DIVERSE DISCIPLINES, ONE COMMUNITY
BiomedicalComputation REVIEW
Published by Simbios, an NIH National Center for Biomedical Computing

Nonprofit Org.
U.S. Postage Paid
Permit No. 28
Palo Alto, CA

Stanford University
318 Campus Drive
Clark Center Room S221
Stanford, CA 94305-5444

seeing science

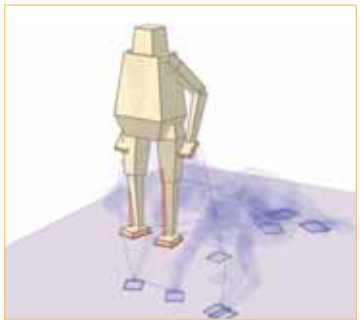
SeeingScience

BY KATHARINE MILLER

Trajectory Optimization And Physical Realism

An animated human figure seeking the optimal path from point A to point B typically relies on computationally expensive hard constraints that force the trajectories to be physically realistic. But contact-invariant optimization (CIO), as applied by **Igor Mordatch**, a graduate student in computer science at the University of Washington, can achieve physical realism more efficiently by changing the contact forces from binary (touching/not touching, which numerical optimizers can't handle in a smooth way) to a softer constraint that is more like a guideline. "It's like you have a jet-pack on your hands or feet," Mordatch says. As the optimization proceeds, it discovers for itself that the contact/no contact solution is optimal, while still preserving the physical realism of a smooth transition. "The gradual transition between contact and non-contact makes sure the numerical behavior is nice," he says. "That's kind of the primary trick."

Mordatch has used the approach to create animated figures that can stand from a prone position, do handstands, climb over walls, and pass objects. More recently, he has been adding physics-based muscle models in an effort to make the work useful for biomechanics researchers. He envisions a two-step process in which the simple models achieve the general motion that is then refined with a full physics-based model. "We haven't really tried that yet," he says. "It's exciting stuff for the future." □



For a trajectory-driven animation using CIO, the animator specifies a figure's initial position and target location (shown here as an "X") as well as the final stance pose (feet under the hips, feet shoulder-width apart, hands in a downward direction). In between, the optimization discovers when and where to place the hands and feet. Initially, the hands sort of slide across the ground as if flying with jetpacks. But after a while the hand contacts converge into single points that become the final solution. Screenshots courtesy of Igor Mordatch. Full movies viewable at http://homes.cs.washington.edu/~mordatch/.