Whiteout documents the design, fabrication and installation of a full-scale prototype using a predictive mesh relaxation algorithm while the physical construct made from white spandex fabric, steel tube, wood members and aluminum connectors verifies the virtual assumptions.

Whiteout is a research project that explores topological evolution of tensile fabric skin systems simultaneously through computational simulation and physical material prototyping. Tensile skin systems are undergoing renewed interest due to advancements in digital tools and fabrication procedures that increase accuracy in both the predictive analysis and physical construction with an otherwise unwieldy material at an architectural scale due to fabric’s flexibility. As an investigation in material logic and tectonics, stretchable fabric (spandex) is topological in its material behavior, since it gains rigidity when stressed in constant tension through double curvature (Figures 1, 2, 3). Therefore, topological conditions are inherent in the material and computation is ideal to manage the variables (Figure 4). The computational systems utilized in this investigation consist of parametric simulation tools used to predict the behavior of the elastic tensile fabric skin, which are compared to the testing of physical material in mock-ups and brought back into the digital model. The results of the investigation lead to computational simulations...
of multiple iterations, material testing through mock-ups, and the fabrication and assembly of a full-scale prototype installed for a temporary exhibition at the Indianapolis Art Center in Indiana in the spring of 2014.

The investigation was initiated with an exploration of embedding geometries into the datum of an existing structural system. Responding to the existing geometry of the wood structure, multiple distinct conical forms were located to create spatial voids (Figure 3). A singular topographic surface unifies the project by stretching upward in reaction to the disparate geometries of the cones while the base of the surface is held down at the perimeter and in the center to ensure consistent tension. The continuously stretched white elastic skin simultaneously promotes the perception of difference of the cone geometries below, while also attempting to pull the parts back into a cohesive singular object. The deformed white surface is simulated computationally using a mesh relaxation procedure to test and predict the behavior of the physical material (Figure 4). After several iterations using different stiffness factors were simulated, physical materials tests were performed and measured (Figure 5). The translation of the physical tests was reintroduced into the physics solver, providing confidence that the skin would behave according to the simulations.

The cone geometries were translated into tubular steel frames using CNC cut jigs to fabricate the bending and welding of components accurately (Figure 6). The skin panels were unrolled and transferred to the physical spandex material for cutting and then the panels sewn together. The skin was pre-fabricated as one continuous surface derived from thirty unique panels (Figure 9). All of the components were flat-packed and delivered to the site as a kit-of-parts ready for assembly (Figure 10).
Mesh Relaxation Protocol

Topological Mesh Relaxation Iterations

i5
srf stiffness: 300
edge stiffness: 4000

i6
srf stiffness: 1000
ter stiffness: 5000

i7 (final)
srf stiffness: 600
ter stiffness: 4500
NOTES

IMAGE CREDITS
All images: Chandler Ahrens, Open Source Architecture

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