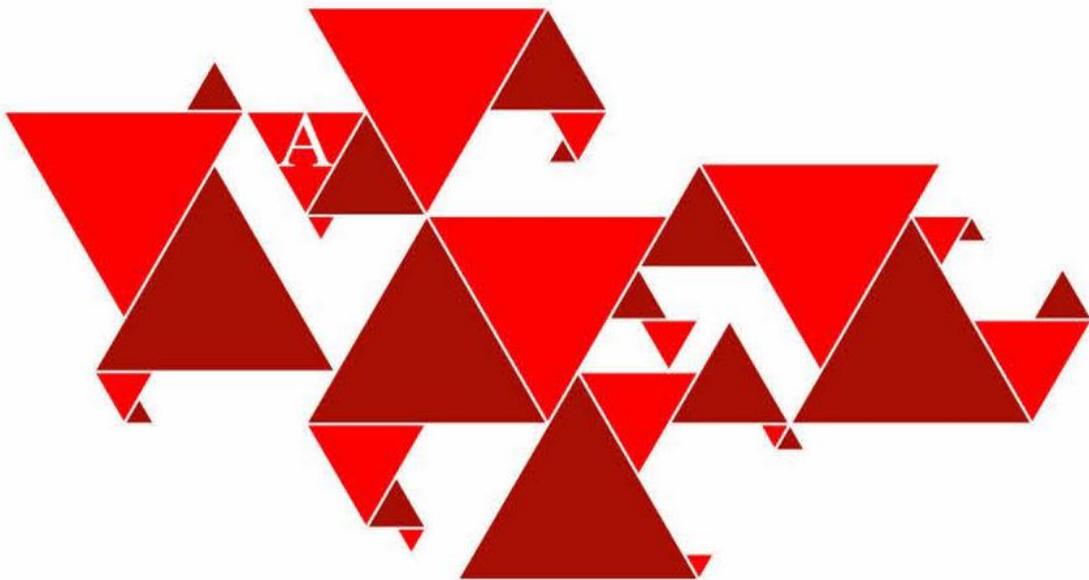


3rd symposium
FORMAL METHODS IN ARCHITECTURE

November 30, December 02 | 2015
ESAP | Escola Superior Artística do Porto, Portugal

BOOK OF ABSTRACTS

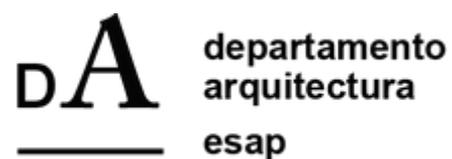
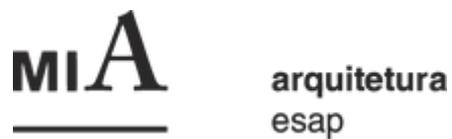


David Leite Viana
Franklim Morais
Jorge Vieira Vaz

CESAP | Cooperativa de Ensino Superior Artístico do Porto

INSTITUTIONAL

The symposium was an initiative between the following departments of ESAP



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KEYNOTE SPEAKERS

(Following the presentation sequence set by the programme)

Tasos VAROUDIS

Senior Research Associate (The Bartlett School of Architecture, University College London)

Beyond the visual field: advances in thinking about and analysing space

José P. DUARTE

PhD (Faculdade de Arquitetura da Universidade de Lisboa)

Inserting new technologies in architectural curricula: from research to practice, and to teaching

GUEST SPEAKERS

(Following the presentation sequence set by the programme)

Sérgio MENDES

PhD (Escola Superior Artística do Porto)

The revision of the Master Plan of the University of Aveiro: a heterogeneous planning management

Cristina RIBEIRO

PhD (Faculdade de Engenharia da Universidade do Porto)

Ontologies: technologies for domain modelling, knowledge re-purposing and knowledge sharing

Miguel SERRA

PhD (The Bartlett School of Architecture, University College London & Centro de Investigação do Território, Transportes e Ambiente, Faculdade de Engenharia da Universidade do Porto)

Metropolitan spatial anatomies: decoding the morphological structure of the city-region

João V. LOPES

PhD researcher (ISCTE-Instituto Universitário de Lisboa)

A data mining based methodology for the multidimensional study of public open spaces

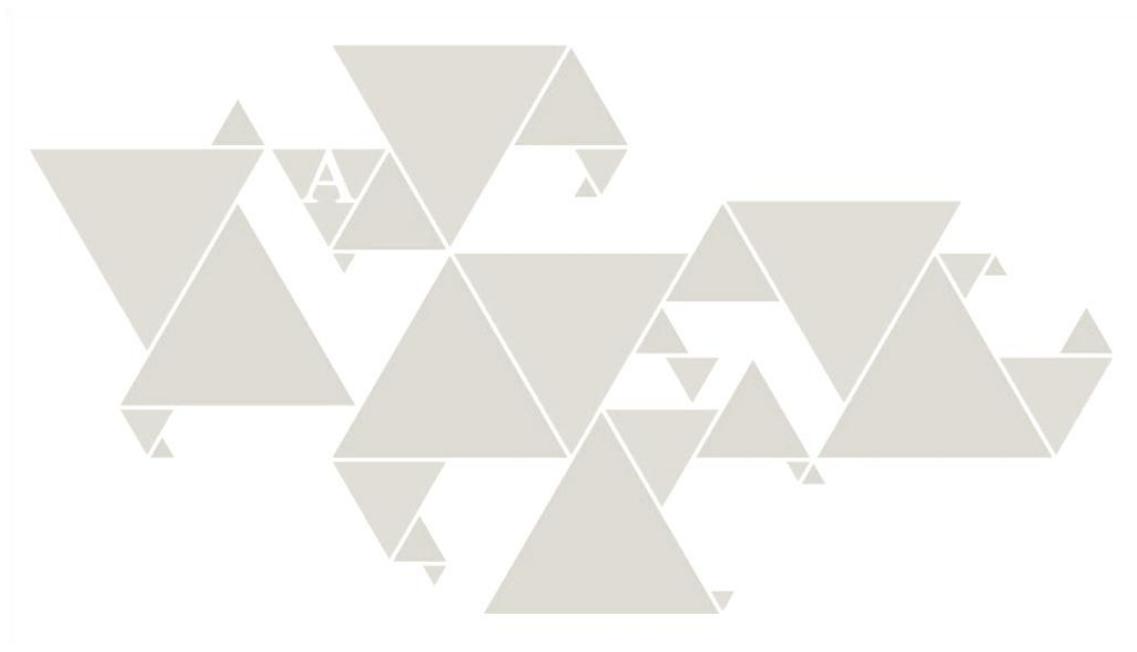
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&
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PhD researcher (Universidade do Algarve & Universidade Aberta)
A new pedestrian bridge between Vila Nova de Cerveira and Goiã

José Nuno BEIRÃO
PhD. (Faculdade de Arquitetura da Universidade de Lisboa)
Semantic structure of formal domains and methods for the development of generic grammars

Vítor OLIVEIRA
PhD (Centro de Investigação do Território, Transportes e Ambiente da Faculdade de Engenharia da
Universidade do Porto)
An integrated approach to urban form

Daniel MOREIRA
PhD researcher (King's College, University of London)
&
Luís RIBEIRO DA SILVA
PhD researcher (The Institute for the History and Theory of Architecture, ETH Zurich)
Temporal structure in music and architecture: a comparative analysis

Alexandra PAIO
PhD (ISCTE-Instituto Universitário de Lisboa)
Digital processes for collaborative answers in Architecture



FOCUS

The main purpose of the Symposium is a contribution to the debate about the application, in the disciplines of Architecture and Urbanism, of new formal methods – new methodological advances based on new developments coming from Mathematics. From the millennial geometry to current shape grammars, several formal approaches to Architecture and Urbanism were presented, with different points of view, different fields of application, different grades of abstraction and formalization. The aim was to look at the potentials and objectives of these formal methods, both those on the horizon as well as those already accomplished, their successes but also their problems. The intention was to promote the use of formal methods in the creation of new explicit languages for problem-solving in Architecture. These problems range from representation, to theory, critique, production, communication, etc., never ceasing to see Architecture and Urbanism as technological activities and well as artistic ones. The more historically established areas of application of mathematical sciences, such as traditional geometries or mathematical developments connected to engineering, were left somewhat outside the focus, without however forgetting the deep connections these establish with the new formal methods. Many of these have a level of development that requires the existence of established academic communities, with their own specialized forums. This meeting, more than an attempt to deepen each specific field, was, above all, about finding points of convergence. This is not limited to a possibly interesting abstract integration of different areas of research, but mainly to advance the multiple crossings between several methods, which fertility has already been proven. A dialogue with semi-formal and even informal methods in current use was also welcome, as a way to deepen the discussion on aesthetics and ideologies controversies that surround the possibilities and reach of a formalization of Architecture and Art.

SCIENTIFIC FIELDS

The focus of the meeting was set on scientific fields which areas of application use methodologies that stem from the mathematical sciences, especially those that have witnessed recent developments

ONTOLOGY IN ARCHITECTURE

The development of ontologies applicable to Architecture and Urbanism emerged from the necessity of finding common linguistic bases for the multiplicity of languages used by the numerous agents in the constructed environment. This is all the more necessary nowadays, as artificial agents are more and more present. These ontologies have been used as a nuclear language in knowledge-bases of constructed environments, as well as logical assistants to design, participatory GIS, automatic acquisition of urban knowledge, and interoperability between several data processing artificial agents (CAD's, GIS, etc.). Several digital tools, such as OWL, Protégé or KOne, with their origin in information technologies, are being used to create ontologies on the architectural domain.

BIM | VDC

BIM (Building Information Modelling) is an activity rather than an object, is a human activity that involves logical thinking, digital entities and a large sort of specific software, with a strong impact in building design and construction activity. The transition to BIM, however, is not a natural progression from CAD (Computer Aided Design), because it involves a paradigm shift from “drawing” to “modelling”; a virtual model consisting of relationships between entities, organized into an object-based inheritance hierarchy. Technological and market trends are good predictors of the short-term future in this field, and it is opportune to analyze and discuss how BIM will be developed in different, yet correlated, aspects like VDC (Virtual Design to Construction) and the developments in peripheral hardware linked to building, prefabrication, assemblies, functions of construction management connected to ERP (Enterprise Resource Planning), ontological and semantic searching and compatibility of BEMs (Building Entity Models) to multiple platforms, IPD (Integrated Project Delivery), automated checking for code conformity and constructability to support Lean Construction, improved import and export capabilities using protocols like IFC (Industry Foundation Classes) and parametric 3D technical catalogues from manufacture industry, the setting up and development of National Building Standards in connection with Green Building, LEED (Leadership in Energy and Environmental Design) or BREEAM (Building Research Establishment Environmental Assessment Methodology) and expanding the scope and discipline-specific BIM tools or even “light” BIM for specific building types like low cost residential houses, or small area building facilities.

CAM

Advances in computation and its use to control production machines are being applied also to Architecture, allowing the automatic manufacture of complex geometries, hardly reachable in ancient techniques and at a fraction of the cost. CAM (Computer Aided Manufacturing) and CNC (Computer Numerically Controlled) machines are enabling greater personalization, flexibility and innovation in architectural design and creative processes, providing society with new products and services.

CELLULAR AUTOMATA

‘Cellular automata’ is a term used to refer to a set of generative grammars, where multiple agents exist with identical or differentiated rules that act concurrently in the built space. The concept of cellular automata structures itself in dynamic mathematical models, with the goal of configuring processes capable of promoting self-replication. Originally it explored a set of quadrangular elements on a grid where, following a set of rules of proximity relative to each cell (cellular automaton) along the grid, growth processes were simulated, based on the logic of complex systems. Cellular automata established itself as a process that started with small elements following simple rules (bottom-up approaches). Research has been revealing a great potential in the fields of Architecture and Urbanism, as it allowed the possibility of creating dynamic patterns, through reciprocal interaction and conditions of neighbourhood between cells. They constitute patterns from which architectural and urban formal hypotheses may appear, following mathematical approaches free from traditional deterministic constraints. Usually they are implemented in digital tools for generic algebraic calculations or in parametric CAD applications.

GIS

Since their emergence, in the 1960's of the 20th century, GIS (Geographic Information Systems) – as territorial analysis and planning digital tools – are evolving to adapt to the new and diffuse means in which territory is appropriated by the information based society. Together with the traditional interlacement of diverse layers of territorial information, the contemporary information practices of geo-spatialization almost allow their complete mapping on-line, dramatically reducing the gap between production and data visualization. Furthermore, the recent 3D presentations enable a friendly visualization of complex data, approaching the common citizen to urban participatory processes. The GIS experimentation field is nowadays exploring crossings with other tools of spatial analysis, such as Space Syntax. Other new emergent tools, as processing, will be able to connect to GIS in a near future.

PARAMETRIC PROCESSES

Research on parametric processes has been tackling the evolution of different methods and technological processes, which lies in the possibility of quick visualization, construction, and modification of concepts associated with design. These systems establish a complementary relationship with generative design, where different parameters from several different components are intrinsically connected through an algorithm – in which the variables are then verified so as to be adjusted to the needs of specific results. From the initial analysis to the execution and production of final components, through the (no less important) phase of form-finding, parametric processes enable singular approaches to the set of conditions of each context. These conditions are formally framed via top-down strategies, or, conversely, using informal combinations of less structuring components as a way to promote results generated through bottom-up approaches.

PROCESSING

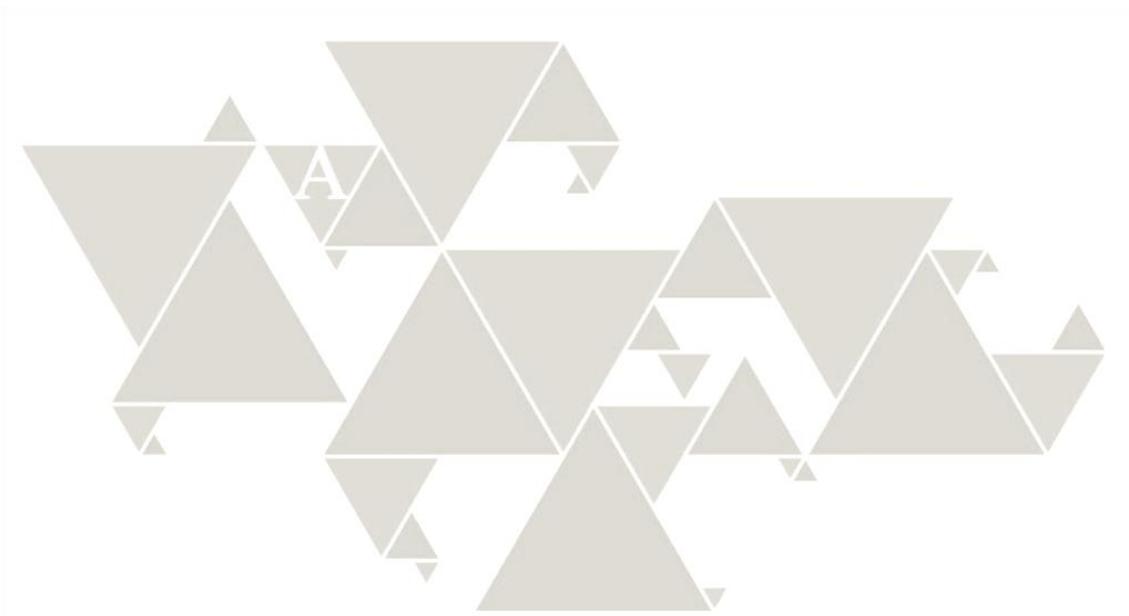
Processing is a creative programming platform (IDE/Integrated Development Environment) supported by the Java language, which assumes the purpose of combining the different programming (and increasingly diverse) areas of digital arts, through structuring of visual media applications and interactive. Having had originally educational purpose – as a tool focused on teaching the graphical component that language, open source condition – quickly encouraged the participation of growing communities, increasing its development in areas such as performing arts, kinetic arts, data visualization interactive real-time experimental architecture, among other fields of artistic creation and applied research. Particularly in the architectural perspective, there is the in-depth research to the generative level design and implementation of limitations associated with "traditional" methods – where processing approaches demonstrates its greatest potential, allowing the user (architect-developer) to define specific dynamic applications that allow putting into practice the processing conditions and complex rules in creating certain architectural objects.

SHAPE GRAMMARS

Shape grammars are technologies belonging to the broader field of generative grammars, dedicated to the production of geometric shapes. A shape grammar includes a generative algebra applied to a set of production rules. These grammars have been used in diverse areas, from technologies to the visual arts, as identifying styles of composition or as a means to refine structural elements. In Architecture and Urbanism this tool is used in history, theory, and critique (with examples like the definition of a grammar of Palladio's villas, or the formalization of Alberti's production rules), as well as on automated design, based on rules defined by the architect, or according to rules or patterns identified from case studies or established practices.

SPACE SYNTAX

Space Syntax consists of a set of theories and methodologies used for the study and treatment of building and urban space. Spaces can be geometrically defined through more or less abstract concepts: either geographic, (volumes, surfaces, axial lines, nodes), or topological (graphs and connections). These spatial elements establish simple relationships between themselves, like visibility or connectivity. It is possible to build a whole set of concepts based on this basic properties, which are usually quantifiable, like integration, depth or controllability. These quantities represent architectural and urban realities, at a physical level (such as accessibility, connectivity), at the level of cognitive psychology (intelligibility, entropy) and of sociology (privacy, control, segregation). The Space Syntax have been extensively used on multiple fields of architectural analysis, especially at an urban scale, such as traffic studies, distribution of facilities or the prediction of geo-localized demand.



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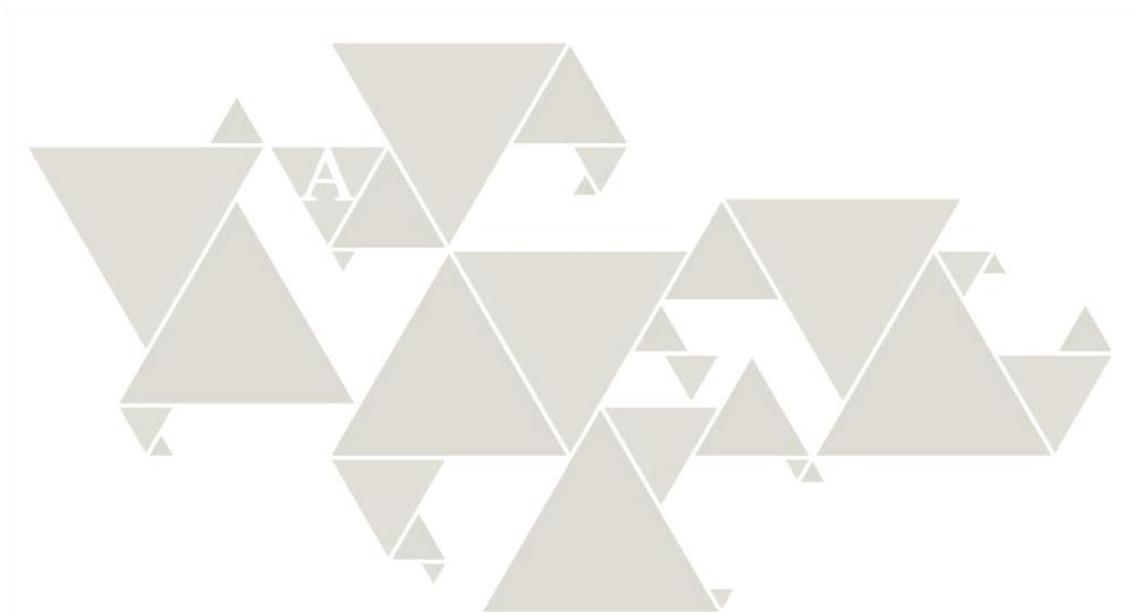
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SPEAKERS BIOGRAPHIC NOTES

(Following the presentation sequence set by the programme)

SÉRGIO MENDES

He holds a degree in Architecture from Escola Superior Artística do Porto (ESAP) and a PhD from Escuela Técnica Superior de Arquitectura (ETSA), Universidad de Valladolid (UVa). Construction's and Technologies Professor of the MSc in Architecture at ESAP since 1996. He is also a member of the Scientific Council of that School. He is the Director of the Architecture Research Laboratory (LIA), a Studies Centre from ESAP. Integrated Researcher at LIA, he develops scientific activity in the area of Construction and Technologies, and is the Principal Investigator (IR) of the project ESAP/2015/P16/DARQ, funded under the ESAP Projects 2015 competition. He is a professional architect since 1986, having held numerous projects of diverse scope, and was a collaborator of Alcino Soutinho, between 1987 and 1991. He was a finalist candidate for the National Prize for Urban Rehabilitation in 2015.

TELMO CASTRO

He holds a degree in Architecture from Escola Superior Artística do Porto (ESAP). He is a teacher at the MSc in Architecture at ESAP. He is a professional architect with awarded projects in different parts of the country, but mainly at the North of Portugal.

MIKE MCKAY

He is Assistant Professor in Architecture at the University of Kentucky, College of Design.

CRISTINA RIBEIRO

She holds a PhD in Informatics from Universidade Nova de Lisboa. She is Assistant Professor in the Department of Informatics Engineering at Faculdade de Engenharia da Universidade do Porto (FEUP) and is Senior Researcher at Instituto de Engenharia de Sistemas e Computadores, Tecnologia e Ciência (INESC TEC). She has collaborated and been in charge of research projects in the areas of cultural heritage, multimedia databases, information retrieval and combinatorial optimisation. She is currently in charge of the SAPO/Universidade do Porto extension lab at FEUP. She has been involved in teaching and curricular development in Electrical and Computer Engineering, Computer Science and Information Science programs at FEUP and has supervised 7 PhD and 28 MSc students. Her current research interests are information retrieval, digital preservation and the management of research data.

FREDERICO SILVEIRA

MArch by Escola Superior Artística do Porto (ESAP). After his graduation, he had different experiences as intern in architectural offices, including an international experience after being selected to a Leonardo Da Vinci scholarship in Spain. He is co-founder and responsible for the architecture department of the project *Ideias à Moda do Porto*, which gives him the opportunity to develop solutions that contribute to a better city, studying society and the way it interacts with its environment. He is also interested in photography (IPF) and 3D modelling and architecture (Light Steel Framing).

CATARINA RUIVO

MArch by Faculdade de Arquitetura da Universidade do Porto (FAUP). She is a PhD researcher at Faculdade Arquitetura da Universidade de Lisboa (FAUL) and had participated in competitions and worked as an architect for different architecture firms.

TASOS VAROUDIS

Dipl.Ing MArch MSc DIC PhD TEE-TCG; he is a professional architect and computing engineer with research focusing on hybrid architecture, computational analysis and interaction, long teaching experience with University College London (UCL), Architectural Association School of Architecture in London (AA), NTUA and RCA and a number of international workshops (ACM CHI, Space Syntax Symposium, NTUA). He leads the spatial and architectural computation for the Space Syntax Laboratory at the Bartlett School of Architecture where he develops methodological and computational innovations combining spatial and data-driven models with machine learning and agent-based models. He is the developer of 'depthmapX[net]' spatial network analyses software that has attracted more than 60000 downloads since its release in 2012. He is currently working on the first book on *Architecture and Interaction*, by Springer.

MIGUEL SERRA

He holds an MSc in Planning and Project of the Built Environment and a PhD in Civil Engineering – Territorial Planning and Environment; both from the Faculdade de Engenharia da Universidade do Porto (FEUP). He is Honorary Research Associate at the Bartlett School of Architecture, University College London (UCL), and a member of Centro de Investigação do Território, Transportes e Ambiente (CITTA, FEUP). His current research focuses on regional and supra-regional spatial networks, geographic information systems (GIS) and data analysis and visualization.

ANTÓN CASTRO

He is an MSc in Architecture and Town Planning student at Escola Superior Gallaecia (ESG). He is concluding his Master Dissertation on BIM and ontologies.

DAVID LEITE VIANA

He is Post Doctorate in Urban Morphology by Faculdade de Engenharia da Universidade do Porto (FEUP); Doctor in Regional and Town Planning by Instituto Universitario de Urbanística (IUU), Universidad de Valladolid (UVa); Diploma de Estudios Avanzados (DEA) by Escuela Técnica Superior de Arquitectura (ETSA), UVa. He has a Diploma in Architecture from Escola Superior Artística do Porto (ESAP). He is Head of the MSc in Architecture and Town Planning at Escola Superior Gallaecia (ESG) and university professor since 2000. He is Invited Professor of the Specialisation Degree on Collaborative Territories: Processes, Design, Intervention and Entrepreneurship, at ISCTE-Instituto Universitário de Lisboa. He is Coordinator of the research field on Territory, Environment and Urbanism at Centro de Investigação, ESG (CIESG) and Senior Researcher at Centro de Investigação do Território, Transportes e Ambiente (CITTA, FEUP). His research scope is on African cities (mainly Maputo), urban self-organization, urban morphology and formal, semiformal and informal methods in Architecture and Urbanism. He was member of the Board of Directors of Centro de Estudos Africanos da Universidade do Porto (CEAUP). He has scientific papers published in books and scientific journals and has been co-awarded, in Istanbul, with the Sir Gerd Albers Award 2006, by the International Society of City and Regional Planning (ISoCaRP). He is currently working on the first book on *(Self)Organization and Urban Form of Maputo*.

JORGE VIEIRA VAZ

He holds a Diploma de Estudios Avanzados (DEA) from Escuela Técnica Superior de Arquitectura (ETSA), Universidad de Valladolid (UVa), a Master in Architecture from the Poznan Technical University and a degree in Architecture from Faculdade de Arquitetura da Universidade do Porto (FAUP). He is a teacher at the MSc in Architecture at ESAP. He is a professional architect with projects in different parts of the world.

JOHAN VAN DER ZWART

He studied Architecture at Delft University of Technology and, after working as a researcher on Landscape Architecture, started his PhD on Building for a Better Hospital, value-adding management & design of healthcare real estate. In addition, he is studying the Master Healthcare Management at Erasmus University Rotterdam. In April 2015 he started as Post Doctoral Architecture & Health at NTNU Faculty of Architecture and Fine Arts.

TOR ÅSMUND EVJEN

He has an MSc in Cybernetics and is Project Manager at St. Olavs Hospital with responsibility for Facility Management and implementation of BIM (Building Information Models) in Central Norway Regional Health Authority. He has experience as a Research Scientist at SINTEF with involvement in international projects MNEMOS and IMS Globman. Special areas of interest are BIM, enterprise modelling, automation, 3D animation and facility management.

João V. LOPES

He graduated architect from Faculdade de Arquitetura da Universidade do Porto (FAUP), exerted since then intense professional activity on architectural and urban design of varying scales, both in collaboration as individually. Post graduated from the Course of Advanced Studies in Digital Architecture (ISCTE-IUL & FAUP), currently holds a FCT grant and is a PhD candidate in the Doctoral Programme in Architecture of the Contemporary Metropolitan Territories (ISCTE-IUL). The works of his thesis explore themes focused in the contrast between Emergence and Composition, and in multidimensional analysis, simulation and project, within the increasing widespread application of digital models to Urban Design through parametric and algorithmic design systems.

Luís ANTUNES

He has been developing his research on new design technology and digital fabrication within the Advanced Studies Course in Digital Architecture (CEAAD), a joint initiative between ISCTE-Instituto Universitário de Lisboa & Faculdade de Arquitetura da Universidade do Porto (FAUP). He explores new digital methods and architecture's tectonic.

TERESA LEITE

Teresa Leite was born in Santa Maria da Feira, Portugal. Studies architecture at Faculdade de Arquitetura da Universidade do Porto (FAUP) and made an internship at Universidade Federal do Rio Grande do Sul, where she integrated a group of research *Brazilian Contemporary House*, integrated in a national research group called "Domestic Spaces – Multiple Dimensions" certified by the National Directory of Research Groups in Brazil. Nowadays, she lives in Porto Alegre, Brazil.

ISABEL CARVALHO

She is a PhD researcher on Digital Media-Art at Universidade do Algarve (UAlg) & Universidade Aberta (UAB), a Post-Graduation degree on Planning and Project of the Urban Environment at Faculdade de Engenharia da Universidade do Porto (FEUP) & Faculdade de Arquitetura da Universidade do Porto (FAUP), a Specialization Course on Urban Management from Universidade Moderna do Porto & Núcleos Urbanos de Pesquisa e Intervenção (URBE). She holds a degree in Architecture from Escola Superior Artística do Porto (ESAP) and she is a professional architect since 2000. She is currently a researcher at Centro de Investigação em Artes e Comunicação (CIAC), where she develops digital installations on different art exhibitions and meetings.

JOSÉ NUNO BEIRÃO

He holds a degree in Architecture from the Faculty of Architecture, Technical University of Lisbon (FA-UTL). In 1998 founded the architecture firm *Bquadrado architects*. He holds a Master Degree in Urban Design at ISCTE-Instituto Universitário de Lisboa and completed his PhD in Urban Design at TU Delft, Netherlands. The theme of his dissertation is the development of design patterns for the establishment of computational platforms for urban design. In his thesis *CityMaker: Designing for Urban Design Grammars* the acronym CIM stands for City Information Modeling stressing the emphasis of information support in urban design. CI stands for City Induction, the name of the research project in which his research was involved. The model shown in the thesis is a test parametric urban design framework using information provided by Geographic Information Systems. Recent events involve the application of this model in real urban design assignments. His current research interests focus on the use of the systems developed during the PhD studies to investigate the following concepts: measuring parameters of urbanity and morphological studies; development of urban design evolutionary systems; customizable systems for social housing including actions at urban plan level; developing strategies for the Portuguese dispersed territories; design and digital fabrication.

RAQUEL MARTINS

She is an MSc in Architecture at ISCTE-Instituto Universitário de Lisboa. She is closing her Master Dissertation and her research interests focus on the use of digital fabrication, and the sort of technological tools related with it, and the social framework inherent to architecture in contexts of large scale building conditions, where prototypes has a significant role on complex constructing systems. As long with it, she explores the relation between digital fabrication and information-based-society.

FILIFE BRANDÃO

He has been developing his research on computational design methods, and their integration with digital fabrication processes, within the Advanced Studies Course in Digital Architecture (CEAAD), a joint initiative between ISCTE-Instituto Universitário de Lisboa & Faculdade de Arquitetura da Universidade do Porto (FAUP).

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He holds a PhD in Civil Engendering and he is Professor at the MSc in Architecture at Escola Superior Artística do Porto (ESAP). He is a professional engineer and researcher at Laboratório de Investigação em Arquitetura (LIA, ESAP) on Formal Methods in Architecture and Engineer.

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He is an MSc in Architecture and Town Planning student at Escola Superior Gallaecia (ESG). He is concluding his Master Dissertation and his research interests focus the relation between patterns and parametric language.

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He is a Postdoctoral Fellow, at Centro de Investigação da Arquitetura, do Urbanismo e do Design (CIAUD), Faculdade de Arquitetura da Universidade de Lisboa (FAUL).

VÍTOR OLIVEIRA

He is Senior Researcher at the Centro de Investigação do Território, Transportes e Ambiente (CITTA) da Faculdade de Engenharia da Universidade do Porto (FEUP) and Professor at Universidade Lusófona do Porto (ULP). He is an architect graduated from Faculdade de arquitetura da Universidade do Porto (FAUP), has a MSc in Planning and Design of the Built Environment (FAUP/FEUP), and a PhD in Planning/Civil Engineering (FEUP). He is a member of the Scientific Council of the Portuguese-language Network of Urban Morphology (PNUM) and of the International Seminar on Urban Form (ISUF). He is editor of the *Revista de Morfologia Urbana* and a member of the editorial board of *Urban Morphology*.

DAVID PATIÑO ÁLVAREZ

He is an MSc in Architecture and Town Planning student at Escola Superior Gallaecia (ESG). He is concluding his Master Dissertation and his research interests focus the use of Space Syntax to analyse the configuration of the Spanish city *O Poriño*, decomposing its urban form and transformation through different phases of development.

CAROLINA COELHO

She is an architect graduated from the Departamento de Arquitetura, Faculdade de Ciências e Tecnologia da Universidade de Coimbra and author of the graduate thesis: "The matter of the architect: the Portuguese society and the architect, today". Currently she is a PhD Candidate at the Centre for Social Studies, researching "Life within architecture", within the Course on Architectural and Urban Culture from DARq FCTUC. Her current research interests center on spatial experience and appropriation, space-use reciprocity, participatory design processes, user research studies and adaptability, applied to schools buildings today. Recently she has been presenting her research findings in international publications and conferences, namely in Milan (Nexus 2012 and EAEA 2013), Barcelona (Arquitectonics 2013) and London (Space Syntax Symposium 2015). She is a graduate teaching assistant at DARq FCTUC for the subjects on Theory of Architecture and the tutoring of Master Thesis.

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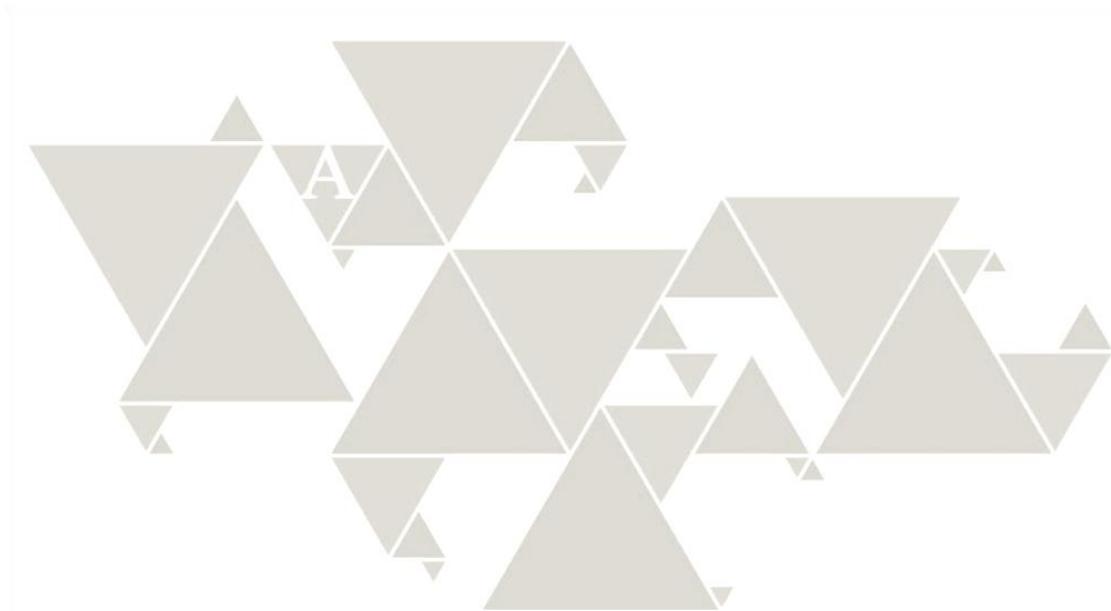
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pr01.

The revision of the Master Plan of the University of Aveiro: a heterogeneous planning management

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ABSTRACT

This paper is concerned with the physical construction of the University of Aveiro Santiago Campus, based on the direct relation of the construction of its facilities to the master plan conceived in the Centre of Studies of the University of Oporto Faculty of Architecture by a team coordinated by Nuno Portas (CEFA: The Revision of the Master plan of the University of Aveiro, 1987/89). Since this is a plan with particular characteristics - it contains only two drawings and a part of the building management was carried out without the use of formalized sketches – it interested us to take notice of the planning management process used in the campus construction. Methodologically we analysed the construction of the facilities in chronological order, always framing the relationship between plan and architecture projects. We intend to show that the planning management developed by this team consisted of a heterogeneous and diverse process, having been adopted formal, semi-formal or totally informal tools, depending on the greater or lesser need for regulation of each situation, elected according to the objectives to be attained in every moment and taking advantage of the opportunities as they have arisen. The procedure undertaken at the University of Aveiro is an important example of what is the application of a variable regulation in urban planning, and was one of, if not "the" experience, which contributed to the formulation, by Nuno Portas, of the theory on which he bases his current definition of *Urban Project*.

pr02.

From scribbling to risking

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ABSTRACT

In the novel *A Caverna*, Saramago metaphorically describes the syntax of the act of drawing: "the creators have like little brains in their fingertips." This subtle testimony reminds us of the importance of the haptic. It is also explained because drawing is, as a methodological or procedural tool of design, the recognizable holder of ideas, the referential repository of the signifying resources of intuition and perception. The meaning of these drawings emerges inevitably in construction, linearly translated into two- or three-dimensional synopses, through calligraphies that sustain and shape in the mind truths and lies about the act of drawing. For this reason, the importance of this instrumental/methodological drawing, its aesthetic manifestation, makes it the fundamental, complex clarification that evidences the integral dynamics of drawing as 'cosa mentale'. This is the basis of understanding, conveying the attractive dimensions of environment, of gesture, of perpetual questioning, of useful detail, of the contour of the spatial solution in its purposeful relationship with construction. This integrated, dimensional broadness, where "(...) each drawing becomes in itself a new element in the reality one must perceive and problematize"¹, produces change in both design and drawing, in sequential repercussion; the before, the now and the then, are interposed through overlapping or comparisons resulting from the evolution of imagination. The drawn record as clarifying language: idea, form, object, are dedicated and materialize in transformative elements of mental imagery, in correspondence with the invention of that which is obvious, with the clarification of the drawn object and its uncomfortable significance. Thus, drawing responds by approximation, "through which it is able to be a vessel for the acquisition and accumulation of numberless knowledge and circumstances of a time, images that there remain until present together, all particles likely to come together to form a new compound"². This is the evocation of drawing as exploratory design, as an articulated postponement of thought that Alberto Carneiro somehow summarizes: "(...) the subject draws the world and itself in the complexity of the succession of moments of its feeling and thinking."³ Its singularity and consistency come close to the literary process and, in the construction of knowledge, are resilience personified by "the thing that scribbles".

¹ Alcoforado, D. (2006). *Abel Salazar: O Desenhador Múltiplo*. p.29.

² Elliot, T. S. (1920). A tradição e o talento individual. In Monteiro-Grillo, J. (ed.) (1997). *Ensaio de Doutrina Crítica*. Lisboa:

² Elliot, T. S. (1920). A tradição e o talento individual. In Monteiro-Grillo, J. (ed.) (1997). *Ensaio de Doutrina Crítica*. Lisboa: Guimarães Editores, p.21-32.

³ Carneiro, A. (1995). *Campo Sujeito e Representação no Ensino e na Prática do Desenho/Projecto*, 1ª Edição. Porto: FAUP.

pr03.

Relative positioning

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ABSTRACT

How we see and understand the world is directly affected by our position in it. Constellations are simply the result of cognitive alignments related to our location in the universe. The horizon or a sunset is simply a visual construct based on proximity and time. It is possible to harness the power of position through anamorphic projection and perspectival techniques in determining a space where one can engage in a new architectural experience. Architectural illusion and perspectival deceptions have been investigated since antiquity in order to alter the perception of a given space. From the Early Renaissance these techniques have been used primarily in an illusionary or optical manner and have never been directed at the creation of physical space. Specifically, anamorphic projection techniques in architecture offer the potential to create dynamic spatial experiences that are three-dimensional and go beyond simple projections; more than images/shapes simply painted onto an architectural surface. By using this process to make space, a reading of space emerges that is both real and perceived. The forms exist in three dimensions (real, physical) but are perceived via procession and emergent perceptions. Much like the diagonal movement through Villa Savoye or the emergent space created by Matta-Clark's cut, views and alignments seek to add value, a new 'something'...a new reading of the space, a perceptual shift. The apparent flattening of space through material qualities and the formal techniques of RELATIVE POSITIONING make it possible for a duality of visual perception to occur. These tensions of object-qualities elicit a spatial ambiguity that puts pressure on the 'real' and opens up a world of wonder and excitement. We become participants in this new environment. Here it is OK to question where illusion is physical and ambiguity is desired.

pr04.

Ontologies: technologies for domain modelling, knowledge re-purposing and knowledge sharing

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ABSTRACT

The digital representation of data, while introducing complexity in human interaction, has also created the context for powerful machine-processable representations. Complexity stems from the need for machine mediation and also from the increasing complexity of data models and data formats. Such diverse information repositories as organizational databases, data streams collected from nature and product catalogues, all depend on models of data that are, in most current information systems, only available to the applications manipulating them. This opacity of data models hinders the development of new applications based on the same domain models or base data. The goal of ontologies, as part of the so-called Semantic Web technologies, is to represent not just the data on which applications are based, but the meaning of the existing relationships and their inherent constraints. This is commonly designated as domain knowledge, and ontologies aim to make it explicit and shareable between people and machines, rather than being closed in people's expertise or in the closed formats of some domain-specific representation. The information captured in ontologies can then be manipulated and re-purposed. It is intended to last longer, and be used even when the applications currently manipulating it are no longer available. Generic information can be accumulated and serve as the basis for more and more sophisticated information systems. Domain-specific knowledge can be captured in ontologies, which are refined as new concepts and more data are added. Concepts from ontology for plants, for instance, can be used in an ontology for food, which has concepts in common with a diet and disease ontology. Information collected according to such ontologies can be easily reused and power applications that would be impractical if they had to amass all the basic and specific information they actually require.

pr05.

Menarch, ontologies in Architecture: a study on Architecture social function

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ABSTRACT

Since the beginning, architecture has been described as a technical art, that connects and studies the merger between men and its environment. Every architect will say that their work affects, both directly and indirectly, subjects surrounding it, not only in an aesthetic way, but also as a presence in the everyday life flow of society. As technology evolves, so does the responsibility of architecture to deepen its concern about social functionality. Quoting Louis Sullivan, "form ever follows function", as a perfect example of the responsibilities on architects since they have the power to manipulate users and turn them into "environmental actors", we can see that there is today a further meaning, a new link between architecture and social environment. Today the way subjects connect with society and space is changed every day, as the transformation of the city is becoming more ephemeral. As we come to learn, the spatial organization is imperative to maintain and grow a stable society. Everyone needs space, as everyone wants to own and discuss space. By necessity space is now more accidental than objective as it is constantly rescued, rehabilitated and appropriated by different users and uses. This is the way that the city has found to consolidate its forgotten or disremembered universes. To build this stable social order is to give a phenomenological and accidental aspect to the environment, instead of a deliberate and intentional action. We know today that the evolution of a social culture evolves alongside the evolution of its own habitat, giving identity to its own place. This spatial order is none but less, an organized physical space that connects different activities and users, as it is also a getaway for the creation and conservation of an urban memory. Creating this outcome might seem fragile and unplanned, however it is no different than the village plans that can be observed since the beginning of the first societies. Given the opportunity and arrangements there are functionally adapted spaces being created, ready to be marked by their own ornamented skin, creating their own identity. Communication, this is the link, the new object, defining the field of architecture and the social study. In the days of digital architecture there is a lot to do in urban communication. We now have the ability to use Parametricism with the purpose of studying and envisioning the energetic patterns and variables within the function of spaces and social communication.

pr06.

Consequences of architectural form on social interaction: function as a basis for housing studies through expanded Space Syntax

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ABSTRACT

This paper is an evolution of former research on how human activities, organized by the architectural form of housing, act on the way individuals and social groups interact with each other. This research aimed to be a global vision of the evolution of housing during the twentieth century, and the development of what is an experimental basis of a formal method of analysis of Architecture which, flexible, may be adapted to new knowledge. The communication will present thirteen case studies of collective housing in Porto, between 1933 and the present day. As it isn't the understanding of a certain architectural period that is searched, but the general understanding of the design logics of housing in relation to different historical and social moments of the twentieth century, the case studies are comprehensive, both at a social and architectural level, and representative of a determined movement, initiative, or phase. They are spaced throughout the studied period and chosen from private and public promotion, as to build a representative chronology of what the architecture of collective housing was throughout the twentieth century. This is done along with the development of a methodology based on Space Syntax, expanded to integrate the architectural functions related to dwelling (seen here as existing as much in the apartment, as in the building and neighbourhood) as an attribute of analysis. The methodology explores the quantification of the relations between functions: relations of mobility – how direct the accessibility between functions is – visibility – how much a function sees to and is seen from each one and the globality of the others – and density – how much larger or smaller a function is than the others in the same social system. From these concepts of privacy and segregation can be defined, as well as others, essentials to their construction, from which we can draw conclusions about the case studies. The methodology developed to quantify privacy and segregation in housing and housing complexes was firstly based solely on two dimensions representations of space, mainly plans, and completed with resource to new software for 3d analysis, DepthSpace3D. Deficiencies of two-dimensional analysis are rectified with the present work, especially when it comes to the analysis of visual relations. These encountered severe limitations when treated with a 2D analysis, especially in the case of multi-storey buildings, and in the analysis of the integration of interior space with the outside, and a three dimensional approach allows to explore.

pr07.

Beyond the visual field: advances in thinking about and analysing space

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ABSTRACT

It's an overview of the advances in visibility graph analysis developed by Tasos Varoudis at UCL in the last couple of years. It is a proxy for an open discussion about visuo-spatial, tran-spatial and multi-dimensional thinking about space and how these complex scenarios can be analysed systematically through advance computation.

pr08.

Metropolitan spatial anatomies: decoding the morphological structure of the city-region

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ABSTRACT

The rise of the city-regional scale has brought with it the recognition of the inadequacy of urban morphology's traditional analytical methods to cope with the territorial extent of contemporary metropolitan phenomena. Indeed, those methods were devised for the study of small, contained and well-defined urban formations – typically, historical towns which had changed little since pre-industrial times – and not of entire city-regional urban systems. Despite some brave attempts to apply such methods to wider territorial scales, this general state of affairs resulted in an increasing perplexity regarding contemporary metropolitan form, and therefore in a lack of substantive knowledge on its physical and spatial characteristics. We propose that the analysis of urban spatial networks – a different field of urban morphological enquiry, of which Space Syntax is the leading manifestation – is capable of providing a way out of this deadlock. Using Oporto's Metropolitan Area as TESTBED, we show how urban spatial network analysis, coupled with unsupervised classification methods, makes possible the study, discovery and summarization of a metropolitan region's fundamental morphological structure – its particular 'anatomy', as it were – easily dealing with its entire territorial extent, while providing precise descriptions at all spatial scales (from the very local to the regional levels). Such anatomy is then summarized as a taxonomic classification of metropolitan 'places' and 'paths', derived only from the actual physical properties of the urban object itself. We conclude by arguing that this new type of morphological description may constitute the basis of a novel, form-led approach for metropolitan spatial planning.

pr09.

BIM ontologies

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ABSTRACT

Computers are changing the language and the architecture display, they are acting as a database to handle more information and be able to design quickly and accurately. Any process becomes quantifiable with a language based on mathematics. Technologies associated with BIM (Building Information Modelling) Picó (2011), Eastman (1999) represent a breakthrough for improving the working methods and the availability of several tools for the management of coordinated, cooperative and computable information. BIM makes the information to be coordinated between multiple users on the same working model, therefore it is possible: to cooperate in architecture design, to share information and to compute a model, thanks to the continuity and consistency of information. BIM is based on the ontology: explicit or formal specification of a shared conceptualization, accepted by the user community. By using a working model, formal methods to coordinate procedures prior to computational design are generated. As in urban ontologies in the development of the project Jacques Teller, Catherine Roussey, John R. Lee (2007), this cohesion of ontologies in the architecture design facilitates the development of the project, data collection and synthesising of the information. The use of BIM tools (Building Information Modelling), Picó (2011) for the creation and implementation of the project stands out in the use of computers. BIM, through its application software, becomes a new way of understanding architecture. It is a common tool of formal methods to communicate architectural knowledge. Collaboration ontology allows BIM to characterize and share a working model of managing information as a knowledge process. The search of the relationship between ontologies creates a language of understanding of the process that it is being developed to contribute to knowledge. Ontologies are contributing to the development of a common template to create a shared understanding. This creates a functional system; objects container, class organizer, interface software and information manager. Ontologies dynamically act as an organizer object of a catalogue of patterns. They facilitate the use and development of software systems for managing knowledge of a data model that uses advanced resources for the implementation of a common vocabulary, Gruber (1991). Currently, modelling ontologies are generated thanks to principles of artificial intelligence (AI), to the development of formal models of shared understanding to guide knowledge to a particular analysis of a specific area, Andone (2006).

pr10.

Data driven simulation model for hospital architecture: modelling and simulating clinical process, architectural layout and patient logistics in a hospital's Building Information Model shape

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ABSTRACT

The aging society in European countries result in an increase of healthcare demand and this is a burden for many countries in which, the amount of available healthcare professionals is decreasing at the same time. Smart organization and management of healthcare in combination with the architectural design of hospital buildings could contribute to getting more work done in a time with a reducing workforce of healthcare professionals, but this demands an interdisciplinary approach between healthcare sciences, business information modelling and formal analytical methods in architecture. There are some first indications that the use of formal methods in architecture for analysing hospital architectural floor plans can enhance architectural quality as perceived by patients and employees, but the combination with BIM as model for organisational planning of clinical processes in a building-in-use is missing in research so far. Although BIM is often used for the building-in-construction, its value for a hospital-in-use is yet to be appreciated. Therefore, this paper explores different formal methods in Architecture in order to combine meta-data of the hospital information system on clinical processes with the modelling of patient- and employee logistics and the architectural analysis of the hospital infrastructure. Aimed result is a blueprint for an integration of formal methods in architecture in the hospital's BIM in order to model both clinical processes and the hospital architecture and measure the impact of the build environment on the clinical outcomes. In future research this approach will be further developed in cooperation with the St Olav's Hospital in Trondheim (Norway). By the end of 2015, this hospital will have 350 000m² buildings modelled in BIM and will then be one of the first hospitals in the world having a virtual system for facility management based on openBIM. The perspective is that these models and analysis techniques can be used to compare clinical processes from different hospitals and test them in different architectural layout options in order to (re)design hospital infrastructure and clinical processes in order to increase both the healthcare professionals' productivity and patients' perception of healthcare quality.

pr11.

A data mining based methodology for the multidimensional study of public open spaces

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ABSTRACT

Public open spaces can only be apprehended from multiple simultaneous perspectives. Urban morphology traditional descriptive methods have recognized limitations in relating the polymorphic and polysemantic nature of these spaces' attributes, derived from the different standpoints on their formal, historical and geographic idiosyncrasies. Identities and similarities may be disclosed by multivariate statistical analysis and data mining techniques by studying the relations between formal and intangible spatial properties in a multidimensional space. In an ongoing PhD research project we outline a method for the synchronic analysis and classification of the public open spaces, departing from a corpus of 126 Portuguese urban squares, whose analysis is intended to interactively (re)define it. Part of the work done so far is presented: (i) firming the concepts, criteria and attributes to extract; (ii) adaptation and/or creation of new analytical methods and tools; and (iii) research on multivariate analysis, data mining and data visualization techniques.

pr12.

Digital tiles

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ABSTRACT

The aim of *Digital Tiles* is to make use of new design technology and digital fabrication to innovate relief tile industry. Nowadays, the relief tile production is based on old fashion methods. On one hand the manual craftsman process, on the other, the industrial mold and press process. We find these both limited and slow. They do not bind creativity and production at ease. From the beginning, the tile industry follows a strict process of four steps: prototype, mold, piece and finishing. Letting go of the old methods, Digital Tiles uses only digital methods and tools to create new pieces, specifically, computer numerical control (CNC) mill and CAD/CAM software. In other words, we skip from prototype to the finished piece. This redefinition allows us to renew the image and improve creation of relief tiles. Removing mold stages from the process, going from digital prototype to piece with an automatic and self-sufficient mechanic and digital process gets us a truer, quicker, limitless design. Digital Tiles is an ongoing research on the advancements of new digital methods alongside with architecture's tectonic. This study shows us that architecture and industry can evolve together when linking tendencies and style with new ways of doing. This paper describes the research done throughout the Advanced Studies Course in Digital Architecture (CEAAD) 2014/2105, a joint initiative between ISCTE-IUL and FAUP.

pr13.

Typological transformations in a same shape

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ABSTRACT

The paper is a critic essay about social housing currently produced in Brazil, specifically the one produced by *Grupo SP*. Part of a 25 offices list that AU-Architecture magazine considered the new generation of architects in the country; *Grupo SP* is the only with significant number of social interest projects. The paper aims to identify patterns used in the design of social housing through the study of two projects developed to competitions: "House in Luanda: Patio and Pavilion" (2010) and "Green Housing in Brasília: the situation of Vila Planalto" (2011). Therefore, all the projects go through a process of two and three-dimensional redraw in AutoCAD and Sketchup. Redrawing allows the recognition of generic shapes, and identification of pattern generators of form: geometries and proportions, plani-altimetric grids and structural modulations. It's concluded that the two works analysed start from the same base-cell, which shows to be current in the *Grupo SP* developed work. Yet the arrange of base-cell is conditioned by the edictal of competitions, results in distinct compositions and relations between public and private – Patio house (Luanda) sets up a semi-private expansion space for the house. While neighbourhood house (Brasilia) breaks the boundary between public and private.

pr14.

A new pedestrian bridge between Vila Nova de Cerveira and Goiàn

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ABSTRACT

The presentation explores the results of the Workshop on Town Planning developed within the MSc in Architecture and Town Planning at Escola Superior Gallaecia (ESG). This Workshop was an opportunity to apply the methodology '*Trac(k)ing*': tracing by tracking – a kinetic approach to two small cities in the border line between Portugal and Spain, in the North of Península Ibérica. The mentioned methodology was initially tested on a very different city, the capital of Mozambique – Maputo – during the development of the post doctoral research coordinated by Viana (2015)⁴. To test the '*Trac(k)ing*' methodology in Vila Nova de Cerveira and Goiàn was a challenge due to the scale of this two villages from Alto Minho and Galicia. The back ground of the exercise was the possibility to think about a new pedestrian bridge between Vila Nova de Cerveira and Goiàn. This is a project that is under discussion by both municipalities (Vila Nova de Cerveira and O Poriño), where the main purpose is to increase the flow of people (residents and visitors) to both villages, especially to the river banks. Both Vila Nova de Cerveira and Goiàn has an urban park related with the Minho river, but the one on Vila Nova de Cerveira has much more people using it than the one on Goiàn. Within this framework, the Workshop main goal was to understand where to set the localization of the new pedestrian bridge. Field-work was developed using a collaborative mapping conduct by Isabel Carvalho (based on her PhD research on Locative Media-Art) and including not only the participants of the Workshop (30 students and professionals) but also local residents. A digital cartography of appropriations, place perceptions and social dynamics and individual memories was juxtaposed to the "official" physical cartography of the site (using smart phones to track peoples' movements in Vila Nova de Cerveira and Goiàn). After it, the information obtained during this process was confronted with a Space Syntax analysis of the spatial system, verifying its configuration and measuring integration, connectivity, choice, synergy, etc. At the end of the Workshop, another digital tool was experimented: a graphic user interface for social behaviour simulation – under development by Tiago Gomes on his Master Dissertation at ESG. The Workshop recommendations about the localization of the new bridge are being taking into consideration by the local municipalities and CIESG is now starting to assist the project that will be prepare to apply for funding the construction of the bridge.

⁴ Viana, D. (2015). *(Auto)Organização e Forma Urbana: Combinando Diferentes Abordagens Morfológicas na Análise de Maputo*. Relatório de Pós-Doutoramento. Porto: FEUP.

pr15.

The social aspect of digital fabrication

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ABSTRACT

How can we build housing for 7 billion people?

Based on the fact that the way architects are building today gives only answer to 1% of the population needs, some architects and offices are investigating and developing prototype projects in order to answer this question. The social questions and the technological innovations of each time have always influenced and implemented new methods in the architectural construction systems: (1) the machines and the new materials of the Industrial Revolution (2) the World Wars of the 20th century with the consequent standardization and prefabrication systems; and (3) the Information and communications technology (ICT) and digital fabrication of the 21st century. Digital fabrication appeared as an answer to the new architectural challenges at the end of the 20th century. New digital tools as well as new software enabled a huge progress in the construction of audacious projects and more complex constructing systems in large scale. However, with the global economic crisis of the last years and the shrink of the construction sector in Europe and USA new possibilities were opened for the use of these new tools in order to answer the present social questions specifically in housing. In 21st century, the digital fabrication associated to an information-based-society introduced new process of thinking and building using fewer resources in a sustainable way. Thus, the use of new digital tools allows architects to develop new architectural construction systems with more sustainable materials and easy assembling systems. This can be demonstrated by three important projects: (1) MOMA – Home Delivery: Fabricating the Modern Dwelling (2008); (2) WikiHouse, Alastair Parvin and Nick Ierodiaconon (2013); and (3) 3D Print House Canal, DUS Architects (2014). The objective of this work is to demonstrate the direct relation between the tools used in each time and the social answer that architecture can give to provide housing for a large amount of population.

pr16.

Cork Re-Wall

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ABSTRACT

Developments in computational design methods and their integration with digital fabrication processes are ushering a customized fabrication paradigm. This paradigm is particularly suited to renovation of old buildings built with traditional construction techniques, a diversified corpus in which interventions are surgical and unique, and where partition walls play the central role. Insulation Cork Board, OSB and plywood, natural and renewable materials, can have an important role in a material system that responds to this context. Cork re-Wall is a parametrically modelled construction system and a file-to-factory digital process with the aim to generate high quality custom solutions that respond to diverse renovation design challenges. Cork Re-Wall parametric wall is composed of a wood frame structure cut out of OSB panels and customizable composite panels of ICB and plywood. The parametric model was developed with two purposes in mind: to simulate the system behaviour and optimize it, as well as to provide an interface for design customization and digital fabrication by an end user be it a client or an architect. This paper describes the research done throughout the Advanced Studies Course in Digital Architecture (CEAAD) 2014/2105, a joint initiative between ISCTE-IUL and FAUP.

pr17.

DepthSpace3D: a new digital tool for 3D Space Syntax analysis

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ABSTRACT

Space Syntax is a proven methodology in architectural and urban studies (A&US) that, as a very high 'numerical calculus' consuming app, can scarcely be of any use without the availability of IT tools. Nevertheless, the current available apps present limitations that prevent SS users to obtain deeper results in their case studies. A main restriction derives from the fact that almost all current apps make only 2D analysis. And when 3D is present, it is limited to axial maps altimetry. Although 2D is fairly sufficient in many cases, other situations demand 3D. Although generalized 3D analysis is the main feature of originality of the project, other features will be present, like an included editor for a generative grammar that can expand the Space Syntax lexicon to be used. Even if the intention is not to discuss Space Syntax paradigms, some fundamental concepts need revision in 3D, such as viewed / viewing spaces and interior / exterior space, so contributing to a better formalization of Space Syntax. After innovation, enablement will be the second strong word of the project. It will provide a large community with an improved tool, whose use can generate a not negligible impact in Space Syntax studies. The academic and non-commercial community will be prayed to download the DepthSpace3D app and use it at will.

pr18.

Semantic structure of formal domains and methods for the development of generic grammars

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ABSTRACT

Why and when do we need a generic grammar? A generic grammar is a compound form of design patterns encoded in the form of shape grammars each encoding recurrent design instructions within a particular design domain. A design is a particular instance of a specific grammar which is itself a specific arrangement of design patterns available in the generic grammar. A generic grammar is used to support the generation of solutions both as an exploratory tool and as a decision support tool within a design domain. This paper specifies the instructions for the development of generic grammars in a particular design domain and the instructions to develop the semantic structure of formal domains. The example of the urban design domain is given.

pr19.

From patterns to parameters

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ABSTRACT

Parametric design allows architects to define an object by the specification of the interaction of environmental forces depending of the needs of the space. Usually, computational design is used to control complex data such as insolation, winds, temperature or noise and use them to make a responsive architecture form; but in this investigation, computational methods and parameterization are used to find a relation between human feeling and topological space based on Christopher Alexander's spatial patterns. Each pattern describes a problem that occurs repeatedly in our environment, and the solution to that problem is also described in a way that it can be used a million times over, without ever doing it the same way twice. When Christopher Alexander begin to describe them in the 1970s, he used them theoretical but now, we can see that the patterns are so well defined that them can be described and used as parameters. To define parametrically, not an architectural form, but the topological relation between space and environment that solves human problems (patterns) is the target of that investigation. In that way, it could be used to start an architectural project knowing the fixed conditions to design a building in harmony with users instead of begin it thinking about form. It is interesting to see how parametric architecture is not just about bubble forms or bio morphs, but it is more about science and data control, and how spatial patterns are useful, correctable and replicable entities which avoid make architecture predictable, pre-programmed or repetitive, but that allows architects to have more control and knowledge about their projects. Finally, what we see is that computational methods in architecture allow increase complexity. The more complex the design is achieved, the closer we are to obtain a more optimized -and less left to chance- digital morphogenesis.

pr20.

A compositional schema for the automated generation of best connected rectangular floor plans

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ABSTRACT

The work described in this paper is part of a larger research aimed at developing design aids for architects to be incorporated in intelligent CAD systems. Current work is concerned with the generation of rectangular layouts. Here, we are looking for those rectangular floor plans only which are best connected, i.e., their adjacency graph must have maximum number of edges that is equal to $3n - 7$ where n is the number of rooms. Generating best connected floor plans is important because, most likely, the adjacency graph of a floor plan solution to a given architectural problem is a sub-graph of the graphs of the best connected ones. As such, in this paper, we propose an algorithm, which automatically generates best connected rectangular floor plans with extra spaces. The extra spaces can be seen as corridors, terraces, garden, parking space etc. Also, we propose some optimization techniques to reduce the size of extra spaces present inside the best connected floor plans.

pr21.

An integrated approach to urban form

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ABSTRACT

The diversity and complexity of the physical form of cities is reflected in the variety of morphological approaches to cope with it. Researchers and practitioners dealing with specific urban form problems are often faced with the need to select between different approaches without much knowledge of their main strengths and weaknesses. Four different morphological approaches are compared: Space Syntax, historic-geographical, process typological and spatial analytical. In particular, the use of four fundamental concepts proposed in these approaches is explored: spatial configuration, morphological region, typological process, and cell. The four concepts are applied in a traditional gateway area of the city of Porto, the Rua de Costa Cabral. The area contains considerable morphological variety, including continuous building frontages, broken frontages of single-family housing, and areas of isolated buildings. The main points of contact between the different concepts and approaches are identified and a general methodological procedure is outlined. The main purpose is to understand how to combine and co-ordinate these four concepts in an integrated approach so as to improve our capacity to describe, explain and prescribe the physical form of cities.

pr22.

Industrial heartbeat of O Poriño

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ABSTRACT

The presentation is about an ongoing research that is being developed at ESG within the framework of the final Master Dissertation. It focuses on the roots of the city of O Poriño, its configuration, spatial structure and, mainly, the role of the industrial core into the transformation of the urban tissue. Using space syntax analysis it will be compared different phases of development attached to specific periods that had more impact on the consolidation of the spatial system. Taking into account different plans that were set to guide the urbanization of the city, the goal of the research is to frame a hierarchy of networks that will be able to accomplish better levels of overall integration, segregation, connectivity, accessibility and interdependent dynamics between the different parts that compose O Poriño. Seeking for the relational interconnections between space and social fluxes, the expected results of the research will set a quantitative overlook of the urban activities that are predominant there. After it, a correlation between this and a qualitative perception of the city will increase the knowledge about O Poriño works, not only at a local level, but also at a regional scale. Using axial maps and segment maps comparative analysis, one can establish the relations between the several morphological elements that assemble O Poriño urban form.

A gathered methodology: towards enhancing adaptable learning spaces

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ABSTRACT

The contemporary learning experience contemplates formal and informal activities occurring in formal and informal spaces in the school. Activities such as individual discovery, group work, formal classes, group presentations, evaluation moments and general conferences, besides socialization and peer interaction (both in scheduled events during classes, as well as in spontaneous meetings decentralised from the classroom), all represent moments of a thorough learning experience. Thus, each of these activities implies specific spatial features, which will have to be accounted for in the existing and future educational buildings. In fact, today's schools bear mixed curricular options that add further complexity to the design. Accordingly, adaptable learning spaces accommodate a more extensive range of activities and users, which are able to cope with curricular, technological and social changes in a long-run, by lessening the frequency of future interventions in the built object due to its pre-perceived provision in the design. Hence, by acknowledging the relevance of adaptability for educational spaces, this paper presents a methodology to identify adaptability for this particular brief. As suggested, if the learning experience takes place in distinct spaces, this methodology will also consider a crossing of methods, in order to deliver quantitative and qualitative results on both spaces' formal and informal features. A Space Syntax analysis plays a critical role, as it focuses on spatial morphology and the concepts of integration, depth, connectivity, visibility and ultimately intelligibility. This will provide conclusions on the implications of spatial placement towards patterns of natural movement and activity and users' clusters. Besides, this method can be undertaken on convex spaces as individual entities, as well as on a topological relation of spaces by axial lines. In fact, the latter is most significant, as it extends the learning experience towards the whole spatial layout, crossing formal and informal spaces and assuming the school as a whole spatial system. These conclusions when associated with qualitative methods such as: walkthroughs, focus groups and observation matrices, depict individual experience and spontaneous appropriation, adding information on the adaptability potential of spaces for non-scheduled learning activities. Moreover, when paired with mathematical entropy calculations for each space, conclusions can be achieved on its quantitative allocation potential, assuming that higher entropy implies a more adaptable space. Conclusively, this paper will develop a comprehensive and gathered methodology for enhancing adaptable learning spaces, by converging outputs from proven yet distinctive methods of spatial assessment into an original and contemporary approach.

pr24.

Temporal structure in music and architecture: a comparative analysis

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ABSTRACT

"Music unfolds in time. Time unfolds in music". (Kramer, 1988, p. 1)

Thus starts Jonathan Kramer his groundbreaking book "The Time of Music: New Meanings, New Temporalities, and New Listening Strategies". Unlike other works on musical time, which deal only with the (more easily quantifiable) issues of rhythm and metre, this book also discusses the (less tractable) issues of motion, continuity, progression, pacing, and proportion in music. Drawing from a basic distinction between linearity and non-linearity, Kramer presents a typology of five musical temporalities — directed linear time, non-directed linear time, multiply-directed time, moment time, and vertical time — claiming some of them to be typical of particular musical cultures or historical periods (tonal music, for instance, is the quintessence of directed linear time). This typology formalizes one of the most fundamental aspects of music (if not the most fundamental). This paper — co-authored by a composer and an architect — shows that Kramer's typology can be applied not only to musical but also to architectural works. This is done by means of a (brief) comparative analysis of examples of directed, non-directed and moment time in each of the two arts (by Bach, Webern, and Messiaen, in music; and Le Corbusier and James Stirling, in architecture). Interesting (and perhaps non-obvious) parallels between music and architecture are thus revealed.

pr25.

Graphic user environment for agent based modelling and simulation

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ABSTRACT

Agent-Based-Modelling (ABM) is at the core of this research within the Master Dissertation at ESG's MSc in Architecture and Town Planning, where emergence of complex systems sets its background. This type of method has been used for decades in several fields to analyse all kinds of complex data from weather forecasts to pharmaceutical purposes. As technologies and computers progress the ability to regulate interactively large portions of data increases. The paper will focus on developing new insights and understanding the process of conceiving emergent architecture using Agent-Based-Modelling (ABM) to capture the complex network of interactions and connections that create systems and make it possible to visualize emergent patterns and unexpected changes and events that otherwise would be too intricate to perceive. The main motivation behind this research is the lack of easy access to tools which can produce results that an architect can use in on a first approach to the project, creating software capable of producing these results became the main goal of this dissertation early on. The main potential of this process is the ability to respond to the many variables in the design of an object, architectural or otherwise, and the dynamic control of these variables in real time as well as the analysis of the results it produces. It is essential in this type of research, have the notion that space is not just a static model but a dynamic one and is constantly changing and since its inception, and, therefore, treats it as such. Graphic User Interface for Social Behaviour simulations is just that, a sandbox that allows such dynamics and experimentation to be tested, from its root, to its results. The main objective is to use this graphic tool for simulating the emergent social behaviours in complex systems like our cities however it can be used as a platform for speculative form-finding if we use a different approach. In order to analyse certain behaviours of a specific social space one must create a system capable of planning complex, constraints-based behaviours for an agent to operate in that environment. Real-time controllers act as regulators to control complex requirements that describe an infinite number of emergent behaviours.

pr26.

Casa da Música' (non)place: between global and local

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ABSTRACT

The notion of "non-places", defined by Marc Auge, and the "liquid" diagnosis, established by Zygmunt Bauman, set the start of a this research within the Master Dissertation at ESG's MSc in Architecture and Town Planning, that seek to analyze the capacity of a topological space, such as the surrounding of Casa da Música (2005), to generate a particular emergent condition, feature from the non-linear phenomena. Specifically, the construction of urban "places" owes its roots to the cognitive creation by all citizens that walks and interacts over a space. This makes it a complex phenomenon (non-linear), because it cannot be defined from the dissection of the cognitive units that constitutes a "place". Within daily pedestrian fluxes along the area of Boavista (Porto), immediate surroundings of Casa da Musica, the specific study area represents an exceptionality in terms of urban patterns; reason why the research focuses on this spot of the city. The work tends to approach this space from the analysis of the current reality, through various time-lapses, capturing pedestrian fluxes in different months of the year. Afterwards the research seeks to explore this space over a virtual environment, through Agent-Based (AB) simulations, with the purpose of register complex networks of interactions and connections that set up the system installed in the area of study, hence identifying agent-based emergent patterns such as unexpected changes and events, what could contribute to the cognitive construction of the place of Casa da Música.

pr27.

Inserting new technologies in architectural curricula: from research to practice, and to teaching

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ABSTRACT

The presentation will describe research carried out with the aim of overcoming the paradox created by mass customization through the use of new technologies. Attempts to solve the problem led to the development of new design methodologies, which in turn led to the use of computer technologies. The presentation will describe the initial research carried out to allow the mass customization of housing, then address other systems developed within professional practice, continue with the presentation of curricular tools for the teaching of computer-based design methodologies, and finish with a short presentation of a series of research projects and graduate work that apply and extend such methodologies, including City Induction, Digital Alberti, and Tecton 3D.

pr28.

Digital processes for collaborative answers in Architecture

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ABSTRACT

In nowadays architecture is in the process of transformation confronted with technological change. Around 98% of the planning, calculation, optimization is based on digital data. This is revitalising the architectural involvement with sources in material practice and technologies. Along with this comes a more and more direct line between the computational design process and physical implementation. CAD-CAM techniques and consequently direct programming gives architects total control over construction process. Additionally, the combination of rapid advances in digital tools with the emergence of social movements for collaboration can play a crucial role in solving some of the challenges presented to urban society. Some of the answers are coming from various fields – sociology, architecture, management, etc. – linking concepts such as participation, inclusion, interaction, collective construction. Social inclusion and entrepreneurship are found on the close relation between population universities and municipalities, with a view to explore synergies that can allow richer innovation processes, as well as an application of solutions at different scales. The answers become progressively by interdisciplinary teams and the use of new digital technologies for planning, generation, simulation and fabrication. It is in this context that is proposed a different architectural approach to digital technologies and social development.

pr29.

Innovation and tradition: crafts in digital age

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ABSTRACT

The presented proposal builds on the idea that engagement between advanced digital manufacturing methods and traditional, raw material enables creation of wide range of novel solutions, applicable in both architecture and design. This conviction arose from our research on cork and cardboard, developed under CACO brand, where we explore new applications of mentioned materials using digital form finding and Computer Aided Manufacturing for its fabrication and design. CACO brand and investigation project builds on the belief that architectural material and formal investigation can contribute to product design improvement and conversely. The disciplines of architecture and product design, although clearly separated, came into interaction several times in the history. Probably the strongest moment of an architect as a multi scale creator are the times of the Bauhaus school, which aimed for architecture strongly integrated with other disciplines of art, design and industry. Our explorations stay in line with a modern objective of reuniting creativity and manufacturing. On the contrary to the popular technological fear, we take an advantage of contemporary digital tools that enable a close-up between architect and manufacturer, more than any time before. Moreover, just as in a traditional craftsmanship, usage of robotic fabricating equipment demands great sensibility and knowledge of material. Consequently usage of advanced fabricating techniques leads to reintegration between architecture, design and manufacturing craft, rather than to substitution of one of them. Caco pieces have their common origins in original interior design of low bar in Bairro Alto (Lisbon, 2010), where we first explored an organic, ergonomic piece in a big scale, created and constructed using CAD CAM tools. They permit high control of the design results, quick, continues changes introduction and almost immediate preparation of documentation for prototyping and production. We are using the 3D modeling in Rhino environment for an initial form finding. Further development and prototyping is performed cooperation with manufacturers that vary depending on the material. Some of the forms are tested in both cardboard and cork, that results in closely related pieces, different in the character due to its materiality. Proposed study is a critical analysis of conducted explorations and its results. Following Cross's (2001) statement that design is a genuine way of knowledge production, we take a look back on the preceding investigation focusing on defining our place as multi scale architects in the context of undoubtedly influential digitalization of design and manufacturing tools.

pr30.

New territories of CAM: Machinecraft

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ABSTRACT

The presentation intends to reflect on the subject of robotic manufacturing and to highlight new development paths for computer aided manufacturing in the field of architecture. This issue will be addressed on two discourse levels. While the first level discusses the theoretical-philosophical framework behind architectural robots, the second investigates resulting methodological implications on an applied research project. The attempt to redefine the status of the machine in general, and specifically of robots and self developed robotic systems, seeks to illustrate the robot as an active design agent.

pr31.

Rethinking conceptual design: methods for the simultaneous integration and evaluation of tower subsystems

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ABSTRACT

The research presented in this paper formulates the key areas of the methodological approach and evaluation methods of a recently completed PhD thesis. The principal argument is the demonstration that the initial phases of the long and complex chain of design development can be shortened by the designer working in the computational environment of a typical laptop, and utilising mainly free open source software. The design domain is the Tower, and the focus is on developing a generative system of design that offers simultaneous integration and differentiation throughout the subsystems of a concept for a tall building during the conceptual design phase. As such, the research focuses on the incorporation of the functional parameters of the tower system with principles of biological models in order to propose computationally generated dynamic systems for the tower typology. In this framework, the tower subsystems are grouped as the structural system, floor system, vertical circulation system, façade system, and environmental system.

pr32.

BIM: customizing the standards

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ABSTRACT

BIM affiliated software is gradually gaining popularity. Offices in different countries have developed specialized teams to work in a BIM framework in order to deal with the complexity of gathering and managing building information. The paper aims to address a key area in relation to the growing implementation of BIM in current practices. If we successfully manage to reach universal BIM guidelines and procedures for design & built projects, hence the constant implementation of building standards, what would prevent the standardization of the profession and potentially the gradual levelling of the architectural design? The question entails how a well-defined system of standardized processes for design & build projects may be practically applied in offices which are characterized by their bespoke design and workflow. This paper will discuss and evaluate the customizing of the standardized BIM approach in the architectural field worldwide. While the term BIM (Building Information Modelling) has been in use since 1970's, its' practical implementation took place almost two decades later and is still in the process of maturing. In the race of becoming excellent in design software it is crucial to preserve one's ability of communicating the design intent beyond the technical obstacles that one had to overcome. Therefore, all major and detailed aspects of Level 2 BIM projects require a commonly agreed execution plan. It is imperative to establish clear and complete protocols and guidelines before one embarks on implementing BIM on architectural projects. Compared to the enduring battle between computer aided design and hand drafting, the argument for BIM implementation has to surmount an even greater series of deep-rooted and often archaic work methods and dispositions. This involves educating equally the office colleagues, the different consultants and clients. The task of bringing clients, consultants and colleagues in agreement requires a certain level of communication skills beyond the technical knowledge. Lack of communication and miscommunications can often cause various project delays and difficulties. Therefore it is necessary that all BIM standards which are to be implemented are well established at the beginning of every project. In this regard it is equally necessary to provide all possible information to the client in order to create a healthy working relationship. This also helps to establish a clear understanding of the different stages of the project; it can provide insight for future project parameters and needs as well as set and manage expectations.

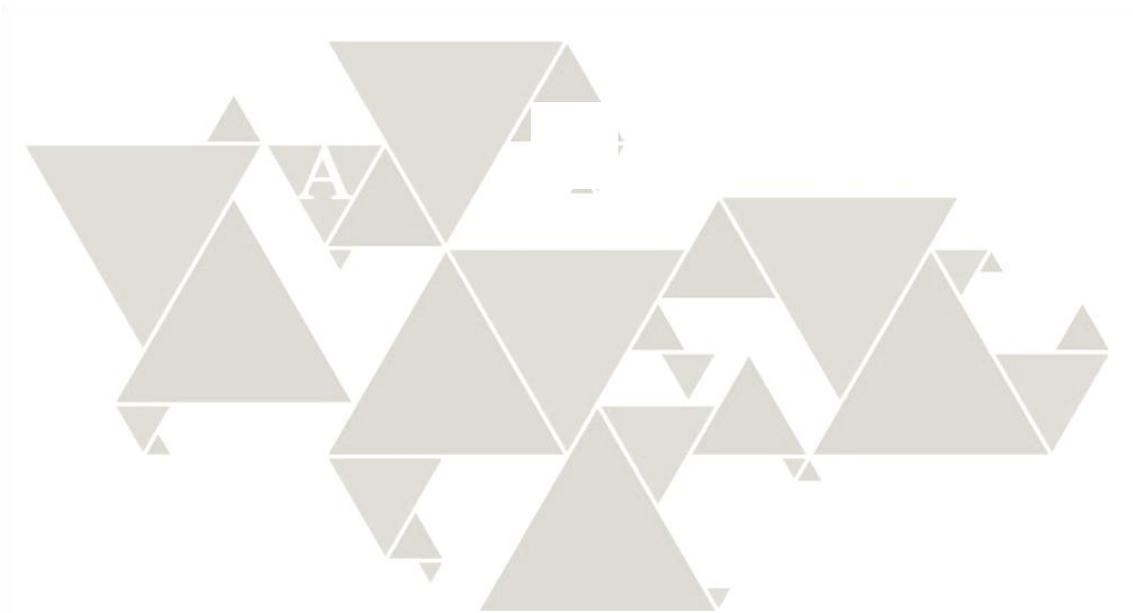
Regular repetition and modular patterns in Architecture

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ABSTRACT

Throughout history, from antiquity to the present day, we can find numerous examples of buildings based on repetition (such as basilicas, palaces and Roman buildings, Kasbah cities, Arab mosques, Christian churches, shipyards etc.) But it is from the mid-19th and early 20th centuries, with the constructive possibilities derived from technological advances and innovation in new materials and their constructive possibilities, when repetition can be considered as a conscious project methodology. Its industrialization, spirit and universal sense made the Modern Movement revolution possible. The challenge of this architectural project lies in the search for formal, pragmatic and experimental strategies, that can, in an artificial way, adapt to the reality of constantly changing external conditions, to ultimately allow time to intervene as designer. The morphological patterns on which this paper are focused are based on the regular repetition of a structural or functional module, which through its own formal and constructive features allows the establishment of domestic laws and strict growth, which gives the whole system condition. It should be noted, that it is not always the module that generates the grid, but sometimes other factors come into play, such as conformational standards, functional requirements or spatial hierarchy, i.e. the system which sets the order and the manner by which it governs the pattern. This is the only reason for the module, and so in these cases, the module autonomy and its visual recognition disappear entirely, fading in the continuity and sequence pattern. This initial analysis helps to make a first classification: Simple Repetition System, based on a regular module repetition to generate the grid; or Complex Repetition System, based on a pattern which is the only reason for the module. This differentiation will be investigated in this paper, studying its evolution and modeling, through analysis of architecture that is deemed most representative.



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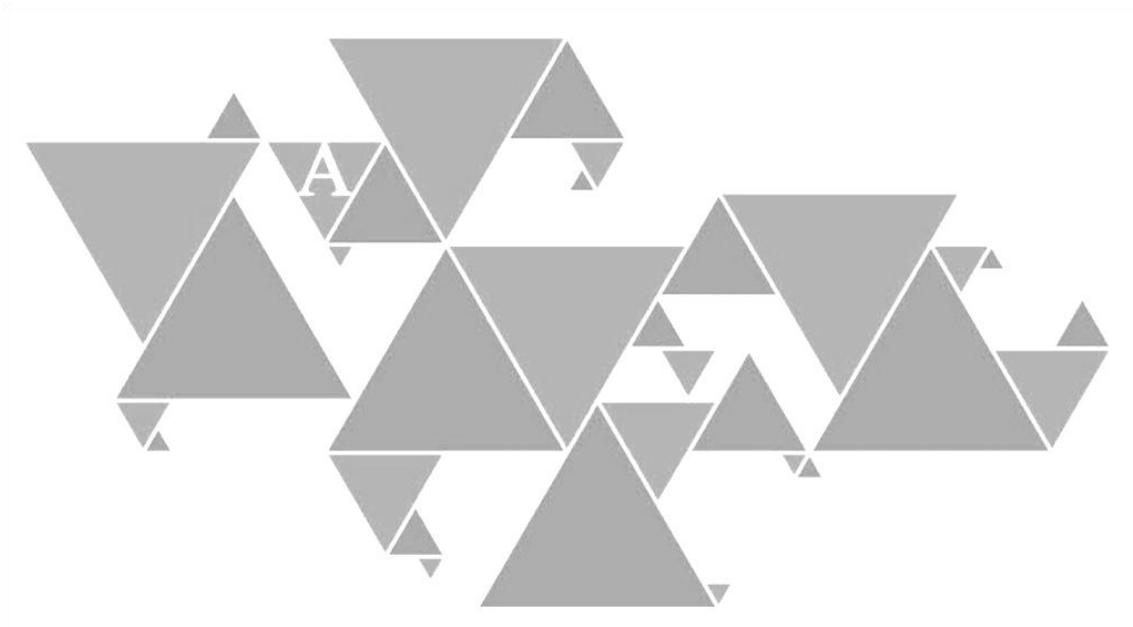
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