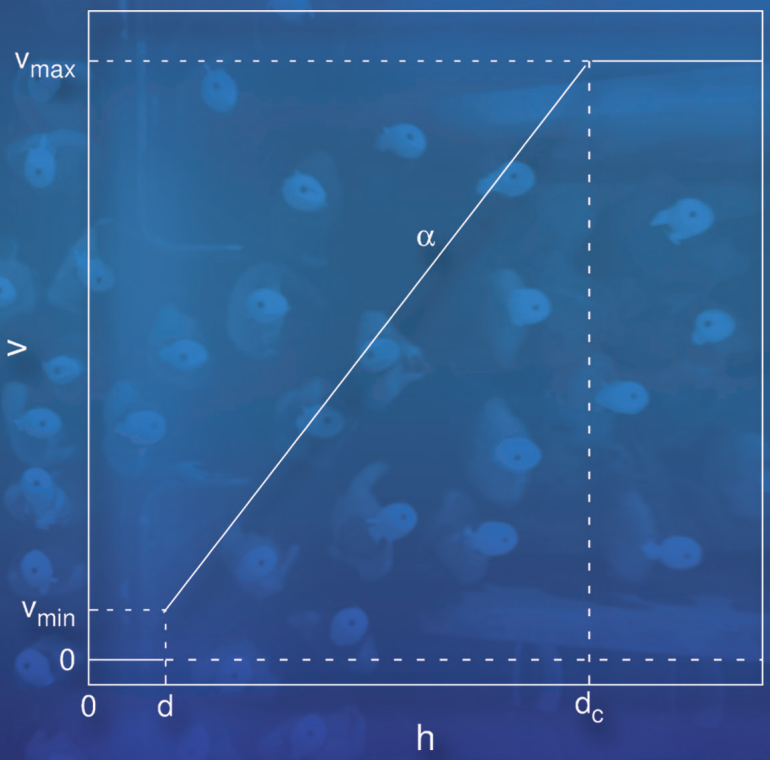
$$v_i = v(h_i), \qquad v(h) = \begin{cases} 0\ \frac{\mathrm{m}}{\mathrm{s}} & , \quad h \le d \\ \alpha(h-d) + v_{\min} & , \quad d < h < d_c \\ v_{\max} & , \quad h \ge d_c \end{cases}$$



Computer simulation of pedestrian dynamics at high densities

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Mitglied der Helmholtz-Gemeinschaft

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The increasing importance and magnitude of large-scale events in our society calls for continuous research in the field of pedestrian dynamics. This dissertation investigates the dynamics of pedestrian motion at high densities using computer simulations of stochastic models.

The first part discusses the successful application of the Floor Field Cellular Automaton (FFCA) in an evacuation assistant that performs faster than real-time evacuation simulations of up to 50,000 persons leaving a multi-purpose arena. A new interpretation of the matrix of preference improves the realism of the FFCA simulation in U-turns, for instance at the entrance to the stands.

The focus of the second part is the experimentally observed feature of phase separation in pedestrian dynamics into a slow-moving and a completely jammed phase. This kind of phase separation is fundamentally different to known instances of phase separation in e.g. vehicular traffic. Different approaches to modeling the phase separation are discussed and an investigation of both established and new models of pedestrian dynamics illustrates the difficulties of finding a model able to reproduce the phenomenon. The Stochastic Headway Dependent Velocity Model is introduced and extensively analyzed, simulations of the model evolve into a phase-separated state in accordance with the experimental data. Key components of the model are its slow-to-start rule, minimum velocity, and large interaction range.

This publication was edited at the Jülich Supercomputing Centre (JSC) which is an integral part of the Institute for Advanced Simulation (IAS). The IAS combines the Jülich simulation sciences and the supercomputer facility in one organizational unit. It includes those parts of the scientific institutes at Forschungszentrum Jülich which use simulation on supercomputers as their main research methodology.

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