Dancing Tent: Computational Structural Modeling and Choreographic Approach for the Kinetic Design of a Tent Structure

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ABSTRACT

Most of the spatial and membrane structures as a pavilion are static; the shapes are defined and fixed after construction. Several examples of kinetic, interactive, and responsive architecture mainly deal with the building components, such as facades and roofs [1][2]. But the whole envelope as a kinetic architecture is uncommon. We are interested in designing a membrane-based tent structure that will 'dance', meaning its shape will not be static. Instead, it will transform its overall shape. The intention behind such an approach is to make the tent's appearance dynamic aesthetically and offer a new spatial experience to visitors through the changing of the inner volume.

Our approach will combine structural and contemporary dance choreography, thus mixing performing art with structural potentials through the action of forces. The form of a tent depends on the number of anchor points and their coordinates. This allows us to make a generic setup of its parametric form digitally, enabling us to make its shape transformable. The transformation can be arbitrary. But, for our 'Dancing Tent' design, we have adopted a choreographic approach of transformation that will create an animated sculptural appearance of the tent.

As a computational approach, we will use *Kangaroo3D*, an interactive physics/constraint solver plugin that interactively works in *Grasshopper3D*, a parametric environment embedded in Rhinoceros3D is a NURBS-based computer-aided design application. While *Kangaroo3D* will provide us with the shape transformation of the tent envelope due to changing the position of anchors, we will use *Karamba3D*, a finite-element analysis plugin that interactively works in *Grasshopper3D*, for analyzing the structural performability of the kinetic tent. In reality, the anchor points will be the tips of the supporting posts, and the post tips, made of wheels or balls, will move following the choreographic tracks to create the tent's shape transformation, i.e., a choreographed dancing movement. This paper will discuss the tectonic aspects of real installation, such as the suitable selection of textile materials, joint details, installation strategy, etc.

Keywords: tent, kinetic architecture, dance, computational design

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