, the experts said that it was a system capable of changing completely the former methods and ways of culture monuments restoration. An object can be made of any material needed, and its shaping is possible in steel, light metals, wood, lead, stone, salt, synthetic mass etc. It should be pointed out that this method is applied for shaping expensive, labour-demanding parts of architectonic plastics, sculptures, ornamental elements and the like, whereby the originals exhibited in museums can be replaced with replicas of the same visual identity but made of other materials resistant to atmospheric and microclimatic

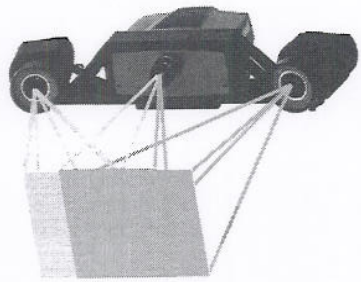
exploitation conditions. For example, stone elements can be replaced with replicas made of the so-called architectonic plastics, and the like.

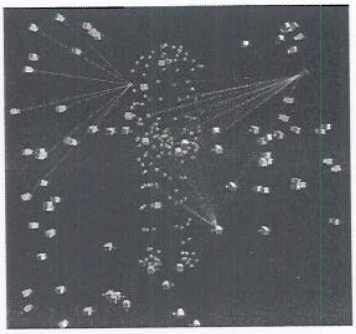
Being based on the entry and processing of very precise graphic data and CAD-tool modelled data, the application of this complex method is neither suitable for developing simple parts of objects nor for the whole objects that can be developed in a cheaper way, using classical or traditional methods.

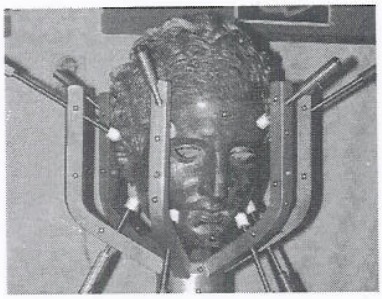
Diagram of the BIS Machine Method Process Flow

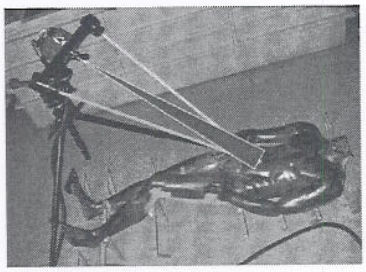


THE SECOND APPLICATION OF BIS MACHINE METHOD APOXYOMENOS PHOTO DOCUMENTATION IMAGING

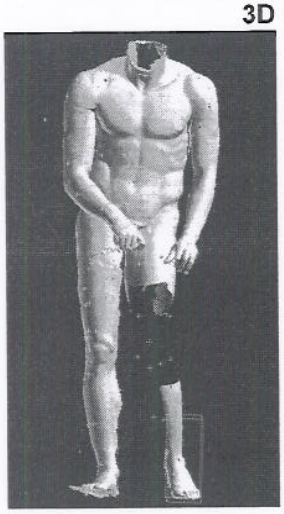


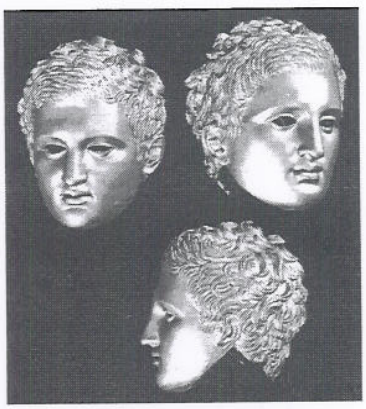






THE SECOND APPLICATION OF BIS MACHINE METHOD APOXYOMENOS PHOTO DOCUMENTATION 3D MODELLING





By Courtesy of Topomatika & Restauratorski zavod, Croatia