Symmetry: Art and Science

The Journal of the International Society for the Interdisciplinary Study of Symmetry (ISIS-Symmetry)

Editors: Vera Viana, Dénes Nagy, João Pedro Xavier, Ana Neiva, Marco Giroulihac, Luís Mateus, Pedro de Azambuja Varela
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SYMMETRY: ART AND SCIENCE
12TH SIS-SYMMETRY CONGRESS
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Editors: Vera Viana, Dénes Nagy, João Pedro Xavier,
Ana Neiva, Marco Ginoulhiac, Luís Mateus, and Pedro de Azambuja Varela.

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Editors of this issue:
Vera Viana, Faculty of Architecture, University of Porto and Aproged, Portugal
veraviana@veraviana.net
Dénes Nagy, International Society for the Interdisciplinary Study of Symmetry, Hungary
snagydenes@gmail.com
João Pedro Xavier, Faculty of Architecture, University of Porto, Portugal
jxavier@arq.up.pt
Ana Neiva, Faculty of Architecture, University of Porto, Portugal
aneiva@arq.up.pt
Marco Ginoulhiac, Faculty of Architecture, University of Porto, Portugal
mginoulhiac@arq.up.pt
Luís Mateus, Faculty of Architecture, University of Lisbon and Aproged, Portugal
lmmateus@fa.ulisboa.pt
Pedro de Azambuja Varela, Faculty of Architecture, University of Porto, Portugal
pvarela@arq.up.pt

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Pedro Alarcão, Vice-Director of the Centre for Studies in Architecture and Urbanism

WELCOMING MESSAGE
Manuel Couceiro da Costa, President of the General Assembly of Aproged (the Portuguese Geometry and Drawing Teachers’ Association)

WELCOMING MESSAGE
Vera Viana, President of the Board of Directors of Aproged and Congress Chair

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ACKNOWLEDGMENT TO THE SCIENTIFIC COMMITTEE

The Editors would like to express their gratitude to the Scientific Committee members who kindly reviewed the extended abstracts that were submitted to this Congress and, in a second stage, the papers into which they were developed. Without this important contribution, the quality of our congress would not have been the same.

We are very grateful for the opportunity of working with each of the Scientific Reviewers mentioned below, without whose contribution this special issue would not have been possible.

Thank you!

The Editors: Vera Viana, Dénes Nagy, João Pedro Xavier, Ana Neiva, Marco Ginoulhiac, Luís Mateus, and Pedro de Azambuja Varela.

SCIENTIFIC COMMITTEE OF THE 12TH SIS-SYMMETRY CONGRESS:

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Escola Superior de Artes e Design

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JOSÉ VÍTOR CORREIA
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Faculty of Fine Arts, University of Barcelona, Spain
LUIGI COCCHIARELLA  
School of Architecture, Urban Planning, Construction Engineering, Polytechnic of Milano, Italy

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Faculty of Architecture, University of Lisbon, Portugal

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Institute for Excellence in Higher Education Global Learning Centre, Tohoku University, Japan

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Faculty of Architecture, University of Porto, Portugal

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Point Loma Nazarene University, United States of America

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University of Belgrade, Servia

MILENA STAVRICK  
Institute of Architecture and Media, Graz University of Technology, Austria

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NATÁLIA PROVIDÊNCIA  
Department of Mathematics, Faculty of Sciences and Technology, Univ. of Coimbra, Portugal

PEDRO DE AZAMBUJA VARELA  
Faculty of Architecture, University of Porto, Portugal

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VASCO CARDOSO
Faculty of Fine Arts, University of Porto, Portugal

VERA VIANA
Faculty of Architecture, University of Porto, Portugal

VÍTOR MURTINHO
Department of Architecture, Faculty of Sciences and Technology, University of Coimbra, Portugal
OPENING SESSION
WELCOMING MESSAGE FROM
THE DEAN OF THE FACULTY OF ARCHITECTURE

I am very pleased to welcome you all to the Faculty of Architecture at the University of Porto and to the 12th edition of the Symmetry Art and Science | SIS-Symmetry Congress. I am particularly glad for being among such a heterogenic group of scholars and researchers, coming from all corners of the world, representing such a rich and diversified set of backgrounds, from science to artistic fields, proving multi and transdisciplinarity as a fruitful and effective approach for producing knowledge.

It is also very important to point out the deep and structural bond between architecture and the concept of symmetry, which can be observed since the first man-made constructions, obviously inspired by nature, and that has been guiding architecture throughout the centuries conveying sense of balance, order, and stability.

An endless conversation could be started on how symmetry is key to architecture design and how it is manifested, in many different situations, on the buildings we daily inhabit. From being an intelligent and economic strategy to assure stability to a structure; to create and highlighting centrality, using radial symmetry forms; or to manifest power, through demonstration of order, organisation, and control, exploring bilateral symmetry, it is a fundamental concept for architecture.

Moreover, it is also very interesting to reflect on how symmetry can sometimes be only apparent, disguised and simulated to suggest order and harmony even if it is not entirely verifiable.

I am also sure it will be a central topic in the discussions within the following days and this book’s pages, therefore I won’t elaborate much on that unlimited field apart from pointing out some of the interesting aspects we can observe in the building hosting this event. So, in parallel to the Congress, I invite you to disguise, in these days, the secret symmetries of our school, and mainly how geometry is determinant to understand each building as a unit and as part of a whole.

Before the last day of the Congress, we will have the opportunity to visit the baroque ensemble of the Clérigos Brotherhood where we can verify the perfect accordance between visual and musical symmetry, despite the simulated symmetries of its lateral facades. I’m quite sure that Álvaro Siza learn a few tricks from baroque architecture, and from Clérigos in particular.

I wish you a fruitful Congress, and I hope you enjoy your stay in Porto.

JOÃO PEDRO XAVIER
Dean of the Faculty of Architecture, University of Porto, and Congress Honorary Chair
WELCOMING MESSAGE FROM
THE CEAU’S DIRECTORATE

Dear Congress Participants,

On behalf of the Directorate of the Centre for Studies on Architecture and Urbanism of the Faculty of Architecture of the University of Porto (CEAU-FAUP), it is an honour to host the 12th SIS-Symmetry Congress at our School.

The importance of the study of Symmetry is widely recognized and has been approached in areas of knowledge as diverse as Mathematics, Physics, Literature, Music, Biology, among many others. The analysis and interpretation of Symmetry also has an enormous relevance to Architecture, precisely because this is an area of knowledge of great scope, between Art and Science, that has long recognized how indispensable are the fruits of transdisciplinary collaborations.

On behalf of CEAU, we welcome you all in our School and wish the greatest success for the work that is now beginning.

PEDRO ALARCÃO

Vice-Director of the Centre for Studies in Architecture and Urbanism
WELCOMING MESSAGE FROM
THE PRESIDENT OF APROGED’S GENERAL ASSEMBLY

Welcome, dear participants of the 12th SIS-Symmetry Congress.

I address you, members of this large community interested and devoted to the research and understanding of the concept and application of symmetry and, also, of geometry, as Chairman of the General Assembly of Aproged, a co-organizer of this event.

Aproged is a Portuguese association of professors of geometry, descriptive geometry, and drawing, from high school and university levels, established in 1995 that, until 2012, dedicated most of its activities to subjects of didactics and pedagogy more directed to a national scope, emphasizing in its activities during this period and on par with official consultancy and training actions, the organization of a set of ten National Meetings and twelve Regional Meetings and correspondent publications. Since 2013, along with its traditional activities, the structure of the Meetings has been replaced by a new version, the Jornadas Didácticas (Didactic Journeys), while the strand of research began shaping its development through the organization of International Conferences that we name Geometrias. So far, we had three Didactic Journeys and five Geometrias and we plan to develop these even further. Therefore, it is an honour for Aproged to cooperate with other institutions with a long and prestigious history and consolidated experience in the field of international conferences and similar events, as is the case of FAUP/CEAU, our host and national reference in the theme of this conference, and SIS-Symmetry, that since 1989 promotes the interaction of experts from all over the world, including countries from four continents.

To these institutions, Aproged addresses the most respectful compliments and, believing that Geometry, symbolized by the letter G, being in the foundation of positive science and avoiding vain speculations, brings us together, also tries to promote new synergies, based on its Portuguese roots, considering the representativeness of the majority of the most qualified schools, research centres and universities of Portugal among its members.

Beyond the Aproged compliments, allow me to add also personal compliments, as an old friend, and co-operator with FAUP, particularly since 1995 with its actual Dean, Professor João Pedro Xavier, but also with SIS Symmetry, in whose 5th International Congress, 2001, in Sydney, Australia, I presented a full paper and got acquainted with Professor Dénes Nagy.

We wish all the participants of the 12th SIS-Symmetry Congress, a wonderful, profitable, and high-level journey.

MANUEL COUCEIRO DA COSTA
President of the General Assembly of Aproged
WELCOMING MESSAGE FROM
THE ORGANIZING COMMITTEE AND APROGED’ S DIRECTOR

The Organizing Committee feels especially honoured in welcoming the participants of the Symmetry Art and Science | 12th SIS-Symmetry Congress who have travelled to Porto or will join us via Zoom. It will be an immense pleasure to be with all of you in the six days of this Congress and we hope everyone enjoys the Faculty of Architecture and the city of Porto, as well as the Keynote Sessions and Paper Presentations in the Congress Program and the activities we prepared for the Social Program. To those who will participate remotely, we wish that, in spite of the distance, everything is interesting and hope to have the chance to meet you personally in a near future.

As Aproged’s Director and International Advisory Board member of the International Society for the Interdisciplinary Study of Symmetry, I would like to express my sincerest gratitude to the Dean of the Faculty of Architecture of the University of Porto for allowing us to co-organize the 12th Congress in such an outstanding building and excellent school. For me and most of the participants, I am sure, this is a true privilege that will not be forgotten. As a Researcher in the Centre for Studies in Architecture and Urbanism, I address my deepest gratitude for the support from the Directorate and, most specially, for having had the opportunity of working with an exceptional group of people.

There has been a huge amount of work involved in the organization of this Congress, but I am sure all of it will be worthwhile and all of us will save good memories from the Congress, from this wonderful building, from the city of Porto and, most of all, from all the new friendships we will gain.

Thank you for being here with us. You are all very welcome!

VERA VIANA
Congress Chair, Organizing Committee member
and President of the Board of Directors of Aproged
BIOGRAPHIC NOTES OF THE EDITORS
AND OPENING SESSION SPEAKERS
Pedro ALARCÃO
Architect, PhD in Architecture under the thesis "Building in the Ruin. About the romanised city of Conimbriga" (FAUP, 2009). Teacher at FAUP since 1993, now being Professor of Project 2 and Architectural Intervention in Archeologic Circumstance of the Integrated Masters' degree in Architecture and Project Methodologies in the Course of Advanced Studies in Architectural Heritage. Has participated in several courses, conferences and workshops on Architectural Heritage organized by various national and international institutions. He published two books and has written extensively and lectured on the fields of architecture and architectural heritage. He developed project activity in the field of heritage conservation and rehabilitation. Member of the Scientific Board of FAUP. Deputy Director of Researcher of the Centre of Architectural and Urban Studies, in Architecture, City and Territory Heritage Group, coordinating the Research Line Atlas of the Ancient Ways and Towns of Portugal. Co-Founder of the International Centre for Architectural Design and Archaeology. Research Interests: architecture, architectural and archaeological heritage.

Manuel Couceiro da COSTA
PhD in Architecture/Visual Communication (1993, Faculty of Architecture of the University of Lisbon – FAUL), started his architectural practise in 1971, in collaboration with several renowned Portuguese ateliers and is founder and CEO of its own architectural office, Arquétipo Atelier, since 1981. Since 1978 started his academic and research careers in ESBAL/FAUL, stressing having been Dean of FAUL (2010-2012). The pedagogical and scientific components of the academic activity have their core in architecture and also in drawing and geometry, with repercussion in research projects, lectures and international conferences, presented worldwide, in 22 countries from all continents. Actually, is researcher at FAUL/CIAUD, the representative of FAUL at the Portuguese Technological Construction Platform (PTPC) and at the European Association for Architectural Education (EAAE; having been Council Member 2012-2018 and chairman of the EAAE/ARCC International Conference – Lisbon 2016), Aproged/GA Chairman, and National Fine Arts Academy (ANBA)/ Effective Council Member

Marco GINOULHIAC
Marco Ginoulhiac (1971 Bergamo, Italy) is associated professor at Faculty of Architecture of the University of Porto teaching the course: “The ludic construction of Architecture”, “Design Studio 3” and “Housing Design”. He is author of some books and several articles around these subjects. He organized international events like conferences, workshops and exhibitions both in Portugal and abroad. He lectured in China, Czech Republic, Hungary, Spain and Germany as guest speaker or as Honorary Fellowship Professor. He belongs to the Executive Board of the Resdomus Architectural Review, to the scientific board of CIAUD – Centro de Investigação em Arquitetura, Urbanismo e Design from FA-ULisboa and to the review panel of the Revista 2i: Estudos de Identidade e Intermédialidade from UMinho. He is responsible for the Erasmus mobility at FAUP and a member of CEAU – Centro de Estudos de Arquitectura e Urbanismo.
Luís MATEUS

Luís Mateus is Assistant Professor at the Lisbon School of Architecture of the University of Lisbon (FAUL), where he teaches in the areas of geometry, computation, and architectural conservation. He is a member of ArcHC_3D and Design and Computing Group research groups from the Research Centre in Architecture, Urbanism and Design (CIAUD). Specialized and develops research in the use of laser scanning and photogrammetry applied to architectural documentation and conservation, as well as in the application of parametric modelling methods to architectural design. He participated in several fundamental research projects with public and private entities, from governmental agencies to private companies. He publishes regularly and supervised several masters and PhD thesis and, recently, supervised two Marie Curie research projects. In the Faculty of Architecture, he was a member of the board of administration (2014), vice-president of the scientific board (2017/2018), and currently is its vice-president. He is vice-president of APROGED.

Dénes NAGY

Dénes Nagy is a Hungarian-Australian mathematician and historian of science. He started his teaching career at the Eötvös Loránd University, Budapest. His later appointments: Arizona State University (Tempe, 1986-88), University of the South Pacific (Suva, 1989-93), University of Tsukuba (Tsukuba Science City, 1993-2000). In 2001, he was appointed Honorary Research Professor of the Institute for the Advancement of Research, ACU, Melbourne, Australia. He is the Founding President of SIS-Symmetry, which organized triennial art-science congresses and exhibitions on five continents since 1989. He was given many honorary titles and awards, including Doctor honoris causa. In 2012, the President of Hungary awarded him the Knight Cross. He gave invited lectures in more than 20 countries in six languages. His list of publications includes 27 volumes and 185 papers in ten languages. His co-authors and co-editors include, among others, the Nobel-prize winners Eugene P. Wigner and Danny Shechtman, and the physicist Kodi Husimi.

Ana NEIVA

Architect, Professor and PhD Researcher by the Faculty of Architecture of the University of Porto. Invited Assistant Professor at FAUP (since 2013) and Assistant Professor at FCAATI - ULP. Neiva was visiting professor at the Technical University of Munich (2019, she is a founding member of the research group "Narratives of the Educational Project in Architecture" at CEAU-FAUP and vice-director of the Centre for Studies in Architecture Arq.ID at Lusófona University. She co-curated the exhibitions "Porto - The City, the School and the masters" for UABB 2015 (Shenzhen, China), "Lo studio Ginoulhiac - 10 Anni. 10 Case. 10 Temi di Architettura" (Bergamo and Porto, 2019), "Petites Folies. Other Landscapes over Douro", for Porto Design Biennale 2021 and she is co-author of the exhibition project for the "Vicente. The Myth in Lisbon" art exhibition (Lisbon, 2019).
Pedro VARELA
Pedro de Azambuja Varela is an architect who graduated in 2006 in the Faculty of Architecture, University of Porto (FAUP), where he also received his Ph.D. in Architecture in 2020 with the thesis entitled *Reconstruction of a Stereotomy, for a multi-semantic stereotomic approach*. He has worked in architecture offices in Porto, Vienna, and New York before establishing his practice AZVAvisuals promoting innovative work in advanced 3D modeling and rendering, as well as in programming and graphic and web design. Parallelly, his architecture projects have resulted in published works in reference magazines and websites. Research activity has started in 2013 with regular publication of articles in conferences and journals such as *ASA*, *eCAADe* and *Nexus*. Member of the Digital Fabrication Laboratory (DFL) since its foundation, Pedro has contributed to various projects dependent on algorithmic design and robotic fabrication.

Vera VIANA

João Pedro XAVIER
João Pedro Xavier is an architect and full professor at the Faculty of Architecture, University of Porto (FAUP), where he received his degree in 1985, his Ph.D. in Architecture in 2005. He worked in Álvaro Siza’s office from 1986 to 1999. At the same time, he established his own practice as an architect. Xavier is a member of CEAU’s research teams (ATPH: Architecture: Theory, Project, History and DFL: Digital Fabrication Laboratory). The relationship between architecture and mathematics, especially perspective, is his main research interest. Author of the books *Perspectiva, perspectiva acelerada e contraperspectiva* (Perspective, accelerated perspective and retarded perspective) and *Sobre as origens da perspectiva em Portugal* (About the origins of perspective in Portugal). He is correspondent editor of the *Nexus Network Journal*, and Council member of the *European Association for Architectural Education* (EAAE). Xavier is the Dean of the Faculty of Architecture of Porto’s University since 2018.