

Editorial

Research undertaken in the computer-aided architectural design (CAAD) field is grounded on the belief that the world of designing (which is believed to be informal) and the world of computing (which is believed to be formal) can be brought together in productive relationships and that it is possible, through computers, to support humans' creative dealing with the world. This IJAC special focus issue on computational geometry and design exploration invites the reader to (re)assess this belief. It probes our field's capacity of – and progress made in – reconciling what Kvan (2004) calls the dual heritage of CAAD research in the sciences and in the creative arts.

It has been argued that CAAD researchers have yet to convincingly substantiate their trust in the merits of designing with computers at a general level. Sceptics include Page (1962) who at the 1962 Conference on Design Methods expressed his view that “computers contribute practically nil to creative design. Essentially they help analyse and evaluate” (ibid., p. 213). Less than a decade later, Alexander (1971) noted that “the [architectural design methods] people who are messing around with computers have obviously become interested in some kind of toy [and] definitely lost the motivation for making better buildings” (ibid., p. 309). Ten years ago, Lawson (1997) observed that “the computer has become a sort of advanced drawing tool [...] producing drawings [that] are not at the heart of the design process but largely concerned with the end products of that process” (ibid., p. 303). More recently, in assessing whether the computer really helps in creative design, Lawson (2007) describes today's CAAD community and its research as “the faithful [who] come together to reinforce their common belief in the wonderful benefits of CAD” (ibid., p. 331).

The above quotes offer our field tough food for thought and it must be acknowledged that CAAD research, as research elsewhere, has room for improvement. This seems to be the case particularly where “formally scientific” rhetoric convinces only those who exercise the kind of tolerance towards personal expression that is usually granted to creative artists. Meanwhile, continued questioning of the belief in computer-aided designing and the implied insistence on its conclusive justification risks failure in avoiding the “dépà vu” phenomenon, which Maver (1995, p. 21) identified as another shortcoming of CAAD research. With this IJAC special focus issue we believe to be able to demonstrate that the state of affairs should be approached in a more differentiated manner. Practice, advanced practice in particular, and the ideas and people it draws from our field and from the education we offer, have long ago rendered the if-question of creative CAAD moot. In our opinion, the question is no longer *if* the computer “helps” (computers allow one to help oneself!) designing “better” (than what? – see Rittel 1984, pp. 318-319). The questions we are interested in are

how the computer can be employed beyond the mere emulation and amplification of functionality offered by tools it has replaced, and more importantly, *how* we can help ensure that computer-aided designing manifests itself in processes and outcomes that may be deemed valuable.

Assuming that design exploration represents the essence of informal and creative designerly action and that computational geometry represents the essence of the application of formal digital procedures in architectural planning, we believe the papers contained in this issue can be regarded as representative of the very core of our field, the area common to both parts of our dual heritage. We have invited original papers that are “concerned with the use of computational geometry in ‘earlier’ design stages, that are less concerned with production and more concerned with the design process, design exploration and design thinking”. Out of the responses we received, we have selected six papers covering investigations through, about and for designing, ranging across various contextual settings that include laboratory research, design studio education and advanced architectural design practice.

Alexander Koutamanis presents a “fuzzy” approach to computer-based geometric modeling, in response to the undesirable “crispness” and determinism that are oftentimes observed in precisely defined computational geometry. “Fuzzification” of architectural representations can be implemented in computer-based modeling systems on top of “crisp” representations, resulting in representations that have sketch-like qualities because form does not have to precisely follow the strokes entered by the designer. Koutamanis introduces this approach at a theoretical level and demonstrates how it might be applied practically as an automated, ambiguity-reducing method.

Jane Burry examines experiences gathered over the course of several years teaching an interdisciplinary parametric design studio. The paper draws upon examples of students’ flexible modeling investigations and categorises them into five exemplary aspects that guide the students’ modeling approaches. Upon this basis, Burry then probes the computation-geometrical spaces and topologies in which parametric designing takes place and distinguishes the overtly geometrical space of form visualisation, the topological space of the data relationships that govern automated form-generating procedures and the spreadsheet space of the parameters that are applied to these procedures.

Dominik Holzer, Mark Burry and Richard Hough use a larger-scale applied architectural project as a case study to investigate ways to foster the interaction between architects and engineers from early design stages onwards. The described process uses a digital toolkit that combines parametric modeling and structural analysis systems. Participating architects and engineers express rules that relate design intentions to structural requirements, along with suitable boundaries for parametric variation to

define solution spaces within which contradicting design requirements are resolved collaboratively. Holzer, Burry and Hough observe an inversely-proportional relationship between the growing explicitness of interrelated design intentions and the number of constant numerical parameters in the parametric model. The paper furthermore derives insights for comparable future design projects and identifies software requirements for improved work flows in future similar processes.

Introducing a computer-aided approach for the engineering design of folding architectural structures, Madalina Wierzbicki and Clarence de Silva indicate that increasing demand for kinematic architecture exposes designers increasingly to tasks of exploring and evaluating (design) variety of (mechanical) variety. Aiming to support the design of kinetic structures in a way that, already early in the process, anticipated and precludes folding failures and damage in the final product, the paper discusses prohibitive challenges in automating the detection of potential folding errors and presents an alternative approach. In this approach, optimisation is aided by a custom tool employing a procedure that integrates both intuitive human observation and algorithmic fuzzy logic. Quantitative tests show promising success of the presented procedure, which users experience as efficacious and controllable.

Neri Oxman explores ways to transcend the geometry-centred description of form by allowing its form evaluation based on geometrical data with respect to spatial, structural and other performance criteria. In this approach, “enabling representations” use vector and tensor math to “reconstruct” already available analytical tools to function as design means for re-representing, evaluating and manipulating form according to performance criteria. These criteria, while lying outside of the immediate realm of geometry, are implicit in geometrical data and possibly of interest to the designer. In this context Oxman assumes inherent and potentially instrumental relations between geometry and performance, devising extended analytical functions to allow performance-informed generative design explorations.

Ivanka Iordanova reports challenges observed in teaching associative geometry and parametric design in which form giving follows performance criteria, and proposes a multi-level pedagogical scheme for introducing computational geometry and parametric modeling into architectural design education. The paper presents a sketch overview of computational geometry applications in architectural design to contextualise the following discussion of challenges encountered in teaching geometry and programming to future architects and a proposal for a “joint strategy” to tackle these challenges. As a part of this strategy, Iordanova introduces into the digital architectural design studio a “referents” library of interactive learning material expressed in the same formats and medium in which digital design outcomes are expressed.

Computing is essential to the work presented in all the following papers, exceeding noticeably the functionality formerly offered by drawing boards. It subscribes, by necessity, to the values that drive design and to concrete designerly intentions in the practices of designing, design toolmaking and design education. In all contributions to this IJAC issue, these values and this orientation towards practice transcend the sandbox of abstract formal rigor, raising the question of whether the belief in computer-aided designing should indeed be continuously challenged and conclusively, i.e. formally justified. Do we need to (and more importantly: would it in principle be possible to) demonstrate categorically or “prove” that the computer – or any other resource for that matter – supports creativity in designing? What would make such a demonstration or (dis)proof necessary or important? What should be the consequences? And, for as long as a rigorous justification or rejection of our enquiries remains to be established, is it objectionable to keep researching into CAAD as faithful believers?

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