LuxMotus: Physics-based Form Generation in a One-to-One Scale Design Studio

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This project examines how parametric modeling techniques can be integrated into the conceptual stage of design-build studios, and used as a basis for developing new digital fabrication techniques. Previous studies have shown that parametric modeling can have substantial benefits when used as a drawing-generator for digital fabrication; most notably it can enable the designer to experiment with numerous new design and tooling possibilities (Jabi, 2013). The use of parametric modeling to inform these processes has also been described as initiating a “psychological change” in designers’ approach to form-creation, and it is often seen as leading to a more adaptive and responsive design outlook (Achten & Kopřiva, 2010). In this paper, digital weaving is considered as a technique for linking parametric-modeling design processes with human-interactive design, and for developing a new tessellation technique in digital fabrication.

The project was developed based on a design-build studio that was executed in four phases: inspiration through nature, parametric modeling theory, weaving technique, and fabrication. First, the studio participants examined mathematical analyses of naturally occurring geometric designs, which helped them to better understand the basic concepts of parametric theory. Rooted in this natural inspiration, they then sketched out a basic pavilion design using a coordinated parametric formula, and explored the possibilities of the design using 3D-modeling software (Rhino/Grasshopper).

After developing the basic form, studio participants employed weaving techniques using linear patterns and Spring-based computational modeling (Lienhard et al., 2013) in order to create tessellations in their pavilion designs. The results of the weaving processes were folded into the overall parametric designs, leading to advanced tectonic solutions. Ultimately, we fabricated the final designs using CNC milling and weaving machines, as well as a vacuum-forming machine.

The most significant outcome of this project is to demonstrate that parametric modeling is not only useful for form-generation, but can also be a valuable tool to develop fabrication techniques. The project is a result of computational design thinking that includes elements of morphogenesis biology, algorithmic and mathematical approaches, and the cutting-edge translation of such approaches to physical fabrication. Potential applications include the creation of complex 3D mesh structures using weaving technology, and the use of such structures in reconfigurable material systems.

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