The aim of these workshops and conference is to help transfer and spread newly appearing design technologies, educational methods and digital modelling supported by information technology in architecture. By organizing a workshop with a conference, we would like to close the distance between practice and theory.

Architects who keep up with the new designs demanded by the building industry will remain at the forefront of the design process in our information-technology based world. Being familiar with the tools available for simulations and early phase models will enable architects to lead the process. We can get “back to command”.

The other message of our slogan is “Back to command”. In the expanding world of IT applications there is a need for the ready change of preliminary models by using parameters and scripts. These approaches retrieve the feeling of command-oriented systems, DOWKRXJKZLWKPXFKJUHDWHUHɈɉFWLYHQHVVWDFNLQZKLFKWKHVRORLVWSOD\VDVHULHVRI

Why CAADence in architecture?

“The cadence is perhaps one of the most unusual elements of classical music, an indispensable addition to an orchestra-accompanied concerto that, though ubiquitous, can take a wide variety of forms. By GHȴQLWLRQDFDGHQFHLVDVRORWKDWSUHFHGHVDFORVLQJIRUPXODLQZKLFKWKHVRORLVWSOD\VDVHULHVRI personally selected or invented musical phrases, interspersed with previously played themes – in short, a free ground for virtuosic improvisation.”
Editor

Mihály Szoboszlai
Faculty of Architecture
Budapest University of Technology and Economics

2nd edition, July 2016

CAADence in Architecture – Proceedings of the International Conference on Computer Aided Architectural Design, Budapest, Hungary, 16th-17th June 2016. Edited by Mihály Szoboszlai, Department of Architectural Representation, Faculty of Architecture, Budapest University of Technology and Economics

Cover page: Faraway Design Kft.

Layout, typography: based on proceedings series of eCAADe conferences

DTP: Tamás Rumi

ISBN: 978-963-313-225-8
ISBN: 978-963-313-237-1 (online version)

CAADence in Architecture. Back to command
Budapesti Műszaki és Gazdaságtudományi Egyetem

Copyright © 2016

Publisher: Faculty of Architecture, Budapest University of Technology and Economics

All rights reserved. No part of this publication may be reproduced, distributed, or transmitted in any form or by any means, including photocopying, recording, or other electronic or mechanical methods, without the prior written permission of the publisher.
CAADence in Architecture
Back to command

Proceedings of the International Conference on Computer Aided Architectural Design

16-17 June 2016
Budapest, Hungary
Faculty of Architecture
Budapest University of Technology and Economics

Edited by
Mihály Szoboszlai
The aim of these workshops and conference is to help transfer and spread newly appearing design technologies, educational methods and digital modelling supported by information technology in architecture. By organizing a workshop with a conference, we would like to close the distance between practice and theory. Architects who keep up with the new design demanded by the building industry will remain at the forefront of the design process in our IT-based world. Being familiar with the tools available for simulations and early phase models will enable architects to lead the process. We can get “back to command”.

Our slogan “Back to Command” contains another message. In the expanding world of IT applications, one must be able to change preliminary models readily by using different parameters and scripts. These approaches bring back the feeling of command-oriented systems, although with much greater effectiveness.

Why CAADence in architecture?
“The cadence is perhaps one of the most unusual elements of classical music, an indispensable addition to an orchestra-accompanied concerto that, though ubiquitous, can take a wide variety of forms. By definition, a cadence is a solo that precedes a closing formula, in which the soloist plays a series of personally selected or invented musical phrases, interspersed with previously played themes – in short, a free ground for virtuosic improvisation.”

Nowadays sophisticated CAAD (Computer Aided Architectural Design) applications might operate in the hand of architects like instruments in the hand of musicians. We have used the word association cadence/caadence as a sort of word play to make this event even more memorable.

Mihály Szoboszlai
Chair of the Organizing Committee
Sponsors

GRAPHISOFT
ARCHICAD

AUTODESK

STUDIO IN-EX
ARCHITECTS & ENGINEERS

MÜEGYETEM 1782

Építészeti Ábrázolás Tanszék
Department of Architectural Representation
Acknowledgement

We would like to express our sincere thanks to all of the authors, reviewers, session chairs, and plenary speakers. We also wish to say thank you to the workshop organizers, who brought practice to theory closer together.

This conference was supported by our sponsors: GRAPHISOFT, AUTODESK, and STUDIO IN-EX. Additionally, the Faculty of Architecture at Budapest University of Technology and Economics provided support through its “Future Fund” (Jövő Alap), helping to bring internationally recognized speakers to this conference.
Members of our local organizing team have supported this event with their special contribution – namely, their hard work in preparing and managing this conference.

Mihály Szoboszlai
Chair of the Organizing Committee

Local conference staff
Workshop tutors

Algorithmic Design through BIM
   Erik Havadi
   Laura Baróthy

Working with BIM Analyses
   Balázs Molnár
   Máté Csócsics
   Zsolt Oláh

OPEN BIM
   Ákos Rechtorisz
   Tamás Erős

GDL in Daily Work
   Gergely Fehér
   Dominika Bobály
   Gergely Hári
   James Badcock
List of Reviewers

Abdelmohsen, Sherif - Egypt
Achten, Henri - Czech Republic
Agkathidis, Asterios - United Kingdom
Asanowicz, Aleksander - Poland
Bhatt, Anand - India
Braumann, Johannes - Austria
Celani, Gabriela - Brazil
Cerovsek, Tomo - Slovenia
Chaszar, Andre - Netherlands
Chronis, Angelos - Spain
Dokonal, Wolfgang - Austria
Étevez, Alberto T. - Spain
Fricker, Pia - Switzerland
Herr, Christiane M. - China
Hoffmann, Miklós - Hungary
Juhász, Imre - Hungary
Jutraz, Anja - Slovenia
Kieferle, Joachim B. - Germany
Klinc, Robert - Slovenia
Koch, Volker - Germany
Kolarevic, Branko - Canada
König, Reinhard - Switzerland
Krakhofer, Stefan - Hong Kong
van Leeuwen, Jos - Netherlands
Lomker, Thorsten - United Arab Emirates
Lorenz, Wolfgang - Austria
Loveridge, Russell - Switzerland
Mark, Earl - United States
Molnár, Emil - Hungary
Mueller, Volker - United States
Nourian, Pirouz - Netherlands
Oxman, Rivka - Israel
Parlac, Vera - Canada
Quintus, Alex - United Arab Emirates
Searle, Mark - Hungary
Szoboszlai, Mihály - Hungary
Tuncer, Bige - Singapore
Verbeke, Johan - Belgium
Vermillion, Joshua - United States
Watanabe, Shun - Japan
Wojtowicz, Jerzy - Poland
Wurzer, Gabriel - Austria
Yamu, Claudia - Netherlands
Contents

14  Keynote speakers

15  Keynote
15  Backcasting and a New Way of Command in Computational Design
   Reinhard Koenig, Gerhard Schmitt
27  Half Cadence: Towards Integrative Design
   Branko Kolarevic

33  Call from the industry leaders
33  Kajima’s BIM Theory & Methods
   Kazumi Yajima

41  Section A1 - Shape grammar
41  Minka, Machiya, and Gassho-Zukuri
   Procedural Generation of Japanese Traditional Houses
   Shun Watanabe
49  3D Shape Grammar of Polyhedral Spires
   László Strommer

55  Section A2 - Smart cities
55  Enhancing Housing Flexibility Through Collaboration
   Sabine Ritter De Paris, Carlos Nuno Lacerda Lopes
61  Connecting Online-Configurators (Including 3D Representations) with
   CAD-Systems
   Small Scale Solutions for SMEs in the Design-Product and Building Sector
   Matthias Kulcke
67  BIM to GIS and GIS to BIM
   Szabolcs Kari, László Lellei, Attila Gyulai, András Sik, Miklós Márton Riedel
<table>
<thead>
<tr>
<th>Page</th>
<th>Section</th>
<th>Title and Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>73</td>
<td>A3</td>
<td>Modeling with scripting</td>
</tr>
</tbody>
</table>
|      |         | Parametric Details of Membrane Constructions  
|      |         | Bálint Péter Füzes, Dezső Hegyi |
| 79   |         | De-Script-ion: Individuality / Uniformity  
|      |         | Helen Lam Wai-yin, Vito Bertin |
| 87   | B1      | BIM |
|      |         | Forecasting Time between Problems of Building Components by Using BIM  
|      |         | Michio Matsubayashi, Shun Watanabe |
| 93   |         | Integration of Facility Management System and Building Information Modeling  
|      |         | Lei Xu |
| 99   |         | BIM as a Transformer of Processes  
|      |         | Ingolf Sundfør, Harald Selvær |
| 105  | B2      | Smooth transition |
|      |         | Changing Tangent and Curvature Data of B-splines via Knot Manipulation  
|      |         | Szilvia B.-S. Béla, Márta Szilvási-Nagy |
| 111  |         | A General Theory for Finding the Lightest Manmade Structures Using Voronoi and Delaunay  
|      |         | Mohammed Mustafa Ezzat |
| 119  | B3      | Media supported teaching |
|      |         | Developing New Computational Methodologies for Data Integrated Design for Landscape Architecture  
|      |         | Pia Fricker |
| 127  |         | The Importance of Connectivism in Architectural Design Learning: Developing Creative Thinking  
|      |         | Verónica Paola Rossado Espinoza |
| 133  |         | Ambient PET(b)ar  
|      |         | Kateřina Nováková |
| 141  |         | Geometric Modelling and Reconstruction of Surfaces  
|      |         | Lidija Pletenac |
149  Section C1 - Collaborative design + Simulation

149  Horizontal Load Resistance of Ruined Walls Case Study of a Hungarian Castle with the Aid of Laser Scanning Technology
Tamás Ther, István Sajtos

155  2D-Hygrothermal Simulation of Historical Solid Walls
Michela Pascucci, Elena Lucchi

163  Responsive Interaction in Dynamic Envelopes with Mesh Tessellation
Sambit Datta, Smolik Andrei, Tengwen Chang

169  Identification of Required Processes and Data for Facilitating the Assessment of Resources Management Efficiency During Buildings Life Cycle
Moamen M. Seddik, Rabee M. Reffat, Shawkat L. Elkady

177  Section C2 - Generative Design -1

177  Stereotomic Models In Architecture A Generative Design Method to Integrate Spatial and Structural Parameters Through the Application of Subtractive Operations
Juan José Castellón González, Pierluigi D’Acunto

185  Visual Structuring for Generative Design Search Spaces
Günsu Merin Abbas, İpek Gürsel Dino

195  Section D2 - Generative Design - 2

195  Solar Envelope Optimization Method for Complex Urban Environments
Francesco De Luca

203  Time-based Matter: Suggesting New Formal Variables for Space Design
Delia Dumitrescu

213  Performance-oriented Design Assisted by a Parametric Toolkit - Case study
Bálint Botzheim, Kitti Gidófalvy, Patricia Emy Kikunaga, András Szollár, András Reith

221  Classification of Parametric Design Techniques
Types of Surface Patterns
Réka Sárközi, Péter Iványi, Attila Béla Széll
<table>
<thead>
<tr>
<th>Page</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>227</td>
<td><strong>Section D1 - Visualization and communication</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Issues of Control and Command in Digital Design and Architectural</strong></td>
<td>Andre Chaszar</td>
</tr>
<tr>
<td></td>
<td><strong>Computation</strong></td>
<td></td>
</tr>
<tr>
<td>235</td>
<td><strong>Integrating Point Clouds to Support Architectural Visualization and</strong></td>
<td>Dóra Surina, Gábor Bődő, Konsztantinosz Hadzijanisz, Réka Lovas, Beatrix Szabó, Barnabás Vári, András Fehér</td>
</tr>
<tr>
<td></td>
<td><strong>Communication</strong></td>
<td></td>
</tr>
<tr>
<td>243</td>
<td><strong>Towards the Measurement of Perceived Architectural Qualities</strong></td>
<td>Benjamin Heinrich, Gabriel Wurzer</td>
</tr>
<tr>
<td>249</td>
<td><strong>Complexity across scales in the work of Le Corbusier</strong></td>
<td>Wolfgang E. Lorenz</td>
</tr>
<tr>
<td></td>
<td><strong>Using box-counting as a method for analysing facades</strong></td>
<td></td>
</tr>
<tr>
<td>256</td>
<td><strong>Author’s index</strong></td>
<td></td>
</tr>
</tbody>
</table>
REINHARD KÖNIG

Reinhard König studied architecture and urban planning. He completed his PhD thesis in 2009 at the University of Karlsruhe. Dr. König has worked as a research assistant and appointed Interim Professor of the Chair for Computer Science in Architecture at Bauhaus-University Weimar. He heads research projects on the complexity of urban systems and societies, the understanding of cities by means of agent based models and cellular automata as well as the development of evolutionary design methods. From 2013 Reinhard König works at the Chair of Information Architecture, ETH Zurich. In 2014 Dr. König was guest professor at the Technical University Munich. His current research interests are applicability of multi-criteria optimisation techniques for design problems and the development of computational analysis methods for spatial configurations. Results from these research activities are transferred into planning software of the company DecodingSpaces. From 2015 Dr. König heads the Junior-Professorship for Computational Architecture at Bauhaus-University Weimar, and acts as Co-PI at the Future Cities Lab in Singapore, where he focus on Cognitive Design Computing. Main research project: Planning Synthesis & Computational Planning Group see also the project description: Computational Planning Synthesis and his external research web site: Computational Planning Science

BRANKO KOLAREVIC

Branko Kolarevic is a Professor of Architecture at the University of Calgary Faculty of Environmental Design, where he also holds the Chair in Integrated Design and co-directs the Laboratory for Integrative Design (LID). He has taught architecture at several universities in North America and Asia and has lectured worldwide on the use of digital technologies in design and production. He has authored, edited or co-edited several books, including “Building Dynamics: Exploring Architecture of Change” (with Vera Parlac), “Manufacturing Material Effects” (with Kevin Klinger), “Performative Architecture” (with Ali Malkawi) and “Architecture in the Digital Age.” He is a past president of the Association for Computer Aided Design in Architecture (ACADIA), past president of the Canadian Architectural Certification Board (CACB), and was recently elected future president of the Association of Collegiate Schools of Architecture (ACSA). He is a recipient of the ACADIA Award for Innovative Research in 2007 and ACADIA Society Award of Excellence in 2015. He holds doctoral and master’s degrees in design from Harvard University and a diploma engineer in architecture degree from the University of Belgrade.
Half Cadence: Towards Integrative Design

Branko Kolarevic

1University of Calgary, Canada
e-mail: brkolare@ucalgary.ca

Abstract: This paper projects an alternative vision of integrated design that is more open, fluid, pliable, and opportunistic in its search of collaborative alliances and agendas. This alternative approach is referred to as integrative design, in which methods, processes, and techniques are discovered, appropriated, adapted, and altered from “elsewhere.” The designers who engage design as a broadly integrative endeavor fluidly navigate across different disciplinary territories, and deploy algorithmic thinking, biomimicry, computation, digital fabrication, material exploration, and/or performance analyses to discover and create a process, technique, or a product that is qualitatively new.

Keywords:

DOI: 10.3311/CAADence.1693

INTRODUCTION

Concepts such as integrated practice and integrated design have gained prominence in architecture over the past decade as relatively new paradigms. What is usually meant by these terms is a multidisciplinary, collaborative approach to design in which various participants from the building industry – architects, engineers, contractors, and fabricators – participate jointly from the earliest stages of design, fluidly crossing the conventional disciplinary and professional boundaries.

Integrated design and integrated practice have emerged as a result of several, initially unrelated organic, bottom-up developments within the industry. At one end, the (re)emergence of complexly shaped forms and intricately articulated surfaces, enclosures, and structures has brought out of necessity a close collaboration from the earliest stages of design among architects, engineers, and builders. The binding agent of the resulting disciplinary and professional integration were various digital technologies of design, analysis, and production that provided for a fairly seamless and fluid exchange of information from conception to construction, often defying the existing ossified legal structures of clearly delineated professional and disciplinary responsibilities.

At the same time, building information modeling (BIM) has emerged as a technological paradigm promising a way to encode comprehensively all the information necessary to describe the building’s geometry, enable various analyses of its performance (from the building physics point of view), and directly facilitate the fabrication of various components and their assembly on site (and also the operation of the building once completed). BIM, as a technological platform, however, demands a structural redefinition of the existing relationships within the industry if the various players are to fully realize the potential of better, faster, more direct exchanges of information. In other words, BIM’s message is that the integration of information within the industry requires process-wise and structural integration of the various disciplines and professions comprising the highly fractured building industry today (Kolarevic 2003). That is how integrated project delivery (IPD) was born as a new collaborative model for the industry that...
brings together the entire team – the owner, architects, engineers, and contractors – from the conceptual stages of the project to its delivery. An equally important (and unrelated) development was the emergence of design-build enterprises that, through the way in which they are structured, inherently imply close integration of design and building. The principal motivation behind them is a reduction in substantial inefficiencies that exist due to the fractured nature of the industry, and the implied, profit-motivated desire for integration. The separate paths towards integrated design and practice stemming from the expansion of design-build within the industry, introduction of building information modeling as an enabling technology and integrated project delivery as a new collaborative structure, and the emergence of complex building forms, are increasingly converging, leading many to believe that integration within the industry is an inevitable outcome as architecture, engineering, and construction enter a “post-digital” age, i.e. as the digital technologies become increasingly transparent in their use. While the higher degrees of integration promise buildings that are better, faster, and cheaper to design and construct, the challenge is to avoid closed systems of integration and keep the integrative tendencies as open as possible, conceptually and operationally.

A BRIEF HISTORY OF DISINTEGRATION
Architecture and building were once “integrated.” For centuries, being an architect also meant being a builder. Architects were not only the masters of geometry and spatial effects, but were also closely involved in the construction of buildings. The knowledge of building techniques was implicit in architectural production; inventing the building’s form implied inventing its means of construction, and vice versa. The design and production, architecture and construction, were integrated – one implied the other.

The disintegration started with the cultural, societal and economic shifts of the Renaissance that challenged the medieval traditions of master builders. Leon Battista Alberti wrote that architecture was separate from construction, differen-

tiating architects and artists from master builders and craftsmen. With Alberti’s elevation of architects over master builders came the need to externalize information (so it could be communicated to tradesmen) and the introduction of orthographic abstractions, such as plan, section and elevation. Architects no longer had to be present on site to supervise the construction of the buildings they designed.

The rifts between architecture and construction started to widen dramatically in the mid-nineteenth century when “drawings” of the earlier period became “contract documents.” Other critical developments occurred, such as the appearance of a general contractor and a professional engineer (first in England), which were particularly significant for the development of professional architectural practice as we know it today. The relationships between architects and other parties in the building process became defined contractually, with the aim of clearly articulating the responsibilities and potential liabilities. The consequences were profound. The relationship between an architect (as a designer of a building) and a general contractor (as an executor of the design) became solely financial, leading to what was to become, and remain to this day, an adversarial, highly legalistic and rigidly codified process. Design was split from construction, conceptually and legally. Architects detached themselves from the act of building.

The twentieth century brought increasing complexity to building design and construction, as numerous new materials, technologies and processes were invented. With increased complexity came increased specialization, and the emergence of various design and engineering consultants for different building systems, code compliance, etc. The disintegration was thorough, deep, but fortunately, reversible, as shown by the various developments within the industry over the past decade, briefly discussed earlier.

REINTEGRATING OUT OF NECESSITY
Over the past decade we have seen in architecture the (re)emergence of complexly shaped forms and intricately articulated surfaces, enclosures,
and structures, whose design and production were fundamentally enabled by the capacity of digital technologies to accurately represent and precisely fabricate artifacts of almost any complexity. The challenges of constructability left designers of new formal and surface complexities – whether “blobs” or intricately patterned “boxes” – with little choice but to become closely engaged in fabrication and construction, if they were to see their projects realized. Building contractors, used to the “analog” norms of practice and prevalent orthogonal geometries and standard, repetitive components, were reluctant to take on projects they saw as apparently unbuildable or, at best, with unmanageable complexities. The “experimental” architects had to find contractors and fabricators capable of digitally-driven production, who were often in shipbuilding. They had to provide, and often generate directly, the digital information needed to manufacture and construct building’s components. So, out of sheer necessity, designers of the digitally-generated, often “blobby” architecture became closely involved in the digital making of buildings. A potentially promising path to integrated design emerged.

In the process of trying to address the material producibility of digitally conceived complex forms, “experimental” architects discovered that they have the digital information which could be used in fabrication and construction to directly drive the computer-controlled machinery, making the time-consuming and error-prone production of drawings unnecessary. In addition, introduction and integration of digital fabrication into the design of buildings enabled architects to almost instantaneously produce scale models of their designs using processes and techniques identical to those used in the industry. Thus, a valuable feedback mechanism between conception and production was established, providing a hint of potential benefits that the integration of design and production could bring.

This newfound ability to generate construction information directly from design information, and not the complex curving forms, is what defined the most profound aspect of much of the formally expressive architecture we have seen since late 1990s. The close relationship that once existed between architecture and construction – what was once the very nature of architectural practice – has reemerged as an unintended but fortunate outcome of the new, closely coupled, digital processes of design and production. Builders and fabricators are becoming involved in the earliest phases of design, and architects are actively participating in construction. In the new digitally-driven processes of production, design and construction are no longer separate realms but are, instead, fluidly amalgamated. As observed by Toshiko Mori (2002), “The age of mechanical production, of linear processes and the strict division of labor, is rapidly collapsing around us.”

In addition, the issues of performance (in all its multiple manifestations) are increasingly considered not in isolation or in some kind of linear progression but simultaneously, in an integrated fashion, and are engaged early on in the conceptual stages of the project, by relying on close collaboration between the many parties involved in the design of a building. In such a highly “networked” design context, digital quantitative and qualitative performance-based simulations are used as a technological foundation for a new, comprehensive, highly integrated approach to the design of the built environment (Kolarevic and Malkawi, 2004).

In light of the technologically enabled changes, innovative practices with cross-disciplinary expertise are forming to enable the design and construction of new formal complexities and tectonic intricacies (Kolarevic and Klinger, 2008). Front, Inc. from New York is perhaps the most exemplary collaborative practice to emerge over the past decade; acting as a type of free agency, they fluidly move across the professional and disciplinary territories of architecture, engineering, fabrication and construction, and effectively deploy new digital technologies of parametric design, analysis, and fabrication. Similarly, entrepreneurial enterprises, such as design-toproduction from Zurich, Switzerland, have identified an industry niche in the translation of model scale prototypical designs into full-scale buildings. Design firms, such as SHoP Architects and LTL Architects in New York and Gang Studio Architects from Chicago, have integrated in-house design and production in many of their projects. Meanwhile, integrated fabrication
specialists such as 3form, Inc. in Salt Lake City, A. Zahner Company in Kansas City, and Octatube in Delft, the Netherlands, represent an industry-oriented broadening to engage the emerging innovative design processes directly and more effectively through close collaboration with designers.

**BROADENING INTEGRATED DESIGN**

While integrated design could be understood as a well-defined (and thus closed) constellation of related disciplines and professions within the building industry, I would argue that we need a much more open conceptual and structural platform on which architecture could continue to develop in its post-digital stage as it embraces ideas, concepts, processes, techniques, and technologies that were until recently considered to be within the domains of “others.” In other words, integrated design should be much more fluid, pliable, and opportunistic in its search of collaborative alliances and agendas. I refer to this alternative approach as *integrative design*, in which methods, processes, and techniques are discovered, appropriated, adapted, and altered from “elsewhere,” and often “digitally” pursued. The distinction between being integrated and being integrative may seem minor, but I think it is rather significant, as it implies a fundamentally different attitude towards collaboration, which need not be limited to the professions and disciplines comprising the building industry (or the particular scale of building). The designers who engage design as a broadly integrative endeavor fluidly navigate across different disciplinary territories, and deploy algorithmic thinking, biomimicry, computation, digital fabrication, material exploration, and/or performance analyses to discover and create a process, technique, or a product that is qualitatively new. Scientific and engineering ideas become starting points of the design investigation. For example, concepts such as minimizing waste are engineering tactics that are increasingly applied to architecture from the outset of design projects. Other engineering concepts, such as optimization, are finding favor too, not just in budgetary considerations and fabrication procedures, but also in formal and organizational strategies. Increasingly, greater attention is given to the analyses of simulated building performance as essential feedback criteria in the design process.

Mathematics and geometry are re-embraced as a rich source of ideas in articulating form, pattern, surface and structure in architecture, and collaborations with mathematicians are increasingly sought out. For example, the expansive, patterned surfaces of the Federation Square building in Melbourne, designed by Lab Architecture Studio, are based on what is known in mathematics as pinwheel aperiodic tiling, enabling the designers to apply different scales of the same pattern across the building as needed. The National Aquatics Center in Beijing (built for the 2008 Summer Olympic Games), designed by PTW Architects from Australia, is a simple box that features a seemingly complex three-dimensional bubble patterning. Its geometric origin is the so-called Weaire-Phelan structure, an efficient method of subdividing space using two kinds of cells of equal volume: an irregular pentagonal dodecahedron and a tetrakaidecahedron with 2 hexagons and 12 pentagons. This regular three-dimensional pattern was sliced with a non-aligned, i.e. slightly rotated rectilinear box to produce seemingly irregular patterning on the exterior. There are other notable examples in which patterning is based on mathematics. For example, Voronoi tessellation is a particularly popular patterning algorithm today, in which distances to a specified discrete set of points in space determine the decomposition of space.

Science, mathematics, and engineering are not the only domains explored for potential ideas. Designers and researchers are looking increasingly for inspiration in nature to discover new materials and new material behaviors, so that buildings (or rather, building enclosures) can respond dynamically to changing environmental conditions. In addition to mimicking the intricate complex appearance and organization of patterned skins and structures in nature, their behavior is also being investigated for possible new ideas about the performance of building skins and structures (Kolarevic and Parlac, 2015). In such “form follows performance” strategies, the impulse is to harness the generative potential of nature, where
evolutionary pressure forces organisms to become highly optimized and efficient [nature produces maximum effect with minimum means]. A nature-imitating search for new ideas based on biological precedents – often referred to as biomimicry or biomimetics – holds much promise as an overarching generative driving force for contemporary architecture as it embraces sustainability as a defining socio-economic and cultural issue today.

All of these developments are part of the perceived broader shift towards integrative design within architecture as it enters a post-digital phase and as it embraces ideas, concepts, processes, techniques, and technologies from elsewhere – just as it did in the past, but much more so now. The move towards integrative design implies an ongoing, endless process, akin to a half cadence, also known in music as imperfect, weak or semi-cadence, because it calls for continuation. But it’s a cadence, nevertheless – a post-digital one, I would add.

NOTE
This is a revised, abridged version of a paper presented at the “Critical Digital” conference held in 2008 at Harvard University Graduate School of Design.

REFERENCES
Author's index

Abbas, Günsu Merin ........................................185
Balla-S. Béla, Szilvia ......................................105
Bertin, Vito ................................................79
Botzheim, Bálint .........................................213
Bödő, Gábor ...............................................235
Castellon Gonzalez, Juan José .........................177
Chang, Tengwen ..........................................163
Chaszar, Andre ............................................227
D’Acunto, Pierluigi ........................................177
Datta, Sambit ..............................................163
De Luca, Francesco ........................................195
De Paris, Sabine ............................................55
Dino, İpek Gürsel .........................................185
Dumitrescu, Delia .........................................203
Elkady, Shawkat L. ........................................169
Ezzat, Mohammed .........................................111
Fehér, András ..............................................235
Fricker, Pia .................................................119
Füzes, Bálint Péter .........................................73
Gidófalvy, Kitti ..............................................213
Gyulai, Attila .................................................67
Hadzijanisz, Konsztantinosz .........................235
Hegyi, Dezső ................................................73
Heinrich, Benjamin .......................................243
Iványi, Péter ...............................................221
Kari, Szabolcs ..............................................67
Kikunaga, Patricia Emy .................................213
Koenig, Reinhard ..........................................15
Kolarevic, Branko .........................................27
Kulcke, Matthias ..........................................61
Lam, Wai Yin ...............................................79
Lellei, László ...............................................67
Lorenz, Wolfgang E. ......................................249
Lovas, Réka ...............................................235
Lucchi, Elena ............................................155
Matsubayashi, Michio ....................................87
Nováková, Kateřina ..................................133
Nuno Lacerda Lopes, Carlos .........................55
Pascucci, Michela .........................................155
Pletenac, Lidija .........................................141
Reffat M., Rabee ........................................169
Reith, András .............................................213
Riedel, Miklós Márton ....................................67
Rossado Espinoza, Verónica Paola ..................127
Sajtos, István ..............................................149
Sárközi, Réka ............................................221
Schmitt, Gerhard .........................................15
Seddik, Moamen M. .....................................169
Selvær, Harald .............................................99
Sik, András ................................................67
Smolik, Andrei .............................................163
Strommer, László ........................................49
Sundfør, Ingrid ...........................................99
Surina, Dóra .............................................235
Szabó, Beatrix .............................................235
Széll, Attila Béla ..........................................221
Szilvási-Nagy, Márta ...................................105
Szollár, András ..........................................213
Ther, Tamás ...............................................149
Vári, Barnabás ...........................................235
Watanabe, Shun .........................................41, 87
Wurzer, Gabriel ..........................................243
Xu, Lei .....................................................93
Yajima, Kazumi ..........................................33
The aim of these workshops and conference is to help transfer and spread newly appearing design technologies, educational methods and digital modelling supported by information technology in architecture. By organizing a workshop with a conference, we would like to close the distance between practice and theory.

Architects who keep up with the new designs demanded by the building industry will remain at the forefront of the design process in our information-technology based world. Being familiar with the tools available for simulations and early phase models will enable architects to lead the process. We can get “back to command”. The other message of our slogan is <Back to command>. In the expanding world of IT applications there is a need for the ready change of preliminary models by using parameters and scripts. These approaches retrieve the feeling of command-oriented systems, although, with much greater effectiveness.

Why CAADence in architecture?

"The cadence is perhaps one of the most unusual elements of classical music, an indispensable addition to an orchestra-accompanied concerto that, though ubiquitous, can take a wide variety of forms. By definition, a cadence is a solo that precedes a closing formula, in which the soloist plays a series of personally selected or invented musical phrases, interspersed with previously played themes – in short, a free ground for virtuosic improvisation."