TASEP on a Linear Network with a Bypass

Nina Pesheva[1], Nadezhda Banzarova[1,2], Jordan Brankov [1,2]

[1] Institute of Mechanics, Bulgarian Academy of Sciences,
4 Acad. G. Bonchev St., 1113 Sofia, Bulgaria
nina@imbm.bas.bg, nadezhda@imbm.bas.bg

[2] Bogoliubov Laboratory of Theoretical Physics,
Joint Institute for Nuclear Research, 141980 Dubna, Russian Federation
brankov@theor.jinr.ru

Keywords: TASEP; traffic flow models; non-equilibrium phase transitions; traffic on networks; biological transport processes

The asymmetric simple exclusion process (TASEP) is one of the paradigmatic models for understanding the rich world of non-equilibrium phenomena. Interesting realizations of the process on networks with complex geometry have been initiated in [1,2]. Here, we extend our study of TASEP, defined on an open network, consisting of head and tail simple chain segments with a double-chain section inserted in-between [1,3,4]. By considering the case when the two branches of the double-chain section are of different length, we model a bypass on a linear track. This case generalizes also the TASEP with a shortcut [5], where one of the branches has a zero length. Results of numerical simulations for relatively short chains are presented when the current through the system takes its maximum value. The studied system might have interesting implications for the traffic flow control as well as for biological transport processes in living cells. An explanation of this phenomenon is offered in terms of finite-size dependence of the effective injection and ejection rates at the ends of the double-chain section [3,4].

References

[1] J. Brankov, N. Pesheva, and N. Bunzarova, Phys. Rev. E 69, 066128 (2004).

[2] E. Pronina, A.B. Kolomeisky, J. Stat. Mech.: Theory Exp., P07010 (2005).

[3] N. Pesheva , J. Brankov, Position-Induced Phase Change in a TASEP with a Double-Chain Section (a Model of Biological Transport), Biomath 1 (2012), 1211211, http://dx.doi.org/10.11145/j.biomath.2012.11.211.

[4] N. C. Pesheva and J. G. Brankov, Position dependence of the particle density in a double-chain section of a linear network in a totally asymmetric simple exclusion process, to appear in PRE (2013).

[5] Y.-M. Yuan, R. Jiang, R. Wang, M.-B. Hu, and Q.-S. Wu, J. Phys. A: Math. Theor., 40, 12351 (2007).