Forum UNESCO - University and Heritage

11th International Seminar

Florence 11-15 September 2006

Documentation for Conservation and Development
New Heritage Strategy for the Future
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FULL PAPERS
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The work being presented is the result of collaboration between the DART (Laboratory for the Documentation, Analysis & Surveying of Land and Architecture) and the LARM (Robotics and Mechatronics Laboratory). Despite their seemingly diverse spheres of research, these two institutes have a long history of opportunities to discuss and share their knowledge, and to research issues on which to base practical, fruitful collaborations.

Our aim is to study characteristics and issues concerning the analysis and conservation of built heritage from the innovative standpoint of robotic systems. The design requirements and special features of the operations of an extremely wide variety of robotised systems have been fully outlined, and are now entirely familiar.

However, in a specific application related to a topic such as built heritage, apparently so far removed from the more general fields of robotics and mechatronics, there are not many precedents.

The sample study presented here, i.e. the pre-Cosmatesque pavement of the basilica of Montecasino, is a good example not only of the flexibility of the field of mechanics, but also of the possibilities for interaction with architecture in general, and the field of surveying in particular.

A study of this type focuses specifically on applying robotised systems to the research and surveying of historic pavements, although the broader aim is to study and explore robotic systems and automated procedures to develop the work and the results, not only during the analysis stage but also for the protection and conservation of historical buildings.

The use of robots in difficult situations is becoming increasingly common, as in the case of inspections of the innermost layers of atomic plants, space voyages and explorations of inaccessible areas of land such as the craters of volcanoes.

There is good reason to suppose that a new, original example could be the study and protection of historical buildings by using self-propelled robots to carry out extremely complex tasks on various types of surface, under the supervision of a human operator. Our idea is to develop a link between robotics and architecture, with a mechanical design that has been specially developed for architectural analysis and restoration, in an extremely innovative application in the field of robotics. It is an attempt to make a robot perform many of the operations required in architectural surveying via automations which can improve procedures and results in terms of speed, accuracy and execution.

**Architectural pavement surveys**

Surveying is intended to mean a complex series of operations such as the collection, evaluation and interpretation of all possible information, not only concerning the geometrical and spatial elements of the building, but also the construction, structural and historical data.

Surveying is used most often in the fields of historical and critical analysis of architecture and restoration. There is no doubt that in order to carry out an accurate historical study of a building, accurate measurements are essential. The survey of a building is not a document on which we can work in hindsight, but it is an integral part of the process of gathering historical and critical knowledge.

A survey carried out with a view to possible restoration works must give a global picture of the building in question, which is exhaustive in terms of dimensional, structural and construction details. It must provide a snapshot of the building’s state of health, its conditions of decay and static conditions. This means it must perform a historical and technical diagnosis, helping to clarify the design intentions, including the sizing and measurement aspects, orienting historical research through illustrative, bibliographical and archive sources.

The survey issues concerning protection therefore require measurements taken accurately, and graphic renderings that pinpoint the characteristics of the building and all its peculiarities, often using scales of representation larger than those normally used in the preliminary survey.

As far as the methods and techniques for documenting Cosmatesque pavements are concerned,
and relatively simple control system, this can give agility and flexibility of action, even to those without great experience in robotics.

Conclusions

We are currently finalising the design of the robot, which is being developed by the two laboratories LARM and RADET, and are constantly reviewing the requirements deriving from the architectural application and inspections carried out in the field of mechanics and mechatronics.

Our aim is to test the possibilities of designing robots and/or robotic systems which are specifically dedicated to the field of Built Heritage, and to historical buildings in particular, and therefore to work in a completely new field for this kind of application.

At the same time, we cannot ignore the objectives regarding the medieval pavement of Montecassino. This not only requires more detailed study to improve the knowledge of this type of work, as yet not widely studied, but there is also the aspect of studying the techniques of documentation, analysis, and therefore protection and conservation, of stone surfaces in general and in particular the pavement of the historic abbey at Montecassino, which lies hidden and unexplored beneath the current basilica.

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Notes

1 - The research team is composed by investigators from DART Laboratory for the Documentation, Analysis & Surveying of Land and Architecture, and LARM Laboratory of Robotics and Mechatronics. In particular at DART the following are involved: Michela Cigola, architect with expertise in Restoration of Monuments, full professor ICAR/17, director of DART; Assunta Pelliccio, architect, post-doc researcher; Sara Mattei, engineer, PhD student; Miriam Volante, engineer, under research contract, Omar Salotto, part time collaborator. At LARM the following are involved: Marco Ceccarelli, engineer, full professor ING-IND/13, director of LARM, Giuseppe Carbone, engineer, assistant professor; Erica Ottaviano, engineer, assistant professor; Chiara Lanni, engineer, PhD student.

2 - The Cosmatesque style started at the beginning of XII-th century and it was used mainly in Rome and Lazio region up to the end of XIV-th century. Its main characteristics can be considered the assembling aspect with square or rectangular panels that are composed of marbles parts and porphyry disks. The first Cosmatesque pavement is that one in the Basilica of Montecassino Abbey that was inspired by oriental sources and ancient Roman