Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

A Universal Power Law Governing Pedestrian Interactions[1]
IOANNIS KARAMOUZAS, Univ of Minn - Minneapolis, BRIAN SKINNER, Argonne National Laboratory, STEPHEN J. GUY, Univ of Minn - Minneapolis —
Human crowds often bear a striking resemblance to interacting particle systems, and this has prompted many researchers to describe pedestrian dynamics in terms of interaction forces and potential energies. The correct quantitative form of this interaction, however, has remained an open question. Here, we introduce a novel statistical-mechanical approach to directly measure the interaction energy between pedestrians. This analysis, when applied to a large collection of human motion data, reveals a simple power law interaction that is based not on the physical separation between pedestrians but on their projected time to a potential future collision, and is therefore fundamentally anticipatory in nature. Remarkably, this simple law is able to describe human interactions across a wide variety of situations, speeds and densities. We further show, through simulations, that the interaction law we identify is sufficient to reproduce many known crowd phenomena.

[1]Work at Argonne National Laboratory is supported by the U.S. Department of Energy, under contract no. DE-AC02-06CH11357. Work at the University of Minnesota is supported by MnDRIVE Initiative on Robotics, Sensors, and Advanced Manufacturing.

Ioannis Karamouzas
Univ of Minn - Minneapolis

Date submitted: 10 Nov 2014 Electronic form version 1.4