The theme of Digitization and Documentation, which inevitably affects the fields of surveying and designing architecture/urban areas, is periodically innovated by the new digital technologies and new multimedia communication systems to acquire, analyze and disseminate the value of our historical heritage.
The research in this field pushes us to overcome the limits imposed by tested technologies in order to be able to extend the field of application in the surveying and representation of the increasingly complex challenges imposed by the needs of conservation and maintenance.
This volume, which follows the three previous conferences of the "Digital & Documentation" cycle in the respective locations of Padua, Turin and Rome,
brings together some of the most significant research experiences that have achieved very competitive goals and objectives by professors and industry experts.
The volume ranges from architectural surveys to 3D models, to photomodelling, from BIM to augmented reality.
Today's communication has almost completely entered the digital world as the only system of language, be it graphic, spoken or artistic. It is no coincidence that the architectural and cultural heritage, as well as the urban aspects of the city, could not avoid undergoing significant change caused by the influence of the digital transition which allows them to be safeguarded, documented and handed down.
Digital, through all its forms, is, today, not only the representation of the asset but also its management through BIM approaches.
The boundaries of representation, digitization and documentation open up and become ever wider, embracing greater goals and responding to growing needs.

volume 4

DIGITAL & DOCUMENTATION

Laura Inzerillo

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Francesco Acuto

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DIGITAL & DOCUMENTATION

The new boundaries of digital & documentation

volume 4

PROSPETTIVE MULTIPLE
STUDI DI INGEGNERIA ARCHITETTURA E ARTE

Laura Inzerillo & Francesco Acuto

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The volume consists of a collection of contributions from the seminar "Digital & Documentation: The New Boundaries of Digitizing", realized at the University of Palermo on the day of September 2^{0h}, 2021. The event, organized by the experimental laboratory of research and didactics MetaLab 3D of DIING- Department of Engineering of University of Palermo promotes the themes of digital modeling and virtual environments applied to the documentation of architectural scenarios and the implementation of museum complexes through communication programs of immersive fruition.
The event has provide the contribution of external experts and lecturers in the field of digital documentation for Cultural Heritage. The scientific responsible for the organization of the event is Laura Inzerillo, University of Palermo.

This publication is made with the contribution of DIING, Department of Engineering of University of Palermo.

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The event "Digital & Documentation" has seen the participation of professors, researchers and scholars from University of Palermo, University of Pavia, University of Bolzano, University of Rome "La Sapienza", University of Roma3, University of Catania, Politecnico di Torino, Politecnico di Milano.

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"Ogni uomo confonde i limiti del suo campo visivo
con i confini del mondo"

Arthur Schopenhauer

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PREFACE

Sandro Parrinello

University of Pavia

Associate Professor of University of Pavia, European Research Ph.D. in Representation and Survey Sciences. Since 2012, he is Visiting Professor at Perm National Research Polytechnic University (Russia) and in 2015 he receives an honorary degree from the State Academy of Civil Engineering and Architecture of Odessa (Ukraine). Since 2005, he is an expert of UNESCO; in 2011 he was appointed Expert and Voting member in ICOFORT as contact person for Italy. He is director of DAda Lab. - Drawing Architecture Document Action Laboratory of University of Pavia, and director of Joint LS3D Landscape Survey & Design laboratory of University of Florence and University of Pavia.

Drawings updating and languages rewriting for the structuring of knowledge

Now in its fourth edition, the conference on Digital Documentation demonstrates how the proposed topic is getting more and more relevant as time goes by. The identity of the digital world and its products are taking on new features.
For years now we have been witnessing a revolution in the procedures that had characterised the cognitive activity related to the science of representation for centuries. It is not just a matter of a "change of medium" or a change in the methodological aspects linked to the progress of technology, but a complete reinterpretation of human-space relationship that contaminates every cultural model. This change covers indeed, within the disciplines related to architecture and heritage, each characterisation of the creative process, outlining, via new configurations, opportunities that have yet to be explored and revealed.
The digital world breaks out of those gears and constructions where it has grown up until now to contaminate every aspect of life in the most profound way. The paradigm is that of Cronenberg's Videodrome, where media produce a dystopian evolution, i.e., the birth of homo videns.
In the film, this contamination between man and media leads to a renewed perception of the world among human beings, resulting in the total fusion of the digital and the flesh as a new way of existence. What is currently happening fortunately seems to have less tragic outcomes.
The digital that we experience on a daily basis does not manifest the horror of its distortion, as it does in the movie. The process of approaching and seducing the digital is supported by a gradual entrustment of functions that trigger the illusion of a greater control over our thoughts, and thus produce a feeling of higher safety towards said relationship.
The digital is becoming more and more soothing and is gradually replacing interpersonal activities that concern more than just relationships between people, but the relationship between people, things and experiences themselves, which are themselves becoming increasingly digital. The digital experience is made of rhythms and times that differ greatly from the real one. Its immediacy is its strongest quality.
"All and now" should be the slogan for the user when researching online. Everyone can get answers and become something else when immersed in the net, just like in Spielberg's Ready Player One, even if these answers are not yet widely used through systems that provide immersive realities.

Apart from the digital interface, the media flood is producing, through the redundancy of continuous, homologated, standardised and incessant messages, a general disinterest in both the facts and possibly the actual matter. Let us just think of the new productive dimension that information has been experiencing for years now.
A piece of news that undergoes even the slightest critical process is born old and is probably similar to a thousand

others being produced at exactly the same time. The proliferation of information causes a detachment resulting in a surrender to the digital world.
Weddings with holograms, digital works of art, cryptocurrencies, digital experiences more attractive than real ones, are just a few examples of what could be considered science fiction just a few years ago. In this panorama, the opportunities for rewriting messages, redefining ethical and cultural models, and conveying data within the digital dimension appear almost unlimited.
So, what is the role of digital documentation? I believe that the task of our generation in these times of great tension is to bring as many experiences as possible into the digital era. What will be forgotten, overlooked, or even accidentally not digitised will be lost forever.
This is a great responsibility if we think of the vastness and heterogeneity of cultural heritage. It remains very difficult to imagine how this can be read and interpreted in order to find a specific position within the complex but nonetheless ordered structure that configures the digital dimensions. I am thinking of the intangible heritage, of the sound of the many dialects, of tastes and smells, and of the many pieces of information that do not yet find a place in the digital dimension, but whose existence is linked to customs and traditions that are being lost.
But the same may be true for information held by a text or a manuscript stored in an archive somewhere remote and thus not easily accessible. The precarious nature of this information seems even too evident today; whatever will not be uploaded not only into the digital domain, but into the network in general, so as to acquire its own digital echo, will probably be forgotten.
All the research experiences presented in this fourth conference have a common denominator: proposing tools to convey information digitally in order to preserve its memory over time. In the first session, about BIM, the development of architecture information systems is focused on historical architecture and the improvement of the modelling processes with respect to the reliability and the compositional and technological interpretation of the historical artefact.
In the second session, the digitisation experiences concerning the drawing archives address the issue of data structuring when bestowing an infographic spatiality on historical memory. In the third session, on the parameterization of models, more heterogeneous experiences are described, which examine how to interact with digital representation and complex models.
Browsing through the pages of these proceedings, many faces of digital documentation emerge, such as many research trends, cultural interests, operational needs. This world rich in knowledge, through the definition of models and modelling procedures, affects the deepest areas of representation.
The volume therefore constitutes a fragment, which is added to the previous volumes, to the other experiences carried out during these study days, but also to other conferences.

It participates indeed in the process of media coverage to which even scientific research must now succumb.
Nevertheless, I am willing to believe that, as usual for the Documentation & Digital Study Days, these proceedings, which are published one year after the conference, let us look back and consolidate our knowledge. One year in the digital information field might well feel like an era.
A global pandemic and the beginning of a new war in Europe occurred in between the conference and the production of its proceedings, thereby making the future of all research uncertain. This is why this fragment, this piece of experience, seems even more important: because information systems, models and the digital world in general should be able to help the progress of human thought but never replace it.
Hence, in a historical moment torn between wars and pandemics, where social and cultural realities contaminate each other, in a process of accumulation and stratification of symbols and signs, we hope to create a language that respects this complexity and represents, protects and supports knowledge.

S. Parrinello

Laura Inzerillo

University of Palermo

Ph.D., Laura Inzerillo is Associate Professor at University of Palermo within the Department of Engineering. Graduated cum laude in Management Engineering at University of Palermo, 1995. Ph.D in Digital Survey and Representation of the landscape and Architecture at University of Palermo in 1999. She won a fellowship ata Columbia University in New York from 1999 to 2000 with the confirmation of researcher at Columbia University from 2000 to 2003 at MUD. She won a post PhD fellowship at Univesrity of Palermo from 2000 to 2004 when she became researcher. Her field of expertise are the digital survey, 3D representation, Descriptive Geometry, reverse Engineering, monitoring. She is editorial member of several International Journals, reviewer member in other several International Journals, chief in editor of a special issue in MDPI Journal. She is actually authors of about 150 paper, 3 monographies, 2 chief in editor books and she won a best award paper. She has been involved in several international and national projects. Actually she is involved in SMARTI ETN - Sustainable Multi-functional Automated Resilient Transport Infrastructures European Training Network HORIZON20-20; in REMED - Application de l'économie circulaire pour une construction durable en Méditerranée ENI CBC MED European Union.

THE NEW BOUNDARIES OF DIGITIZATION:
FROM BIM TO PARAMETRIC MODELLING

This conference was the first appointment held using an hybrid mode: the first after the pandemic period. For this reason it was characterized by a particular enthusiasm due to the beauty of the meetings in presence and not in a remote way. In this background of happiness, we held our meeting. Moreover, Palermo had not appeared on the international scene, in the scientific disciplinary sector ICAR 17, for several decades and this occasion represented an expected and hoped-for return from the scientific community of the sector. Why do we talk about new boundaries of representation? In what sense do we mean the boundary of representation? New technologies take over more, and more rapidly, over those just introduced in the world of digitization and acquisition. The experiments of young researchers reach such avant-garde levels as to constitute a new starting point. The experience of the less young researchers and the innovativeness of the most immature researchers become a perfect glue for an effective and accurate methodological approach. The D&D conferences were born with the aim of giving voice to the research of young researchers to open new horizons of investigation in collaboration with the professors of the area, engaged for years in the various fields of research.

The themes that go beyond the boundaries of one's knowledge to expand to those of the scientific community, have been addressed in this fourth edition of the international conferences D&D, Documentation and digitization. It was not only a presentation day but a training day where the experiences and the passion of the speakers guaranteed an active participation of the guests.
The scientific insights, the methodological rigor, the passion and enthusiasm, with which the research was conducted and, consequently, handed down to us, have been driving forces for the entire scientific community.

Given the extensive participation and, given the versatility of the research ideas, three sessions have been planned: the first relating to BIM, the second to the digitization of archive drawings and the third to parametric modelling and video mapping.
The first session saw, as protagonists, researchers from Turin, Milan, Naples, Rome and Pavia. Daniela Oreni focused the research on the question of the 3D modelling within the BIM structure, the HBIM for the conservation and restoration of historic buildings and their representation. The Building Information Modelling is going to cover all design all over the fields of interest, in these last years. It is a new methodological approach of digital modelling which, with its interoperability, uses the tools and methods between tradition and innovation of the representation of anthropized reality whether it already exists or is in the design phase. The practitioner who intends to use BIM as an operational tool, must have matured the essential concepts of digital modelling and interoperability

between architectural and structural design with particular attention to aspects not only stylistic-architectural, but structural and plant, etc. working on the built heritage and on the one to be built; he must be able to compare contents, tools and modelling methods for the interpretation of the typical complexity of the built and the under construction.
He must possess skills in the communication of information typical of advanced modelling, skills in relationships for teamwork, familiarity with BIM tools and methods, processing capacity of a BIM concept map, creativity in the preparation of technical data sheets that illustrate the theoretical contents for a more immediate and user-friendly approach. However, it often happens that the professional, by necessity, improvises himself as a BIM connoisseur, without having the appropriate skills, creating complex and difficult to manage BIM models. The role of the researcher is to experiment and propose new simplifying methodologies of the BIM model; to implement interoperable concept maps of great effectiveness and simplicity at the same time.
Pierpaolo D'Agostino
Marika Griffo focused her research on the semantics through models in their ex-ante and ex-post classification processes. The 3D survey obtained by a photogrammetric or laser scanner process has innumerable potentials. However, the point clouds obtained from data processing represent a single and indistinct object, deprived of any ontological structure. Therefore, it is necessary to perform a deconstruction and classification of the cloud in order to create a semantic and explanatory model. Thanks to this deconstruction, the final model is easier to read and interpret. How does all this intervene in BIM modelling? When should semantic classification be introduced in BIM? In reality, the semantic code is created ex-ante through the use of hierarchical models in BIM space. The model obtained contains ontologically defined objects which are grouped by analogy or equivalence or are separated by diversity. In both cases the system is built thanks to a semantic construct, which has the purpose of organising the data in such a way that their classification is truthful and effective. Ultimate and fundamental goal of modeling is the understanding of the object.

Laura Inzerillo

SESSION - III

PARAMETRIC MODELLING AND VIDEO MAPPING

Francesco Di Paola
University of Palermo

Francesco Di Paola is Associate Professor at University of Palermo within the Department of Architecture. Graduated cum laude in Building Engineering-Architecture at University of Palermo, 2003. Ph.D in "Representation and Surveying of Architecture and Environment" at University of Palermo in 2007. He is a member of the Scientific Board in the Interdepartmental Research Center "Coscienza" of the University of Palermo. His research mainly topics are in the field of Architectural Geometry, Algorithms Aided Design, Survey, Cultural Heritage Fruition in VR/AR. He is a member of several area research associations, he is member of scientific/technical committees of international conferences, he is reviewer member in several International Journals and guest editor of a special issue in MDPI Journal. He has been involved in several international and national projects. He is actually the author of more than 110 publications in scientific journals, proceedings of national/international scientific papers and monographs. He won a best paper award and, in 2007, he was awarded the UID Silver Targa by the Association of Italian Unity of Design (UID)

Graziano Mario Valenti
University of Rome "La Sapienza"

Graziano Mario Valenti is an associate professor, afferent to the Department of History, Design and Restoration of Architecture at the University of Rome "La Sapienza".
In 2014, he was awarded the national scientific qualification for the role of full professor. His research activity - articulated in the study and development of theory, conception, realization and testing of experimental models - is focused on the application of new digital technologies to support the design, construction, knowledge and communication of industrial and architectural products, with particular regard to cultural heritage and with the specific objective of anticipating future operational scenarios and solving current application problems. An expert in computer science, since the origins of his research activity, he has directly designed and implemented, using multiple programming languages, numerous procedures and applications for sharing, integrating and representing data of a heterogeneous nature distributed over a geographic network. A particular object of study that cuts across all of his research is the definition and representation of integrated and dynamic digital models that take on the role of both a container and a processing unit for heterogeneous information.
From 2000 to the present, he has participated in numerous university research projects funded by "La Sapienza" University and MIUR, frequently assuming the role of scientific coordinator.
Author of monographs and numerous scientific papers, he has spoken as a speaker or reviewer at international congresses and conferences.

INTRODUCTION

Virtual representation, free-form surface modelling techniques and numerical control manufacturing, with their intrinsic dynamic and interactive capabilities, have profoundly expanded and enriched the repertoire of geometric shapes, generating innovative design skills and creative languages.
There is no doubt about the opportunities for exploration, contamination, relationships and overlapping of ideas, measurements and information, which the continuous evolution of expeditious, parametric and automatic procedures brings to the use of the many products of the information age.
Adopting computation as a form of design is profoundly different from simply using tools geared toward increasing the productive capabilities of the designer. This approach implies first of all an extension of design actions to techniques and strategies, whose main strength is measured in the ability to promote new and different ways of thinking.
The added value of digital culture is rooted in the complementarity and synergy of all graphical and expressive methods of architectural language, hinging on the foundations of Scientific Representation. The latter play a basic role for infographics, constitute an essential cultural baggage and enrich the researcher with the awareness of possessing the tools of knowledge and governance of the geometric properties that regulate space, in order to be able to both read and communicate the design.
In computational design, the programming and the design domains come together to identify a form of creativity capable of interpreting information into procedures and rules for the project. In this field, new research perspectives declined in the specific contexts of the project (architecture, design, representation, territory, technologies, communication interfaces) integrate digital and emerging technologies in the elaboration of a product. The computation is seen as the process that regulates the information and the interactions between the elements involved in the definition of the design of the form, its responsive reactions to the context and the application of the same digital technologies to the production.
The emerging techniques of parametric and generative modeling, algorithmic-visual and computational programming, the methodology of "form-finding" and optimization processes with genetic algorithms constitute the tools of geometric-formal control that, in addition to bringing a methodological and applicative renewal, connects and hybridizes fields, processes and disciplines.
In Industrial Design, as in multi-scale architectural design, the explication of algorithmic thinking promotes research directions based on the centrality of the concept of code-procedure for building geometric- informative models. The parametric and semantic digital three-dimensional model simulates, collects and manages not only geometric data, but also structural, energy related and construction aspects of the work, putting them in relation with each other and thus

improving the interaction and dialogue between the design figures involved in the process. Furthermore, in the field of Design, generative and pre-figurative systems are now often associated with new production processes that are no longer of a "mechanical" type (cutting, turning, milling) but "plastic", linked to the additive modes of digital fabrication. In the near future, most industrial processes will have a digital matrix as a generator of governance and production control. The generative approach is useful for the designer to translate even the most complex visions into tangible signs, conceiving objects that can significantly adhere to the specific needs of people, contributing to the construction of unprecedented and fruitful design paths.

The contributions explore the themes of digital design and, specifically, the systematic aspects central to the relationship between computation and design.

The researches of Giorgio Buratti, Domenico D'uva, Marco Filippucci and Mirco Cannella provide a significant contribution to this scenario, describing a vast applicative and theoretical panorama, which ranges from the small scale of the industrial product to the large scale of territorial analysis, at the same time offering useful conceptual connections, which consolidate the general and increasingly shared theoretical apparatus of digital work, both for research and for the project.

Giorgio Buratti experimentally demonstrates how, through the coding of generative procedures, it is possible to investigate and use morphologies typical of the natural world for design, functional and manufacturing optimization purposes. His applications concern articulations of minimal surfaces and fractal geometries, whose parametric and generative definition must necessarily find its foundation in theoretical knowledge and critical capacity, useful for identifying and describing its formal genesis step by step.

Domenico D'Uva's research concerns the territorial scale, addressing those situations defined as "fragile", whose analysis and mapping, due to the complexity of the landscape and the scarcity of pre-existing information, require an unconventional approach based on integration of heterogeneous sources. The problem highlighted in the illustrated case study finds a solution in the definition of an optimized workflow that systemize various digital technologies.

Marco Filippucci, retracing a vast repertoire of exemplary case studies, emphasizes some critical issues and solutions that have profoundly transformed the meaning of design and model; focusing in particular on the problem of the explication of the process of representation, he emphasizes the temporal separation - postponement - of the representative result with respect to the act of drawing, which he pertinently associates with the renewal of the ancient discipline of descriptive geometry.

Finally, Mirco Cannella, delves into aspects that are different in type to the previous ones. The researcher discusses the potential and criticalities of augmented reality systems used for fruition purposes in architectural and archaeological contexts. In particular, his contribution focuses on procedures for georeferencing digital models in the real context, determining solutions that overcome the operational difficulties of current systems on the market.

The researches illustrated here, in their diversity and in some ways complementarity, are indicative of a mature thematic area, of great potential and rapidly developing: a resource of opportunities that will certainly be able to inspire and motivate future young researchers.