Interaction of pedestrian motion and traffic networks

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In urban areas car traffic and pedestrian motion interact in many different situations. For both dynamics separately various models exist. The description of road traffic has a long history and many different models are available. These range from models following a microscopic description [5] to models of a macroscopic viewpoint [1, 3]. For road networks these equations can be combined by suitable coupling conditions [1]. On the other hand similar approaches can be used in order to describe the motion of pedestrians [2, 6, 4].

In the present work we combine existing models for car traffic and pedestrian motion to a coupled description taking the mutual interaction into account. Therefore we extend the flux function of the car traffic by a suitable dependence on the pedestrians on the roads. Similarly influences the traffic density the path of the pedestrians.

In several numerical examples we compare different choices of coupling conditions and their influence on the coupled dynamics. Further test cases consider situations of daily experience e.g. like the the crossing of pedestrians at a crosswalk.

References

[1] G. M. Coclite and M. Garavello and B. Piccoli, *Traffic Flow on a Road Network.* SIAM J. Math. Anal.,3, 2005, 1862–1886

[2] R. Colombo, M. Garavello, M. Lecureux-Mercier, *A Class of Non-Local Models for Pedestrian Traffic.* MMMAS 22 (4), 1150023 , 2012

[3] P. Goatin, *The Aw-Rascle vehicular traffic flow model with phase transitions*, Math. Comput. Modelling, 44 (2006), pp. 287-303.

[4] D. Helbing and P. Molnar, *Social force model for pedestrian dynamics.* Phys. Rev. E, 51 (1995), pp. 4282-4286.

[5] S. P. Hoogendoorn and P. H. L. Bovy, *State-of-the-art of vehicular traffic flow modelling.*J. Syst. Control Engrg., 215 (2001), pp. 283-303.

[6] R. L. Hughes, *The flow of human crowds.* Annu. Rev. Fluid Mech. 35 (2003), pp. 169-182.