ICT15-082 - Computational Design of Geometric Materials

Abstract

The advances in the domain of digital additive manufacturing technology (i.e., 3d-printing) are beginning to afford new opportunities, like the creation of sophisticated cellular materials at varying scales. In this project we want to research novel materials whose mechanical behavior is described by the complexity of their geometry. Such ``geometric materials'' are cellular structures whose properties depend on the shape and the connectivity of their cells, while the actual physical substance they are built of is constant across the entire object.
We will develop the first computational model for the analysis and simulation of complex geometric materials, as well as a so-called goal-based computational design framework for their synthesis. Goal-based means that the desired behavior can be specified a-priori by the designer, and an appropriate geometric structure that best approximates the given goals is computed automatically. Our main research problem is how to map mechanical properties to geometric connections of cellular structures. So far, little has been done in that direction, but due to the current 3d-printing possibilities, we consider this topic highly innovative. Geometric materials are interesting for two major reasons: (1) they are versatile and easily customizable, and (2), they are well suited for 3d-printing. They are getting more and more into the focus of interest of several design communities, most notably architectural [1], and product design [2]. With our results we expect to achieve significant impact in the interdisciplinary and currently very vivid digital fabrication community.

Scientific disciplines:
Computer graphics (50%) | Applied geometry (50%)

Keywords:
geometric materials, cellular materials, geometry processing, computergraphics and modeling, computational geometric design

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Further links to the persons involved and to the project can be found under
https://www.gmbh.wwtf.at/funding/programmes/ict/ICT15-082/