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The 5th Open German-Russian Workshop on Pattern Recognition and Image Understanding

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General Information

The general goal of the series of workshops, held in former years in Berlin, St. Petersburg, Erlangen, and Valday, is to establish and improve scientific contacts between researchers from Russia, Germany, and other countries in order to advance the important field of Pattern Recognition and Image Understanding.

Workshop Committee

Prof. Y. Zhuravlev	(Moscow, Russian Federation)
Dr.-Eng. I. Gourevitch	(Moscow, Russian Federation)
Prof. B. Radig	(Munich, Germany)
Prof. H. Niemann	(Erlangen, Germany)
Prof. P. Levi	(Stuttgart, Germany)
Prof. O. Salvetti	(Pisa, Italy)

Session IV
Applications II
(16:30–18:30)

7 **Mobile Robot Navigation in Context of Spatial Data Processing,** *Lubos Král, Miroslav Kulich, Libor Preucil, Petr Stepan*

9 **Towards an Image Understanding Architecture for a Situated Artificial Communicator,** *Christian Bauckhage, Gernot A. Fink, Franz Kummert, Stefan Posch, Gerhard Sagerer, Daniel Schlüter*

2 **A Control Structure for an Observation System for Service Robots,** *Petra Moessner, Peter Weierich, Heinrich Niemann*

56 **On Mathematical Models Related to Automated Safety Systems for Subway Platforms,** *I.B. Gurevich, Y.I. Zhuravlev, Y.G. Smetanin*

Wednesday, 23.9.98

Demonstrations
(9:00–12:30)

D1 **Computer Vision Technology to Improve Safety of Car Driving,** *M.M. Lange*

D2 **Quickly retrainable program system for signal recognition on the basis of support point method (handwritten symbols, spoken commands),** *V.V. Mottl, A.B. Blinov, A.V. Kopylov, A.A. Kostin*

D3 **Program system for the analysis of 3D data of seismic explorations for oil and gas in the crystalline basement interval,** *V.V. Mottl, A.B. Blinov, A.A. Kostin, A.S. Yermakov*

D4 **Demonstration Version of OTEKS Applied Program Package for Processing of Experimental Data Tables,** *N.G. Zagoruiko*

D5 **Program System of Pattern Recognition and Data Analysis LOREG,** *V.V. Ryazanov, O.V. Senko, A.P. Vinogradov, V.A. Voronchikhin, Yu.I. Zhuravlev*

D6 **Open System for Image Analysis and Processing Problems Solving with Data Base Functions,** *I.B. Gurevitch, A.V. Khilkov, N.S. Polikarpova, Yu.G. Smetanin, Yu.I. Zhuravlev*

15 **Pattern Matching Using Distorted Color Histograms,** *Georg Thimm, Juergen Luettin*

19 **Research paths coding within an image analysis and synthesis laboratory,** *L. Moltedo, O. Salvetti, D. Vitulano*

43 **The Test Recognition Pattern with Genetic Algorithms Use,** *A.E. Yankovskaya*

31 **Optimization procedures in spectral approaches to pattern recognition problems,** *S.A. Makhortykh, M.M. Ustinin*

Session II
Image, Signal and Speech Processing, Analysis and Understanding V
(11:30–13:00)

57 **Some problems of Image Coding and Stereovision,** *V.N.Kozlov*

17 **Nonliniar Filtering for Solving the Problem of Variability in Speech Recognition,** *Alexander M. Krot, Mikhail A. Shcherbakov and Polina P. Tkachova*

11 **Computation of Projective Invariants using the Trifocal Tensor,** *Eduardo Bayro-Corrochano and Joan Lasenby*

Session III
Applications III
(14:30-16:00)

20 **The Brain Matcher,** *Sergio Di Bona, Stefan Huwer, Heinrich Niemann, Ovidio Salvetti*

8 **Use of Registration Methods to Correct Movement in 3D Magnetic Resonance Breast Images,** *Luisa Vieira, Peter Undrill, Fiona Gilbert*

58 **An Interval Approach to Discover Knowledge from Multiple Fuzzy Estimations,** *Vagan Terziyan, Seppo Puuronen, Helen Kaikova*

Discussion
(16:30-18:00)

Outlook and Further Research
in Pattern Recognition and Image Understanding

Research paths coding within an image analysis and synthesis laboratory

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Introduction

Emerging research and development activities aim to define integrated environments for image analysis and synthesis. From early '90, I.S.O. working groups oriented to formulate standard proposals are involved in the discussion of functional specifications for an unified area of Computer Graphics and Image Processing [ISO].

In 1994, a CNR Project named "Knowledge through Images: an Application to Cultural Heritage" [CI] was launched, covering activities in the areas of acquisition and processing of images, rendering of realistic images, mapping and manipulation of common properties in real and synthetic images, so far as coding and storing methods for multimedia databases, visual interfaces and virtual reality systems.

Integrated environments including the above mentioned functionalities permit a user to solve problems requiring more than one computation procedure for their solution: for instance, the design of real-time virtual reality applications where data should be visualised in a three-dimensional space merging both real and synthetic images.

In order to experiment methodologies and techniques in integrated environments, the CNR Project needed to identify an application area where methods dealing with real and synthetic images were required. The area of Cultural Heritage safeguard was individuated, considering the study and representation of degradation processes of stony materials, typical of historical buildings. In particular, main work dealt with geometric and descriptive information and images relative to pudding-stone and travertine ashlars.

This paper describes some of the results obtained within the Project.

We started designing a 'laboratory' for image analysis and synthesis and then we developed specific tools implementing appropriate functionalities [MMS], such as the evaluation of morphometric and densitometric properties or colour distribution in real images.

A main concept is that a user can activate functions "from his point of view". In fact, when the user utilises the functions available for solving his peculiar problem, he identifies a research path of tools. Since a tool enables the user to store his research paths, such a path set can be considered as a language. The associate grammar is, then, the knowledge of the user who can avoid wrong paths- and then wrong results. This is the meaning of the sentence "from the user point of view".

With regard to the Cultural Heritage application area, a user is allowed to extract and manipulate properties or characteristics for classifying images or structures and simulate pictorial dynamic events. As a result, the data deriving from such studies can "enrich" the tools environment and so the knowledge available for the user himself. The Cultural Heritage experts may be helped to solve, then, complex problems like: to "objectivise" the "naked eye" analysis process usually followed to achieve the diagnosis about the conservation state of a monument; to propose possible future "scenarios" useful to decide treatment methodologies.

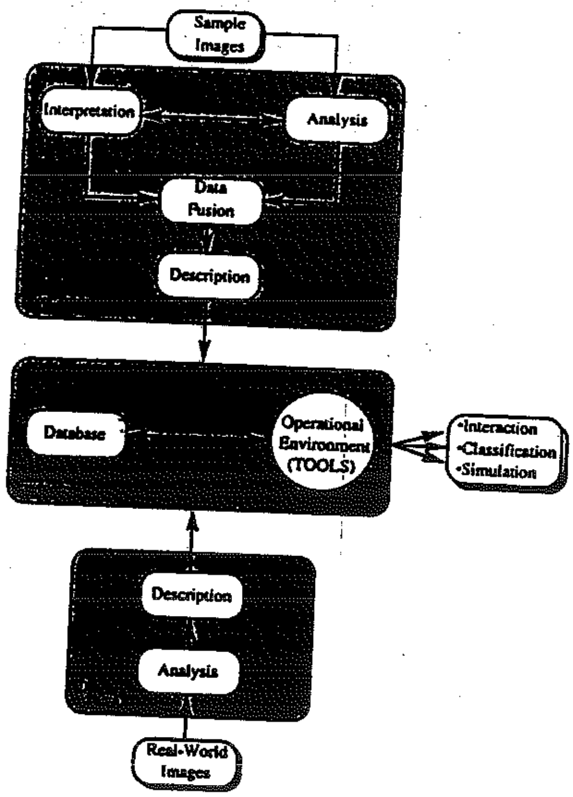
After designing and prototyping our operational environment, that is our laboratory, the tools implemented have been tested and verified on a specific study case, that is the degradation analysis of ashlars composing the Aosta Roman Theatre. In particular, due to the complexity of the problem faced, different research paths were defined and coded using a syntactic approach based on an original language and its relative grammar.

The system architecture

In some detail, our laboratory contains information characterising images derived from studying sample images with well-known features [BEFS]. A database component is also included in the system capable to store and manage different kinds of data, from images to models, from scene descriptions to statistical parameters, from graphical models to texture features, and so on.

Usually, the problem faced needs that the user is able to activate and control properly chains of processing modules, data input/output and store partial or final results, sometimes useful for further elaboration procedures.

In Fig. 1 the architectural sketch of our general-purpose system oriented to assist users in image analysis and synthesis is shown. A first block, called *static domain*, has the function of defining and building the system knowledge, by extracting densitometric and morphometric characteristics from paradigmatic images constituting the basic data-set for learning. A main goal in this environment is to obtain proper model for image description. A second block, called *dynamic domain*, is devoted to process real-world images, both performing data analysis and feature extraction for further elaboration. The kernel of the system, called *knowledge*, contains a multimedia database, in which paradigmatic data and processing results are stored together with relationships and properties, and an operational environment, in which tools for data processing and management are available to the user. Some tools can be used, for instance, to perform operations on real or synthetic images or on formal models describing both images and complex data processing procedures. The system can interact with the external world in order to receive different types of further information, for instance from an expert. All information gained allows the user to classify images or simulate complex visual events.



If we associate a symbol to the modules or procedures available in our system, we can obtain a string at the end of a study - i.e. of a research path inside the tool. The obtained string is the path followed by the user from starting data to a final result. Now, if the user accepts the obtained result, he can store the corresponding path and, then, the string. In this way, the user can build a language - able to grow in size - where there are all paths interesting, from its point of view. In the path storing phase, both the string and the name, given by the user to distinguish the path, are stored. We can consider the tool as a grammar [HU] where there are: terminal symbols: symbols corresponding to operators; non terminal symbols: names given by the user (research path titles); a start symbol linked to each non terminal symbol.

An Example of Coding Research Path

Let us consider the problem to foresee the future conditions of the material composing a monument. In order to decide next conservation actions, a virtual restoration and simulation of further degradation of a material become quite interesting.

The approach followed is shown in Figure 2, while the corresponding grammar is displayed in Figure 3.

In this case we have only one production rule, where the non terminal symbol is Sim_Furt_Degrad, i.e. the research path title "Simulation of Further Degradation", and the terminal symbols correspond to the utilised operators.

Finally, Figure 4 shows the general analysis and synthesis model for shapes extraction.

Simulation of further degradation

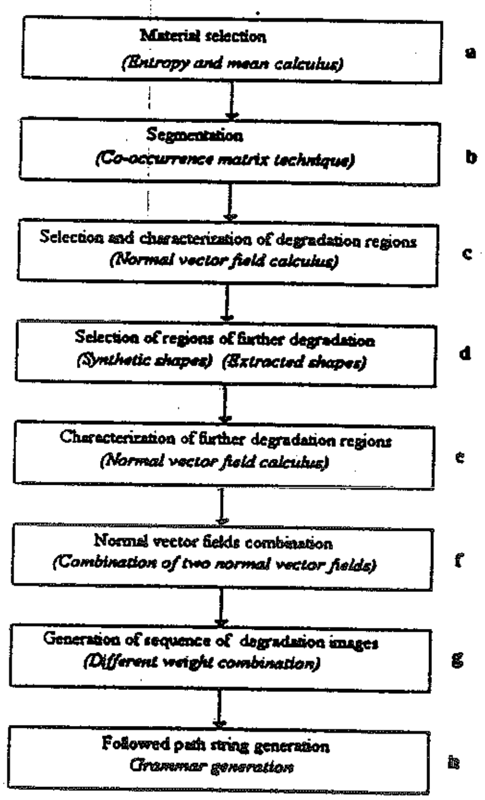


Figure 2. Block scheme of operations sequence relative to further degradation simulation.

S = Start symbol;
Vt = { a,b,c,d,e,f,g,h };
Vm = { Sim_Furt_Degrad };
Sim_Furt_Degrad → abcdefgh

Figure 3. Grammar relative to the followed research path.

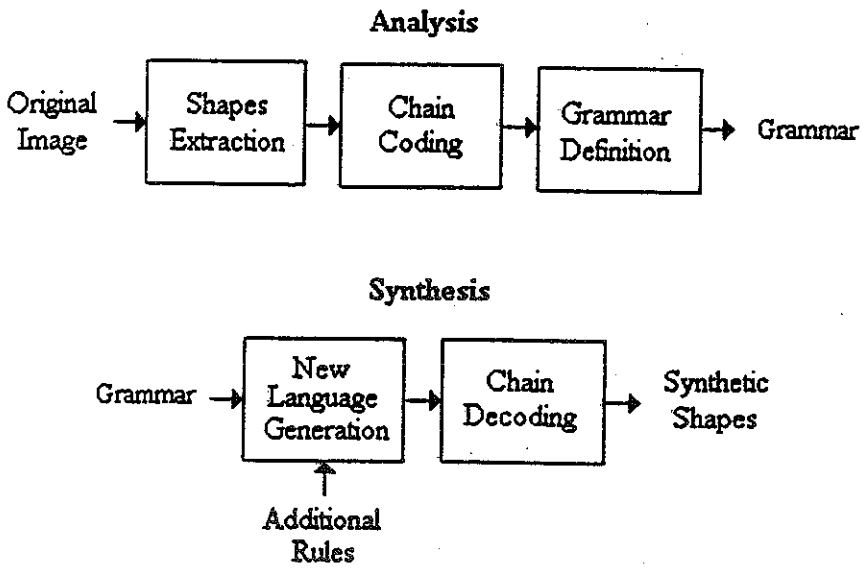


Figure 4. An analysis and synthesis model for shapes extraction.

Concluding Remarks

In this paper we described a way for using an image analysis and synthesis laboratory. A grammar has been defined for coding research paths within the laboratory functionalities. Difficult problems in the Cultural Heritage field have been investigated by means of this approach. In particular this tool allowed to help experts interested in both the conservation state diagnosis and treatment methodologies decisions.

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