



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 Ginouliac, Luís Mateus,
Pedro de Azambuja Varela

Symmetry: Art and Science, 2022

Special issue for the 12th SIS-Symmetry Congress

Congresses of the International Society for the Interdisciplinary Study of Symmetry:
1989 (Budapest, Hungary) | 1992 (Hiroshima, Japan) | 1995 (Washington, D.C.,
United States of America) | 1998 (Haifa, Israel) | 2001 (Sydney, Australia) | 2004 (Tihany,
Hungary) | 2007 (Buenos Aires, Argentina) | 2010 (Gmünd, Austria) | 2013 (Crete,
Greece) | 2016 (Adelaide, Australia) | 2019 (Kanazawa, Japan) |
2022 (Porto, Portugal)

SYMMETRY: ART AND SCIENCE 12TH SIS-SYMMETRY CONGRESS

Porto, Portugal
July 11-16, 2022

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

Host Institution:
Faculty of Architecture, University of Porto

The digital edition of this Special Issue is hosted in the Scientific Repository of the University of Porto
More information about the publication in <https://symmetrycongress.arq.up.pt/proceedings/>

Printed edition:

Viana, V., Nagy, D., Xavier, J., Neiva, A., Ginoulhiac, M., Mateus, L. & Varela, P. (Eds.). (2022). *Symmetry: Art and Science | 12th SIS-Symmetry Congress [Special Issue]*. *Symmetry: Art and Science*. Porto: International Society for the Interdisciplinary Study of Symmetry.

Printed by Nozzle, Lda. (nozzle@sapo.pt)

This publication is licensed under a Creative Commons Attribution - Non-commercial - No Derivatives 4.0 International (CC BY -NC-ND 4.0):

You are free to share, copy and redistribute the material in any medium or format, as long as you follow the license terms, giving appropriate credit and providing a link to the license. You may do so in any reasonable manner, but not in any way that suggests the editor or author(s) endorses you or your use.

You may not use the material for commercial purposes. You are free to:

Share: copy and redistribute the material in any medium or format and

Adapt: remix, transform, and build upon the material,

under the following terms:

Attribution: You must give appropriate credit, provide a link to the license, and indicate if changes were made. You may do so in any reasonable manner, but not in any way that suggests the licensor endorses you or your use.

NonCommercial: You may not use the material for commercial purposes.

ShareAlike: If you remix, transform, or build upon the material, you must distribute your contributions under the same license as the original.



If you wish to remix, transform, or build upon the material, you must have the author(s)'s permission. The license's text is available at <http://creativecommons.org/licenses/by-nc-nd/4.0/>.

If you wish to do anything listed as not allowed, please contact the first editor (veraviana@veraviana.net) or the authors of each paper.

The *Symmetry: Art and Science* with the ISSN 1447-607X (formerly, *Symmetry: Culture and Science*, ISSN 0865-4824) is the Journal of the International Society for the Interdisciplinary Study of Symmetry (SIS-Symmetry, for short). The opinions expressed herein are the sole responsibility of the Authors and do not necessarily reflect the opinions of SIS-Symmetry, the Editors, or the 12th SIS-Symmetry Congress Scientific Committee.

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

The *Symmetry: Art and Science* | 12th SIS-Symmetry Congress was a joint organization between the Centre for Studies in Architecture and Urbanism (CEAU), the Faculty of Architecture, University of Porto (FAUP), the International Society for the Interdisciplinary Study of Symmetry (SIS-Symmetry) and Aproged, the Portuguese Geometry and Drawing Teachers' Association.

Congress homepage: <https://symmetrycongress.arq.up.pt/>

Congress Venue: Faculdade de Arquitectura da Universidade do Porto, Portugal.

Congress Chairs: Vera Viana, Dénes Nagy, and João Pedro Xavier.

Organizing Committee: Vera Viana, Ana Neiva, Marco Ginoulhiac, Luís Mateus, and Pedro de Azambuja Varela.

Cover layout: Pedro de Azambuja Varela

Image: FAUP's library image by Pedro de Azambuja Varela over BIM model by Miguel Martins.

Overall revision and graphic edition: Vera Viana

Legal Deposit of the printed version: 502398/22

International Society for the Interdisciplinary Study of Symmetry

Executive Board: Dénes Nagy (President, Hungary/Australia), Ioannis Vandoulakis (Treasurer, Greece), Sayed Alireza Behnejad (Secretary, United Kingdom), and Éva Gyarmathy (Hungary).

Oversight Committee: Ted Goranson (Chair, United States of America/Australia), Claudio Guerri (Argentina), and Eugene Katz (Israel).

International Advisory Board: Jean-Yves Béziau (Chair in South America, Brazil), Marcin Schroeder (Chair in Asia, Japan), Vera Viana (Chair in Europe, Portugal),

Rima Ajlouni (United States of America), Beth Cardier (Australia), Liu Dun (China), Patricia Muñoz (representing SEMA (Sociedad de Estudios Morfológicos de la Argentina), Argentina), Janusz Rębielak (Poland), and Dmitry Weise (Russia).

International Symmetry Society in Australia: Lynn Arnold (President, Australia)

TABLE OF CONTENTS

(The sequence of chapters follows the order of presentations in the [congress program](#).)

<u>ACKNOWLEDGMENT TO THE SCIENTIFIC COMMITTEE</u>	001
<u>OPENING SESSION</u>	006
WELCOMING MESSAGE	
João Pedro Xavier, Dean of the Faculty of Architecture, University of Porto and Congress Honorary Chair	
WELCOMING MESSAGE	
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 Aproved (the Portuguese Geometry and Drawing Teachers' Association)	
WELCOMING MESSAGE	
Vera Viana, President of the Board of Directors of Aproved and Congress Chair	
Chapter 01	
<u>ΣΥΜΜΕΤΡΙΑ – SYMMETRIA – SYMMETRY:</u>	
<u>ZOO- AND ETHNO-MATHEMATICS, BIRTH OF THE TERM IN GREECE, SURVIVAL IN THE THEORY OF ARCHITECTURE, REBIRTH IN ART AND SCIENCE, AND THE FUTURE TASKS, WITH OUTLOOKS TO “PORTUGUESE SYMMETRIES” AND CAMÕES, AND TO THE GOLDEN SECTION WITH LESS “GOLD” AND WITHOUT LEONARDO</u>	
Dénes Nagy, President of the International Society for the Interdisciplinary Study of Symmetry.....	
	014
Chapter 02	
<u>MAURITS CORNELIS ESCHER:</u>	
<u>WHEN A SIMPLE EMPTY PLANE COMES TO LIFE</u>	
Carlos Santos.....	
	030
Chapter 03	
<u>ANTISYMMETRY IN PORTUGUESE CERAMIC TILE FACADES</u>	
João Nunes, Andreia Hall and Paolo Vettori.....	
	034
Chapter 04	
<u>SPACE TESSELLATIONS. POLYHEDRAL SCULPTING</u>	
Werner Van Hoeydonck.....	
	040

Chapter 05

INTERLACING ISLAMIC ART
WITH THE TEACHING OF SYMMETRY IN PORTUGUESE SCHOOLS

Paula Rita, Nuno Bastos and Andreia Hall..... 048

Chapter 06

SYMMETRY AND LANDSCAPE REPRESENTATION:
INTERNAL ORDER AND PICTURESQUE SINGULARITY

Joan Carles Oliver..... 056

Chapter 07

SYMMETRY RELATIONS IN CROSSED-ARCH DOMES:
COMPARISON BETWEEN THE PERSIAN AND SPANISH-MUSLIM TRADITIONS

Clara Pimenta do Vale..... 062

Chapter 08

SYMMETRY IN SHAPE AND SYMMETRY IN MOTION
OF DIGITAL 3D CHARACTERS

Ratko Obradovic, Ivana Vasiljevic, Filip Mirceski and Isidora Djuric..... 070

Chapter 09

SPLIT PLYWOOD AS A PLATFORM FOR CREATIVE RESEARCH ON SYMMETRY
BETWEEN BEAUTY AND SYMMETRY, BETWEEN ART AND DESIGN

Adi Hamer Yacobi..... 078

Chapter 10

TRANSFORMATION IN IMPLEMENTATION.
SYMMETRY CONCEPTS IN INDUSTRIAL DESIGN PRODUCTS

Patricia Muñoz..... 088

Chapter 11

SYMMETRY AND VARIANCE
GENERATIVE PARAMETRIC MODELLING OF HISTORICAL BRICK WALL PATTERNS

Sevgi Altun, Mustafa Cem Güneş, Yusuf Hüseyin Şahin,
Alican Mertan, Mine Özkar and Gözde Ünal..... 096

Chapter 12

DYNAMIC SYMMETRY, HARMONY, AND BALANCE
IN NAQSH-E-JAHAN SQUARE OF ISPAHAN

Mohammadmahdi Alizadeh and Clara Pimenta do Vale..... 104

Chapter 13

FOUR HOUSES BY KAZUO SHINOHARA. SYMMETRY AND TOPOLOGY

Filipe Magalhães..... 112

Chapter 14

(IN)VISIBILITIES FROM THE INTERVAL'S DISSYMMETRY.

REFLECTIONS THROUGH TÁVORA'S JAPAN AND SARTRE: THE TENNIS PAVILION

João Cepeda..... 116

Chapter 15

FRONTALLY FRAMED COMPOSITIONS.

ITERATIONS THROUGH A RECOGNIZABLE TROPE

Ana Luisa Soares..... 124

Chapter 16

SYMMETRY IN MATHEMATICS AND THE MATHEMATICS OF SYMMETRY

António Machiavelo..... 135

Chapter 17

APPLICATION OF APERIODIC TILING TO LATTICE SPATIAL STRUCTURES:

A FAMILY OF APERIODIC PATTERNS ON SPHERICAL CAPS

James Durn and Alireza Behnejad..... 138

Chapter 18

PERSPECTIVE PEROVSKITES

Eugene Katz..... 146

Chapter 19

A COMBINED RESEARCH PLATFORM OF STRUCTURAL MORPHOLOGY,

DEALING WITH THE ORDERED 3D SPACE

Michael Burt..... 154

Chapter 20

FULLERENE-LIKE ARCHITECTURE OF POLLEN

Irina Delusina and Eugene Katz..... 160

Chapter 21

PERSIAN VELVETS OF THE 17TH CENTURY:

SYMMETRY, CRAFT, AND TECHNOLOGY

Carol Bier..... 168

Chapter 22

APPLYING SYMMETRY IN FIGURED VELVET DESIGN

Barbara Setsu Pickett..... 176

Chapter 23

CROSSINGS. FLYING OVER ANTISYMMETRIC TRUCHET FRIEZES

Andreia Hall, João Nunes and Paolo Vettori..... 184

Chapter 24

PLAYING SYMMETRIES. PORTUGUESE SIDEWALKS

Alda Carvalho, Carlos Santos, Jorge Silva and Ricardo Teixeira..... 192

Chapter 25

SYMMETRY CONCEPTS AS DESIGN APPROACH.

AESTHETICS BETWEEN IRREGULARITY AND REGULARITY

Cornelie Leopold..... 202

Chapter 26

SYMMETRY IN MOTION:

STELLAE OCTANGULAE, AND EQUIFACED POLYHEDRA

Gunter Weiss..... 210

Chapter 27

POLYHEDRONS, ART, AND ARCHITECTURE IN RENAISSANCE VENICE

Cosimo Monteleone..... 218

Chapter 28

ANALOGY AND SYMMETRY:

SOME HEURISTIC SPATIAL GENERALIZATIONS OF THE OCTAGON

Antonia Redondo Buitrago..... 226

Chapter 29

TORRICELLI'S COMPUTATION OF THE AREA UNDER THE CYCLOID

Maria Zack..... 234

Chapter 30

S, M, L, XL, Y, Z. IMAGES WITH COUNT, WEIGHT, AND MEASURE

Os Espacialistas..... 244

Chapter 31

FUNCTIONAL ASYMMETRY IN FLY'S WING VEINS AS PIPE NETWORK

Kazuki Sugiyama, Yoshihiro Kubota, and Osamu Mochizuki..... 254

Chapter 32

SEED, TREE, FOREST...

BUILDING HARMONY SYMMETRY THROUGH (SACRED) CREATIVITY

Joana Ribeiro..... 260

Chapter 33

CHARACTERISTICS OF WATER SUPPLYING NETWORK ON LEAF

Yuki Ishizaki and Yoshihiro Kubota..... 268

Chapter 34

RELATIONSHIP OF PROPORTIONS, FLOORPLAN PATTERNS, TYPOLOGY,
AND SYMMETRY IN RELIGIOUS ARCHITECTURE WITH PARTICULAR FOCUS
ON THE ROMAN CATHOLIC CHURCH ARCHITECTURE IN INTERWAR HUNGARY

Eszter Hajós-Baku..... 272

Chapter 35

THE LANGUAGE REVIVAL DIAMOND (LARD).
REVIVALISTICS IN THE MIRRORING SERVICE OF RECTIFYING LINGUICIDE

Ghil'ad Zuckermann..... 279

Chapter 36

CONSTRUCTING SYMMETRIC BAMBOO DOMES AND BAMBOO SPHERES.
THE SHAPE OF FULLERENES C60 AND C80 AS A TEMPLATE FOR DOMES

Caspar Schwabe..... 286

Chapter 37

SYMMETRY IN ENCODING INFORMATION.
SEARCH FOR COMMON FORMALISM

Marcin Schroeder..... 292

Chapter 38

A SEMIOTIC FOLLY: SEEKING THE OPPOSITE OF A CIRCLE

Lynn Arnold..... 300

Chapter 39

THE DEVELOPMENT AND ROLE OF SYMMETRY IN ANCIENT SCRIPTS

Peter Revesz..... 308

Chapter 40

UNEXPECTED SENSE OF SYMMETRY INSIDE THE PROJECTION

Luigi Cocchiarella..... 316

Chapter 41

SYMMETRIES IN CLASSICAL MUSIC.
FROM GUILLAUME DE MACHAUT TO CESAR FRANCK

Carlota Simões..... 324

Chapter 42

MATHEMATICAL ASPECTS
OF A NEW SPHERICAL MUSICAL INSTRUMENT: SPHEREHARMONIC

Maria Mannone and Takashi Yoshino..... 332

Chapter 43

SYMMETRY IN LITERATURE, THE PERSPECTIVE OF A MATHEMATICIAN

Natalia Bebiano..... 338

Chapter 44

THE GOLDEN SECTION:

THERE WAS ALWAYS A FIRST TIME - BUT WHEN WAS IT?

Albert Van der Schoot..... 348

Chapter 45

ON THE UBIQUITY OF SYMMETRY IN LOGICAL GEOMETRY

Hans Smessaert and Lorenz Demey..... 356

Chapter 46

AMBIGUOUS SYMMETRY: THE TYPICAL CASE OF HUMAN BEINGS

Jean-Yves Beziau..... 362

BIOGRAPHIC NOTES OF THE EDITORS AND OPENING SESSION SPEAKERS

ACKNOWLEDGMENT TO THE SCIENTIFIC COMMITTEE

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:

ALBERT WILTSCHÉ

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

ALEXANDRA PAIO

Department of Architecture and Urbanism, ICSTE - University Institute of Lisbon, Portugal

ALIREZA BEHNEJAD

Department of Civil and Environmental Engineering, University of Surrey, United Kingdom

ANA NEIVA

Faculty of Architecture, University of Porto, Portugal

CARLOTA PIRES SIMÕES

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

CHRISTOPH PÖPPE

Freelance journalist, formerly, in Spektrum der Wissenschaft, Germany

CLAUDIO GUERRI

Facultad de Arquitectura, Diseño y Urbanismo, Universidad de Buenos Aires, Argentina

COSIMO MONTELEONE

Department of Civil, Environmental and Architectural Engineering, University of Padua

ÉVA GYARMATHY

Hungarian Academy of Sciences, Hungary

EUGENE KATZ

Jacob Blaustein Institutes for Desert Research, Ben-Gurion University of the Negev

GERARD PARKE

Department of Civil and Environmental Engineering, University of Surrey, United Kingdom

GIUSEPPE AMORUSO

Department of Design, Polytechnic of Milano, Italy

GIUSEPPE FALLACARA

Department of Civil Engineering Sciences and Architecture, Politecnico di Bari, Italy

GUNTER WEISS

Dresden Technical University, Germany

HANS-PETER SCHRÖCKER

Faculty of Engineering Sciences, University of Innsbruck

HELENA MENA MATOS

Department of Mathematics, Faculty of Sciences, University of Porto, Portugal

HELLMUT STACHEL

Institute for Discrete Mathematics and Geometry, Vienna University of Technology, Austria

HENRY SEGERMAN

Department of Mathematics, Oklahoma State University, United States of America

HIROTAKA SUZUKI

Department of Architecture, Kobe University, Japan

IOANNIS VANDOULAKIS

Hellenic Open University, Greece

JANUSZ REBIELAK

Cracow University of Technology, Poland

JOÃO PEDRO XAVIER

Faculty of Architecture, University of Porto, Portugal

JOSÉ BÁRTOLO

Escola Superior de Artes e Design

JOSÉ PEDRO SOUSA

Faculty of Architecture, University of Porto, Portugal

JOSÉ VÍTOR CORREIA

Faculty of Architecture, University of Lisbon, Portugal

LINO CABEZAS

Faculty of Fine Arts, University of Barcelona, Spain

LUIGI COCCHIARELLA

School of Architecture, Urban Planning, Construction Engineering, Polytechnic of Milano, Italy

LUÍS MATEUS

Faculty of Architecture, University of Lisbon, Portugal

MARCIN SCHROEDER

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

MARCO BEVILACQUA

Department of Engineering, University of Pisa, Italy

MARCO GINOULHIAC

Faculty of Architecture, University of Porto, Portugal

MARCO HEMMERLING

Cologne Institute for Architectural Design, TH Köln - University of Applied Sciences, Germany

MARIA ZACK

Point Loma Nazarene University, United States of America

MARIJA OBRADOVIĆ

University of Belgrade, Serbia

MILENA STAVRIC

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

MINE ÖZKAR

Istanbul Technical University, Turkey

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

RUI FAUSTO

Faculty of Sciences and Technology, University of Coimbra, Portugal

SAMUEL LOPES

Department of Mathematics, Faculty of Sciences, University of Porto, Portugal

TED GORANSON

College of Engineering & Computer Science, Australian National University, Australia

TAKASHI YOSHINO

Department of Mechanical Engineering, Toyo University, Japan

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), Apoged/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 Inter-medialidade* 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 Kōji 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 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 AZVAvizuals promoting innovative work in advanced 3D modeling and rendering, as well as in programming and graphic and web design. Parallely, 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

Vera Viana studies polyhedral geometry and the relationships between Architecture and Mathematics as an Integrated Researcher at the Centre of Studies of Architecture and Urbanism (CEAU) in the Faculty of Architecture, University of Porto. In 2020, Viana concluded her Ph.D. thesis on Didactic Applications on Polyhedra for the Teaching of Geometry in Trás-os-Montes and Alto Douro's University. Director of Aproged, the Portuguese Geometry and Drawing Teachers' Association since 2009, Viana organizes the International Conferences *Geometrias* (since 2013), *Jornadas Didácticas* (since 2016) and is Editor-in-Chief of all *Geometrias* Conference related publications and Boltim da Aproged (2009-2022). Conference Report Editor for the Nexus Network Journal since 2014. Viana has been engaged, since 2001, in the development of educational resources with dynamic geometry, three-dimensional modelling and algorithmic modelling software, having authored presentations, papers, book chapters, a website, and a Ph.D. thesis on the subject.

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.

