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Editorial

Steering of form—New integrative approaches to architectural design and modeling

Architectural applications have received increasing interest from the Geometric Design and Computer Graphics community in the past years, mainly in connection with problems related to the design and fabrication of large-scale architectural freeform structures. New challenges in modeling arise through a new understanding of the relation between architectural design, material properties and structural behavior. It becomes increasingly evident that the state-of-the-art 3D modeling tools are not sufficiently well-suited to solve these challenges. New tools that integrate shape, design, function, structure, and fabrication have to be developed.

This special issue sought to publish the most innovative and advanced research results in this new field. It aimed at bringing material and physical constraints of structural design and material implementations into the CAD community, and to stimulate research in this direction.

We were looking particularly for alternatives to the top-down descriptive approach to modeling and hierarchical associate parametric modeling in favor of the integration of solvers to achieve multiple goals related to constructability and structural form finding. Of particular interest were approaches which achieve this in a design exploratory way and encourage the development of processes that support design intent and intervention in these processes.

The issue consists of six unique and strong papers addressing a variety of aspects relevant to informed computer-aided architectural design. Deng et al. present a novel numerical solver for constrained optimization which forms the core of an interactive tool for shape exploration of architectural freeform structures which are subject to geometric constraints imposed by material, function or fabrication. Williams et al. describe the theory of isotropic membrane stress under gravity load and employ a particle method for its numerical simulation to form finding of shell structures. Fivet and Zastavni present a geometric approach for interactive, constraint-based structural equilibrium design that allows the identification and visualization of solution domains and the possibility of switching dependencies for specific elements of graphic-statics constructions. Jordan et al. describe the selection, definition and implementation of a method for the design and construction of structures using a novel material: in this case chocolate, forming a part of a growing discourse where computational methods increase the feedback between form generation methods, material properties and fabrication constraints. Senatore and Piker present a series of design tools for intuitive form finding in the context of design and education by extending real-time physics into structural design analysis. Reichert et al. describe their biomimetic design approach to fibrous structures similar to those found in exoskeletons of lobsters using a fiber laying robotic fabrication process for a research pavilion at the ICD Stuttgart.

We take this opportunity to thank the editors of Computer-Aided Design for having invited us to edit this issue. It is a great opportunity to bring our field of research and practice to the attention of a new and wider audience. Last, we would like to thank all contributors for being part of this special issue and writing high-quality papers, but also all reviewers whose comments helped to improve the papers significantly.

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