DESIGN SCIENCE LABS

Why architectural research needs laboratories for integrated and networked simulation

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Abstract. The ever increasing complexity of architectural projects demands efficient tools to assist within their associated design processes. We present an infrastructure initiative to tackle these challenges with Design Science Labs that are heavily rooted on simulation techniques in various academic fields. The merits of these techniques are discussed under the prospect of research and teaching experience as well as practical applicability. For an increased benefit, strong interoperability between these simulation techniques is desirable, but still not easily achievable. The infrastructure initiative aims to build smooth bridges between these fields and to gain additional architectural design space from their interaction.

1. Introduction

This paper describes an infrastructure initiative of our university aimed at setting up a network of research laboratories that enable the integration of state of the art simulation methods into the architectural design process. The basic premise of the initiative is that the architectural profession needs to start thinking big in its approach to research and to scientific methods.

While traditionally architects were content with studio space as their working environments, we argue that it’s time architects take to developing their design work in close collaboration with specialized research laboratories. Given the complexity architecture inherently possesses and the ever increasing societal demands new constructions need to fulfill, architects

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have no other choice but to become very professional about their working methods. The close coordination and integration of various types of simulation methods into the design process is a key aspect of this. In fact, the collaborative interdisciplinary teamwork from the earliest stages of design has long become standard in international competitions. Yet, despite occasional examples of the contrary, adequate laboratories that would allow to conduct and research similar design strategies in academia are still largely missing in most architecture schools.

An inspiration for this integration of scientific processes into the design practice is Buckminster Fuller, who coined the term design science, defining it as “the effective application of the principles of science to the conscious design of our total environment in order to help make the Earth’s finite resources meet the needs of all humanity without disrupting the ecological processes of the planet.”

The integration of simulation methods into the design process has been a constant subject of CAAD research over the past 30 years at least (Augenbroe and Winkelmann 1991; Chaisuparasmikul 2006; Flemming and Mahdavi 1993; Mahdavi et al. 1997; Maver 1988). While advances in physical based simulation methods have improved dramatically in certain fields, leading to entirely new subdomains in building design, the integration of these specialized domains into the design process is still unsatisfactory, despite the fact that the notion of building performance and energy efficiency are currently getting a lot of public attention (Cody 2005). The initiative put forward here differs from earlier work in that it puts its focus not so much on the development of unified standards and more coherent or more powerful software packages, but on establishing smooth collaborative processes between the individual laboratories. Furthermore the labs are based on a notion of performativity that goes beyond physically based digital simulation to reflect also the cultural and social aspects of design (Kolarevic and Malkawi 2005; Hauser 2005). Thus we believe that the issue is best addressed by networking spaces and people, not just by developing new software (although that remains an important part of it).

The rationale for this undertaking as well as the outline of its implementation is described in the following sections. Since simulation is a central part of the present project, we provide three general arguments how the architectural practice may take advantage of it in Section 2. The most useful fields of application are particularized in Section 3. The relationship between digital and analogue simulations as our approach in the design science labs concept, as well as a brief description of the individual laboratory setups is discussed in Section 4. Our proposed approach to achieve interdisciplinary connections and exchange mechanisms between these labs is outlined in Section 5.