The installation entitled A(g)ntense was built and exhibited at the design exhibition “Blindspot Initiative Group Exhibition” in Los Angeles in 2014 (Figure 1–4). The installation is an experiment to take an agent-based approach to structurally integrated architectural design through simulation of two types of agents’ behaviors: material physics simulation behaviors and generative form-finding behaviors based on the swarm algorithm. The construction materials of the installation are high-strength fishing wires that provide tensile capacity and acrylic sheets that provide rigid support to hold compression loads. The agent-based algorithm for this installation includes three material physics simulation agents: node agents to simulate particles under the influence of other forces, tensile link agents to simulate the tensile wire behavior connecting nodes and rigid link agents to simulate rigid structural connection between nodes. It also includes the following agents for generative form-finding: swarm agents to simulate cohesion, separation and alignment behaviors and also to generate the three material physics simulation agents, force field agents to control the larger scale formation of swarm agents, and force field control agents to manage multiple force field agents and change their locations and intensities (Figure 5 & 6). The swarm agents generate node agents along their trajectory and connect them with tension link agents.
and rigid link agents. These agents generate the formation of nodes and the network of tensile and compression links (Figure 7). This formation and network are then self-optimized by material physics simulation agents to achieve a structural equilibrium to be constructed under the real gravity (Figure 8).

The geometries generated and optimized by the agents were taken into another computational process to prepare for fabrication. The network of rigid lines were converted into paths of outlines and holes for laser cutting fabrication process of acrylic sheets (Figure 9). The trajectory lines of tensile wires were unfolded and reorganized as 2D drawings with marks to indicate locations to tie rings for the joints (Figure 10). The joint between high-strength fishing wires and acrylic sheets consisted of interlocking metal rings and slotted holes on the acrylic sheets (Figure 11). The built installation contained thirty-one layers of acrylic sheets, 153 tensile fishing wires and 5,508 ring joints. The installation assembly started from attaching the tensile wires on the ceiling and then acrylic layers were installed from the top to the bottom. After installing the acrylic sheets and adding weights to the tensile wires, the sheets moved to their optimal location by themselves, and the overall form was naturally created as modeled in the agent simulation. This proves the effectiveness of the agents for material physics simulation without sacrificing the generative design quality emerged out of the agents with generative behaviors.
Swarm Trajectories without Self-optimization

Close-up of Joints of Acrylic Sheets and Tensile Wires with Metal Rings

Structural Behaviors and Optimization Mechanism

Swarm Trajectories on the Top View
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IMAGE CREDITS

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