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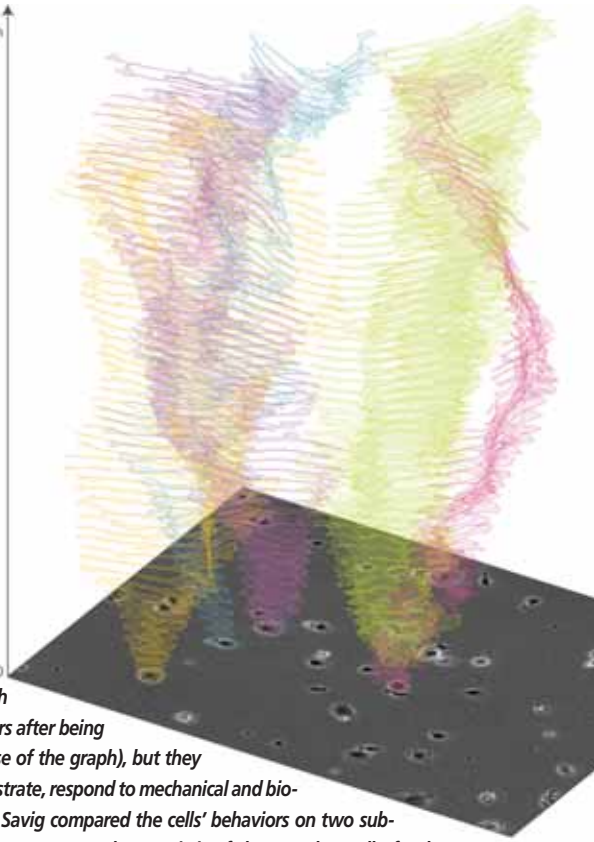
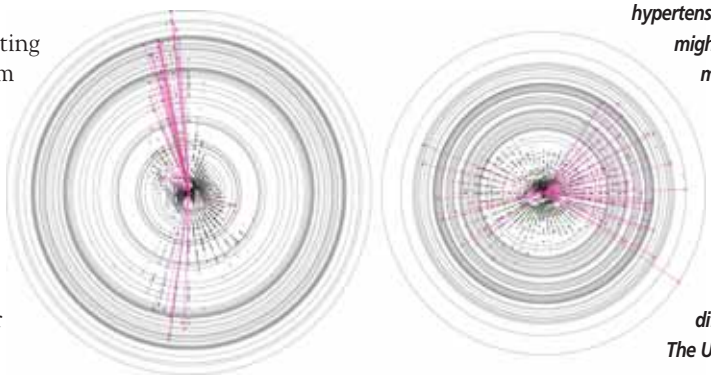
BY KATHARINE MILLER

Architectural Computation Visualizes Cell Choreography

Several years ago, **Jackie Wong, MArch**, mentored by **Jenny E. Sabin, MArch**, an architectural designer and lecturer in the School of Design at the University of Pennsylvania, developed a tool for understanding and visualizing ice dancers' movements. He mapped the relationships between the arms, legs and head of the skater to generate visual patterns that describe the structure of various choreographies. Using this architectural work as inspiration, **Erica Savig, MArch** (UPenn 2008), now a graduate student in cancer biology at Stanford, and **Mathieu C. Tamby, PhD**, a post-doctoral fellow at UPenn, devised a related algorithm to analyze and understand how the tissue microenvironment within pulmonary arteries alters the movement of vascular smooth muscle cells in the context of pulmonary hypertension. The ongoing work is part of a collaboration between architects and cell biologists at UPenn known as **Sabin+Jones LabStudio**, which was founded and is co-directed by Sabin and **Peter Lloyd Jones, PhD**, associate professor of pathology and laboratory medicine at Penn, (and now lecturer in Architecture).

"Jackie Wong had existing dance steps and visualized them into 3-D representations," says Savig, one of the first architectural students recruited into the unique collaboration, "We worked backwards, visualizing cell movements to search for unseen patterns and the fine details of their unknown choreographies." □





Tracing Cell Choreography to Determine How Microenvironment Alters Cell Behavior. *This colorful 3-D graph traces the morphologies and movements of five different smooth muscle cells through time (vertical axis). Two hours after being seeded, the cells are small and nearly round (base of the graph), but they soon spread their filopodia as they probe the substrate, respond to mechanical and biochemical signals, and interact with one another. Savig compared the cells' behaviors on two substrates: fibrillar and non-fibrillar collagen—a substrate more characteristic of the vascular wall of pulmonary hypertensive patients. To identify visual signatures that might one day help personalize diagnosis of pulmonary hypertension, she created visual abstractions of the tracings. Here looking at the data from two cells compressed into 2-D (at left), the disorder of cell movements on non-fibrillar collagen (rightmost image) is clearly visible. The algorithms behind these computationally generated representations allow extraction of numerical measurements for these differences. Courtesy of Sabin+Jones LabStudio, The University of Pennsylvania.*