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Bridging the Gap: From Cellular Automata to Differential Equation Models for Pedestrian Dynamics

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Abstract

Cellular automata (CA) and ordinary differential equation (ODE) based models compete for dominance in microscopic pedestrian dynamics. Both are inspired by the idea that pedestrians are subject to forces. However, there are two major differences: In a CA, movement is restricted to a coarse grid and navigation is achieved directly by pointing the movement in the direction of the forces. Force based ODE models operate in continuous space and navigation is computed indirectly through the acceleration vector. We present two models emanating from the CA and ODE approaches that remove these two differences: the Optimal Steps Model and the Gradient Navigation Model. Both models are very robust and produce trajectories similar to each other, bridging the gap between the older models. Both approaches are grid-free and free of oscillations, giving cause to the hypothesis that the two major differences are also the two major weaknesses of the older models.