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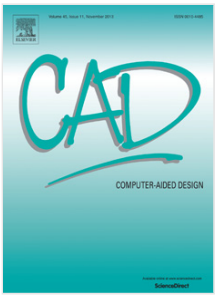

Material ecology

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Material Ecology

Preface for the Special Issue of CAD: Computer aided Design

The world of design has been dominated since the Industrial Revolution by the rigors of manufacturing and mass production. Assembly lines have dictated a world made of standard parts framing the imagination of designers and builders who have been taught to think about their design objects and systems in terms of assemblies of parts with distinct functions. The assumption that parts are made of single materials and fulfill predetermined specific functions is deeply rooted in design and usually goes unquestioned; it is also enforced by the way that industrial supply chains work. These age-old design paradigms have been reincarnated in Computer-aided Design (CAD) tools as well as Computer-aided Manufacturing (CAM) technologies where homogeneous materials are formed into pre-defined shapes at the service of pre-determined functions.

Inspired by Nature, a new design approach has recently emerged called *Material Ecology* that aims to establish a deeper relationship between the design object and its environment. Key to this approach is the realization that the environment and the design object interact through multiple dimensions and a spectrum of environmental variables. A simple analysis would show that the dimensionality of environment space is much larger than that of conventional design space. This *dimensional mismatch* leads to and results in an *ecological mismatch* where design objects do not quite fit in their respective environments. Material Ecology aims to bridge this gap by increasing the dimensionality of the design space through multifunctional materials, high spatial resolution in manufacturing and sophisticated computational algorithms. In doing so, a holistic view of design emerges that considers computation, fabrication, and the material itself as inseparable dimensions of design which results in objects that are ecological from the outset.

The papers included in this Special Issue are authored by research groups from around the world and introduce a suite of biologically inspired digital fabrication tools, techniques, and technologies enabling designs that have a profound connection with an environment.

Kristensen et al (ETH, Zurich) introduce a novel fabrication method combining slip forming and digital fabrication for concrete structures. In this additive fabrication process a robotic arm is implemented to form the concrete while it hardens, eliminating the need for complex custom milled formwork and enabling the reuse of the mold over multiple extrusions thus offering greater efficiency and control.

Reichert et al (ICD - Institute for Computational Design, Stuttgart) propose a new approach to the design and construction of material-based sensing and actuation. The authors focus on autonomously responsive architectural systems that can adapt to environmental stimuli through hygroscopic material properties. In this framework, all functions are integrated into a single material. Inspired by plant mechanics, the research focuses on hygroscopic actuation in plants as a model for passive, autonomous and materially embedded responsiveness.

Ahlquist et al (University of Michigan) present a digital framework and software environment for computational design of geometrically complex pre-stressed form and bending-active