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FACING THE CROWDS

Preventing disaster in an unruly world.

Illustrations by Paul Torrens

On January 3, 2008, more than a hundred thousand people gathered at the Sri Durga Malleswara temple in southern India, setting the stage for disaster. When the crowd surged forward to garland a statue of the goddess Durga, six were trampled and killed.

Disasters like this kill hundreds of people a year and have typically been hard to prevent. But now an intervention may be at hand, thanks to crowd simulations developed by Paul M. Torrens, a geographer at Arizona State University. Torrens's computer simulations let planners drop a few thousand virtual people into a burning building, then sit back and take notes—with heat coming only from the computer itself. The specific scenarios Torrens creates could show firefighters how to save the most people, tell architects where to place exits or barriers in stadiums, and guide police forces in corralling unruly mobs.

Most traditional methods for simulating the movement of crowds treat individuals as purely physical, with no social or emotional reactions. Torrens's model, on the other hand, turns each individual into an "avatar" with an artificial mind. Avatars can plan their own route, adjust their path on the fly, and even respond to the body language of fellow cybercitizens who may be jostling them.

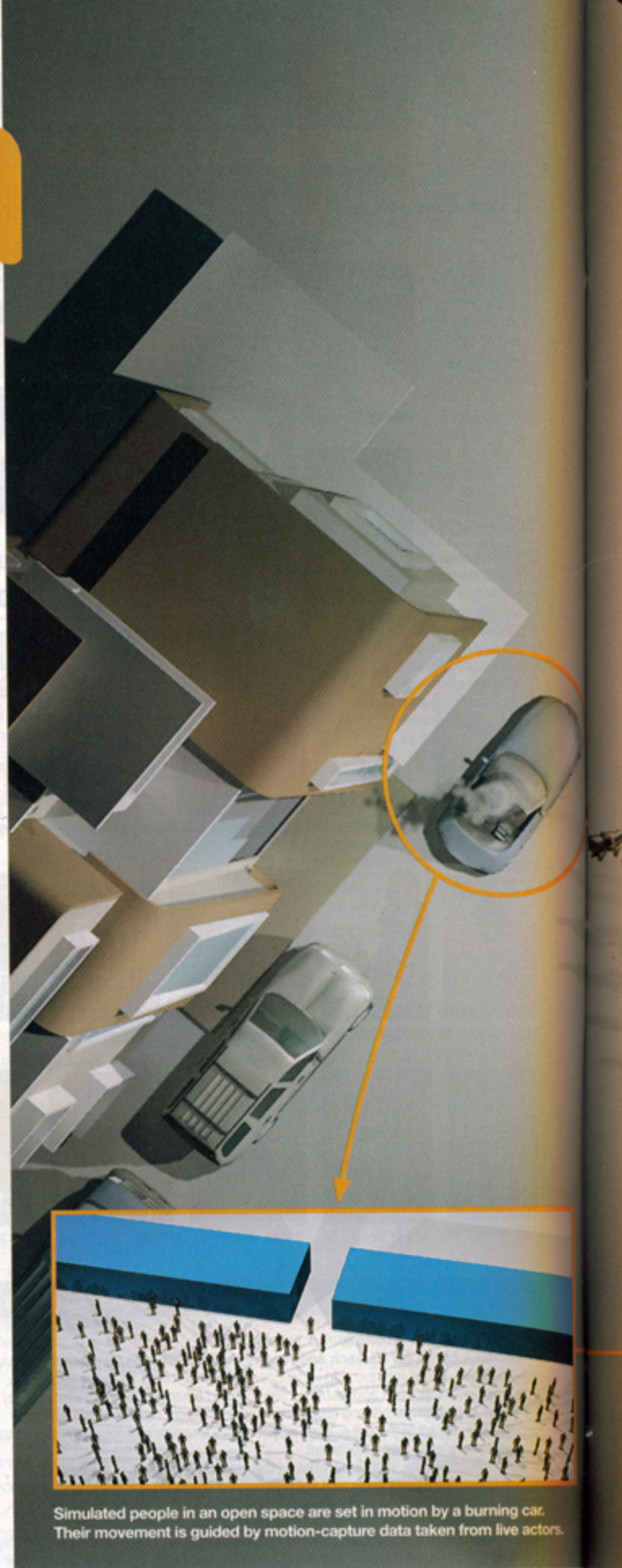
Each avatar's awareness in Torrens's simulations derives from a "vision cone"—a field of view—that projects into the world of the simulation itself. As the simulated crowd moves, an avatar reacts to anything that comes within its cone, whose dimensions may change depending on how quickly that avatar is moving or whether it is panicked—both speed and panic will make the cone narrower. Also influencing the dimensions of the cone are personal attributes like age, disabilities, and body type. The system relies mostly on the autonomy of the avatars, enabling Torrens to create realistic computerized simulations for almost any situation or length of time.

The model is already functional, but Torrens, who is funded by the National Science Foundation to the tune of \$1.15 million, is busy upping the avatars' IQs. He is also in talks with a few interested parties, including the Scottsdale, Arizona, police department, which may want the system customized for its internal use. Even the U.S. Department of Justice is reviewing a proposal.

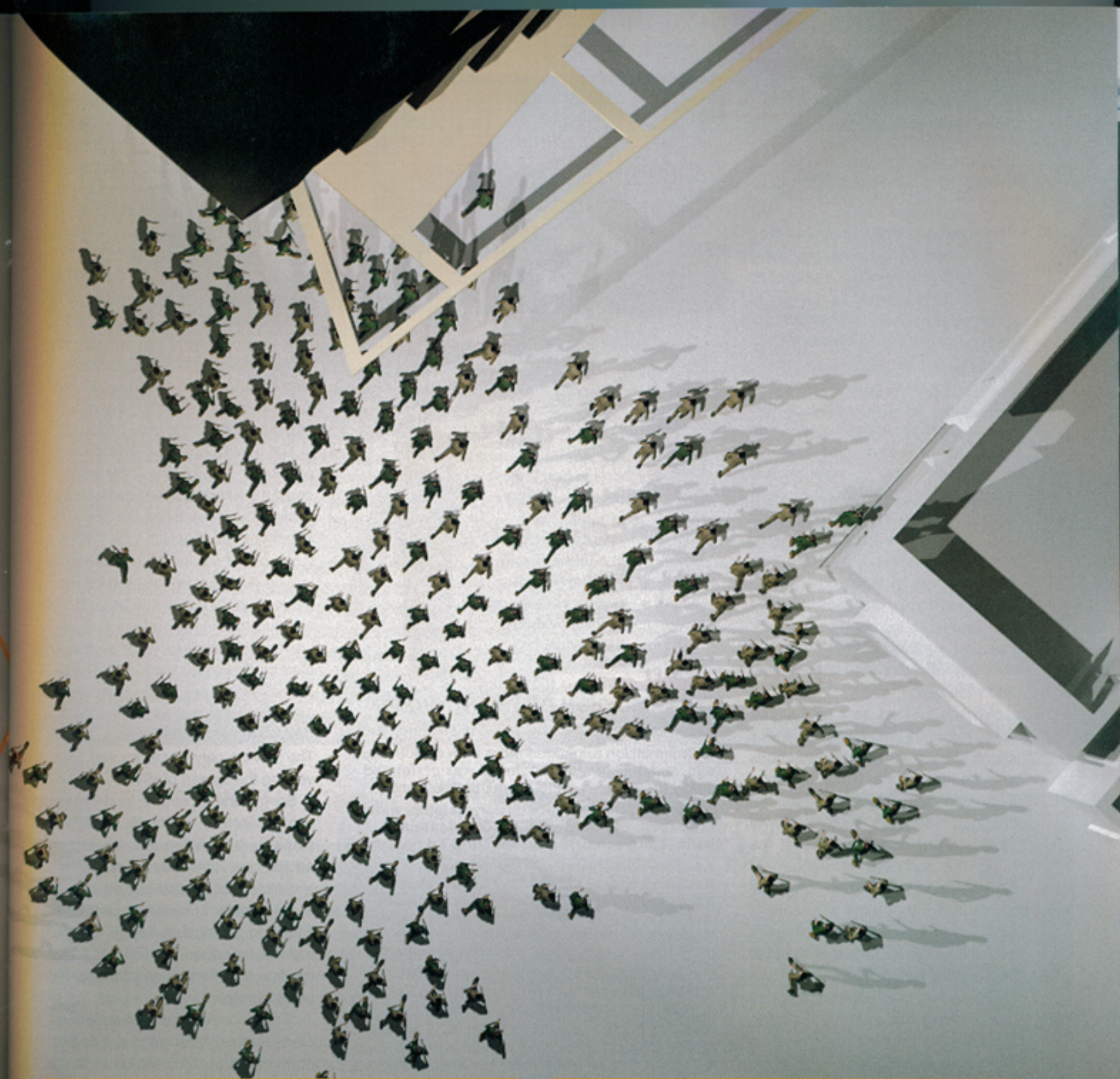
Torrens thinks this is just the start. He sees the day when his simulations could be modified to model disease transmission through casual contact, shopping on a crowded street, or pedestrian safety at a traffic intersection. His latest project: a riot module to test ways of containing civil turmoil.

Matthew Hutson

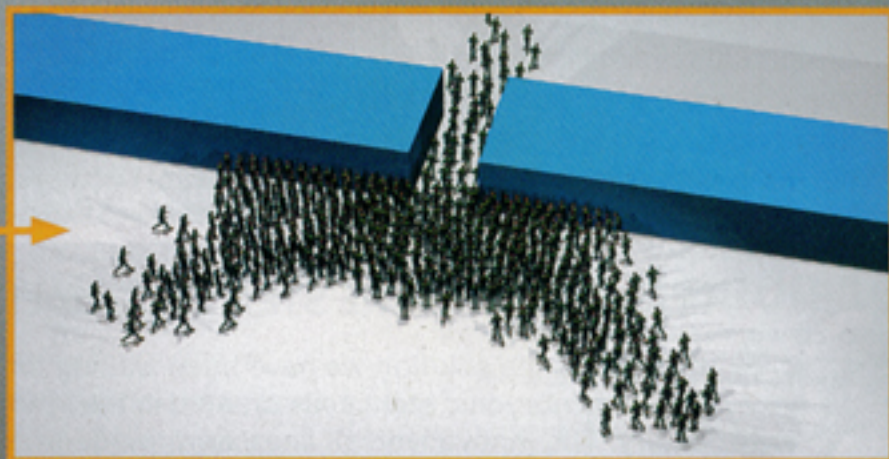
DISCOVER ONLINE For more detailed simulations of crowd movement from Paul Torrens, go to discovermagazine.com/web/crowds



Simulated people in an open space are set in motion by a burning car. Their movement is guided by motion-capture data taken from live actors.



As the people flee, they search for an exit. The use of a single gate for both entry and exit can set the stage for disaster.



The crowd thickens at a bottleneck. In close quarters, pedestrians will "slip and slide," twisting their bodies to pass through.