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,

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 personally selected or invented musical phrases, interspersed with previously played themes – in short, a free ground for virtuosic improvisation."

Back to command

Edited by Mihály Szoboszlai
Editor

Mihály Szoboszlai
Faculty of Architecture
Budapest University of Technology and Economics

2nd edition, July 2016

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

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Theme

CAADence in Architecture
Back to command

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
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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.
Connecting Online-Configurators (Including 3D Representations) with CAD-Systems
Small Scale Solutions for SMEs in the Design-Product and Building Sector

Matthias Kulcke

Abstract: As small and medium enterprises, such as craftsmen in the building sector, are often unable to invest in larger scale software solutions, full-blown online product configurators with embedded real-time 3D rendering appeared to have been out of reach for most of them so far, because of comparatively high investments; considering programming and launch as well as maintenance, especially regarding the necessary effort to ensure smooth front-end availability and performance. This paper discusses the possibilities to develop and implement online-configurators with 3D representations as small scale solution for SMEs in the design-product and building sector. In this context an exemplary overview is presented and discussed; starting with the parametric design of the product in Rhino/Grasshopper, moving on to the translation of its geometry into webGL embedded in a JavaScript/PHP-combination for 3D representation in a simple online-configurator and then importing customer-chosen values for the definition of product-instances back into the Rhino/Grasshopper CAD environment, with the aim of semi-automatically creating production data for the CNC-milling of customized product-parts.

Keywords: configurators, 3D visualization, mass customization, SMEs, semi-automated customer dialogue

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INTRODUCTION

In 2013, Piller and Piroozfar have shown a variety of concepts and approaches to use mass customization [which is spelled “mass customisation” in the title of their publication] and the accompanying tools, such as online-configurators, in the building sector and the field of architecture [1]; there appears to be a growing trend to apply mass customization in this area e. g. in offering furniture to customers who are enabled to make final adjustments of the product before ordering. The configurator database of 2015, released by Paul Blazek et. al. [2] lists comparatively few configurators in this sector, considering that parametric design as a term and technique has been around in
design and architecture for quite some time. One of the reasons may be the considerable technical effort to ensure smooth front-end availability if 3D representation is wished for [3], but generally also budget and easy implementation in the overall workflow play an important role for small and medium enterprises, and lack of one or the other may be a serious obstacle.

1. ACCESSIBILITY OF 3D VISUALIZATION WEBSITES

In recent years the accompanying online-solution to OpenGL, WebGL (which is commonly used within JavaScript frameworks) has offered a technical environment for relatively easy-to-implement interactive 3D representation. Using the canvas-tag as part of HTML5, web-applications can be programmed that allow for an interactive 3D representation of more or less complex objects. In the following example of a simple modular shelf system in an online configurator, PHP has been used in addition to enable the user not only to interact with the 3D representation of the object by zooming and turning, but also by changing its parameters and thus altering its geometry (Figure 1).

These parameters not only change the online 3D representation, but can also be send to the manufacturer, who first and foremost need the data (altered by individual specification), not necessarily the 3D web-image. The latter usually serves, as its main purpose, as an illustration of the changes made by the customer to him-or herself.

2. DATA-PROCESSING IN RHINO/GRASSHOPPER

In the proposed workflow the manufacturer is using Rhino/Grasshopper to further process the data sent by the customer (Figure 2). Rhino is used here since it is still a comparatively low-cost CAD tool with a powerful selection of APIs, enabling further manipulation. Also, it is especially suited for parametric design tasks with a low-barrier approach via the free of charge Grasshopper plug-in for graphical macro programming.

2.1 Importing Customer-Generated Data

Grasshopper is equipped with a special node, which allows to import text from a .txt-file. This means the geometry of an object constructed within Rhino/Grasshopper may be changed with-
out even touching any lever inside the Grasshopper UI, the 3D model is changed just by opening the .gh-file.

### 2.2 Further Customer-Dialogue

The .gh-file is the basis for visualization output out of Rhino. It provides the 3D model as the basis for photorealistic renderings, plan with measurements and price-calculation, that can be send to the customer as text/and or .jpg-file as part of a (standardized) e-mail or in print.

#### 2.3 Semi-Automated Export of the Machine Program

An export node similar to the text import can be used to further process the data and automatically write the program for the CNC milling machine and/or e.g. for the output of parts lists which then can be used in the shop or within additional software to optimize material use.
3. PREPARING PRODUCT-SPECIFIC DATA-ENVIRONMENTS

3.1 Production of the Product-Specific Grasshopper Geometry

If the manufacturer has a certain product he/she wants to offer via an online configurator, the product needs to be parametrically constructed once, using the text-import node for referencing the discrete and steady variables, which will be supplied later by the customers. The production of such a macro program in Rhino/Grasshopper can be externalized; this software-combination is of advantage regarding the described overall workflow scenario, since it doesn’t require deep programming knowledge to produce e. g. modular and especially orthogonal products or product parts, that leave certain parameters up to the customers’ choice. Still, that doesn’t imply, that craftsmen have to turn to programming. Such graphical macro programming can be managed by students, alumni and professionals working in the fields of design and architecture - persons who are closer to the products in question than professional programmers, but still (often) already equipped with the necessary IT skills.

3.2 Production of the Product-Specific Machine Program

During a workshop in 2013 in Cologne held by Hans Sachs from responsive design studio [4] and his colleague Sebastian Bächer the author learned about their specific strategy of automatically generating text out of fixed and variable text blocks that translated with the help of simple Visual Basic scripting into full .mpr-syntax. A .mpr-file in turn can be used e. g. inside the software WoodWop, which allows for digital communication with the CNC milling machine in the shop. The production of this part of the product-specific .gh-file requires a certain specific degree of know-how which can be acquired in a two-day workshop, or else this piece of the macro program can also be punctually externalized whenever a new product is introduced. The general aim is to reduce or eliminate the need for shop floor programming (SFP) [5].

4. CONCLUSION

The proposed workflow offers designers and craftsmen/manufacturers a comparatively low-cost solution for implementing parametric design and online configurators in the overall strategy of their enterprise. It shows an approach that opens up the possibility to make parametric design and mass customization part of the online-marketing of SMEs in the design- and building sector without the need of a high initial investment. It does however call for a closer cooperation between a younger generation of designers and architects with producers who run their businesses as craftsmen on a broader scale than is usually the case. In addition to this the task remains to provide individually configurable semi-automatic data processing from the CAD model to the CNC milling machine (or other machines) for SMEs, that are easy to implement and meet the needs of individual enterprises [6].

4.1 Outlook on Design Education

Students in design and architecture often have the chance to learn about parametric design (e. g. using the Rhino/Grasshopper combination); the connection to mass customization however, is made less frequently. Next steps in developing this area in the building sector could be, on the part of design education, to regularly introduce parametric design techniques accompanied by theory and practical exercises directed also at mass customization strategies in design and architecture.

4.2 Outlook on the Automated Production of Product-Specific Machine Programming

The digital strategy of Hans Sachs and Sebastian Bächer to automatically combine fixed and variable text blocks including customer choices into full .mpr-syntax within the Grasshopper macro program could also be applied by just using PHP-programming. The practicality of this alternative approach needs to be tested as a next step refining the proposed workflow.
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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."