

LECTURE SERIES  
DIGITAL DESIGN LITERACY

# THEODORE SPYROPOULOS

Director of the Architectural Association's  
Design Research Laboratory,  
Director of Minimaforms



## BEHAVIORAL AGENCY

Behaviour will be discussed as a generative model for architecture embracing an intimate engagement between social and material interaction. Architecture within this framework examines a scenario based form of operational research that shifts our understanding of the world from the fixed and finite to one that is dynamic and evolving. Models of interaction are constructed that look towards population based scenarios that challenge a system to accommodate and respond to evolving characteristics of the human environment. The lecture will cite a historical perspective that underlies this agenda for architecture and present supporting work developed at the AADRL and Minimaforms.

Theodore Spyropoulos is an architect and educator. He is the director of the Architectural Association's world-renowned Design Research Lab (DRL) in London. He has been a visiting Research Fellow at MIT's Center for Advanced Visual Studies working with the Interrogative Design Group, and he cofounded the New Media Research Initiative at the Architectural Association. Theodore has taught in the graduate school of the University of Pennsylvania, and in the Royal College of Art, Innovation Design Engineering Department. Previously he has worked as a project architect for the offices of Peter Eisenman and Zaha Hadid Architects. He has studied at the AA, Bartlett School of Architecture and the New Jersey Institute of Technology. He directs the experimental architecture and design studio minimaforms with his brother, Stephen Spyropoulos. Recent projects include a series of thematic landmarks for a Renzo Piano master-planned national park in Athens; a large-scale work of Land art in Norway; a vehicle in collaboration with the artist Krzysztof Wodiczko; and an immersive participatory environment for the city of Detroit. The work of minimaforms is in the collections of the FRAC Centre, Orléans, France; the Signum Foundation, Poznań, Poland; and the Archigram Archive, U.K. In 2008 their project Memory Cloud was named one of the top 10 international art installations by the Telegraph.

The firm has recently exhibited its work at the Museum of Modern Art, New York; the Detroit Institute of Arts; the Institute of Contemporary Arts, London; FRAC Centre, Orléans, France; Futura Gallery, Prague; Slovak National Gallery, Bratislava, Slovakia; the Architecture Foundation, London; Arco, Madrid; UTS: Gallery, Sydney; and Palazzo Donà, Venice.

# FABIAN SCHEURER

Dipl.-Inform. (Univ.) SIA,  
Partner/CEO DesignToProduction



## BUILDING COMPLEX DESIGN

The firm DesignToProduction supports architects, engineers, and fabricators to plan and produce complex architecture with digital tools. By extracting the underlying rules of the design, translating them into mathematically precise parametric models and matching them to advanced digital fabrication methods, the Swiss/German team of computer-scientists and architects helped building architectural landmarks like the Centre Pompidou Metz or the Mercedes Benz Museum in Stuttgart. Fabian Scheurer, head of the Zurich office, is presenting recent projects and insights into the workflow from design to production.

Fabian Scheurer (born 1969 in Munich, Germany) is founding partner of designtoproduction and leads the company's office in Zurich. After graduating from the Technical University of Munich with a diploma in computer science and architecture, he worked as assistant for the university's CAAD group, as software developer for CAD-provider Nemetschek, and as new media consultant for Eclat in Zurich. From 2002 until 2006 he studied the use of artificial-life methods in architectural construction as a member of Ludger Hovestadt's CAAD group at the ETH Zurich and managed to transfer the results to a number of collaborative projects between architects, engineers, and fabrication experts. In 2005 he co-founded designtoproduction as a research group at ETH to explore the connections between digital design and fabrication. At the end of 2006 designtoproduction teamed up with architect Arnold Walz and became a commercial consulting practice, since then having implemented digital planning and production chains for projects like the Hungerburg-Funicular in Innsbruck (by Zaha Hadid), the Rolex Learning Center in Lausanne (by SANAA), or the Centre Pompidou in Metz (by Shigeru Ban) and many others. Fabian Scheurer has taught as guest lecturer/tutor at the AA in London and the IAAC in Barcelona. Since 2012 he is lecturer for Digital Modeling and Production at HTW Chur (Switzerland).

## FRANCIS AISH SAM JOYCE

Francis Aish,  
Partner, Head of Applied Research  
and Development, Foster + Partners  
Sam Joyce, Design Systems Analyst,  
Foster + Partners



### HUMAN INTUITION COMPUTATIONAL RIGOUR

Francis and Sam will describe the work of the Applied Research and Development team at Foster + Partners. Through project examples, they will show how integrated design teams can combine human intuition and computational rigour to generate performance-driven design options, and suggest optimal solutions.

Francis Aish is a Partner and Head of Applied Research and Development at Foster + Partners. He studied Aerospace Systems Engineering at the University of Southampton, and is currently completing an Engineering Doctorate at UCL. He joined Foster + Partners in 1999, and is responsible for the research and development of systems to model and solve complex, multi-disciplinary design problems. In the course of this work he has been involved in over 200 projects and competitions, including the Swiss Re HQ, the Smithsonian Institution, and Beijing Airport.

Sam Conrad Joyce studied Structural and Architectural Engineering at the University of Bath before joining Foster + Partners in 2008. He then pursued an industrial doctorate in systems with Bath and Bristol Universities supported by Buro Happold. He has since returned to Foster + Partners as a part of the Applied Research and Development team, with a particular focus on the progressive integration of engineering and architecture via computation. His ongoing doctoral research covers design systems, optimisation and explores ideas in cybernetic feedback and control as well as open-ended strategies for computational design innovation.

# RALPH BÄRTSCHI

Dipl. phys., Dr. sc. math.



## DIGITAL MATERIALITY IN ARCHITECTURE

The thrust of digital advancement in design and manufacture has changed architecture. A Digital Materiality is emerging, where the interplay between data and material can be seen as a constructive structuring of architecture. This extensive collaboration can be analytically developed and implemented on an architectural scale, leading to new forms of architectural expression and material sensuality. Against this background, the lecture will consider the hegemony of digital fabrication and the avatars of robotic manufacture in architecture. It will address the digital border crossing between the digital and the material and consider various project and contexts.

Ralph Bärtschi studied physics at the university in Zurich and received a PhD in mathematics at the ETH Zürich for a rigorous proof in the field of many particle physics. He then worked for several years as a software engineer mainly in the field of GIS systems for acoustical noise treatments planning. Since 2006 he works for the chair of Gramazio & Kohler where he was involved in most of their projects for CAD and robotic software development. He is cofounder of the company ROB Technologies AG which brings new techniques of digital fabrication to the market.

# CLEMENS PREISINGER

Dipl. Ing. Dr. Techn.



## MAKE YOUR FORCES DANCE PARAMETRIC STRUCTURAL MODELING WITH KARAMBA

Nowadays highly complex architectural designs are possible by using parametric approaches. Tools like Grasshopper – a plug-in for the popular modeling program Rhino – allow to define the logic behind an intended design. This enables one to easily adapt and optimize it. Karamba is a Grasshopper plug-in for structural simulation based on the finite element method. Like Grasshopper it works interactively. One can instantly see how changes in the geometry affect structural performance. A short introduction into the main building blocks of a Karamba model will demonstrate how it interacts with parametric designs. Several examples will be presented that show how Karamba was used in the early design stage of architectural projects.

Clemens Preisinger, PhD. Bollinger-Grohmann-Schneider Engineers; Karamba. Clemens was born in Linz, Austria and is a structural engineer. After finishing his academic studies at the Technical University Vienna he worked as a research assistant at the Institute for Structural Concrete at the TU Vienna. This four years term at the TU combined research activities and lecturing and resulted in a PhD-thesis with the title 'Numerical and Experimental Investigations Regarding the Transformation of Flat Slabs to Double Curved Shells'. From 2006 to 2008 he worked as an engineer in a civil engineering office with its main focus on underground engineering and bridges. In 2008 he changed to Bollinger-Grohmann-Schneider an engineering office with its main activities in the field of structural design. From 2009 to 2010 he has been a project assistant at the University for Applied Arts and has contributed to a project with the title 'Algorithmic Generation of Complex Space-frames'. Since 2010 he is developing the parametric, interactive finite element tool 'Karamba'.

# CARLOS DE LA BARRERA

Ph.D. Architect



## GENETIC ALGORITHMS AS A DESIGN STRATEGY IN ARCHITECTURE, FROM THE RESEARCH TO THE PRACTICE

Genetic Algorithms (GAs) were invented by John Holland around 1960 and 1970. GAs are based on Darwin's natural selection, that suggests the environment can encourage or discourage the reproduction of organisms depending on their characteristics. The descendants of the organisms inherit some of their characteristics and properties that determine their adaptation to the environment. Therefore, the less organisms fit have fewer options to survive than the most. Iterate this process is what is known as evolution of species. A GAs works evolving a randomly population of candidates for a problem. Then each individual in the population is evaluated and sorted depending on its outcome. The fittest (best rated) will have more options to crossover than less. Therefore its digital DNA will spread more quickly through the population. Because of this, the population average result improves with each generation. The lecture will focus in a series of Genetic Algorithms applied to different scales of architecture, explaining the translation from the research to the practice.

Doctor Architect Carlos de la Barrera is graduated from of U. Mayor (Santiago de Chile, 2003). He finished his master's degree in a research area called "Genetic Architecture" at the ESARQ-UIC (Barcelona-2004) holding a Diploma in Advanced Studies in June 2006, Being evaluated with the highest distinction. His Ph.D. explored the generation and optimization of forms trough computational algorithms based on strategies of biological evolution. The title of his Ph.D. thesis is "Genetic Algorithms as Architectonical Design Strategy", and was evaluated with Cum laude degree at UPC Barcelona. Carlos has been taught at the Superior School of Architecture of Porto (ESAP), Institute for Advanced Architecture of Catalonia (IaaC), Elisava School of Design, University polytechnic of Catalonia (UPC) and University Polytechnicof Madrid (UPM). Currently, Carlos is associated professor at IE School of Segovia and is the head of the computational geometry group at IDOM-ACXT in Barcelona.

## OLIVIER BERNARD NICOLAS LEDUC

Engineers and Architects, RFR

CONSTRUCTIVE GEOMETRY  
INNOVATIVE GLASS AND  
STRUCTURAL DESIGN



The refurbishing project of the Eiffel Tower's first floor will be put into perspective thanks to the overview of key projects which were carried out at RFR. Geometrical, technological and structural aspects will be presented transversally in order to provide a global view of the technical design of this non-standard geometry project.

Nicolas Leduc studied structural engineering at Ecole Spéciale des Travaux Publics in Paris where he graduated in 2001. After this graduation, he completed architecture studies in 2006 in Ecole Nationale Supérieure d'Architecture de Paris-Malaquais where he now teaches structure, geometry and scripting. For eight years, he works at RFR as a specialist in analysis and optimization of non-standard complex skins and structures. He takes part in technical development and construction aware geometry design of skins and supporting structure of complex facades such as the glass sails of the Louis Vuitton Foundation.

Olivier Bernard is specialist in engineering of steel, glass and concrete structures: general conception, technical and architectural, advanced 3D modeling, finite elements calculation, exploration of complex geometries for structural optimization.



## SEAN HANNA

Lecturer in Space and Adaptive Architectures,  
Course Director: MSc/MRes Adaptive Architecture  
and Computation,  
Academic Director: EngD Virtual Environments,  
Imaging and Visualisation.



### ADAPTIVE ARCHITECTURE AND THINKING MACHINES

The computer is not just a representational tool. Allowing for some speculation on the future of the industry it is becoming possible to see a role for computation that takes quite a different approach: not as a drawing board but as a mind. This lecture presents several projects from the Bartlett in the context of how we use machine learning, generative algorithms and similar technologies to adapt to changing and complex environments, deal with uncertainty, and make sense of scales beyond our intuition.

Sean Hanna is a Lecturer in Space and Adaptive Architectures at UCL, director of the Bartlett Graduate School's MSc/MRes programmes in Adaptive Architecture and Computation, and academic director of UCL's Doctoral Training Center in Virtual Environments, Imaging and Visualisation. Prior to academia, his background is in architecture and design practice, in which his development and application of design algorithms includes major projects with architects Foster + Partners and sculptor Antony Gormley. His current research is primarily in developing computational methods for dealing with complexity in design and the built environment.

# LEDA DIMITRIADI

Assistant Professor ENSAPM



## ECUMENOPOLIS: LEARNING FROM UTOPIA

Constantinos A. Doxiadis (1913-1975), author of about 130 architectural and urban design projects in 26 countries and in almost all of the continents of the world, also known for his effort to introduce a science enclosing architecture and urbanism named Ekistics – the “Science of human establishments” – makes, after his studies on urban growth, the hypothesis of one continuous linear city expanded in the whole planet: through this extreme schematization, he predicts then the world’s urban future. The same person (an architect then!) establishes in the 60s the first company of Information technology in Greece and equips it with the first computer of the country, the gigantic UNIVAC 1107. He marks thus explicitly the links between the science of territories and data management, urban strategies and technology, urban planning and computation.

Leda Dimitriadi, assistant professor at the Ecole nationale supérieure d’architecture Paris-Malaquais, obtained a diploma in architecture engineering from the National Technical University of Athens, and a Master Degree and a PhD in Aesthetics and Sciences of Art from Université Paris I. She has worked as an architect and participated in interdisciplinary research projects. Her PhD thesis was questioning the technological evolution in architectural design through the study of flexibility and transformability.