Hurst exponent in a simple order-book model with the asymmetric simple exclusion process

Daichi YANAGISAWA[*1], and Shingo ICHIKI[2]

[1]RCAST, The University of Tokyo, 4-6-1 Komaba, Meguro-ku, Tokyo 153-8904 Japan

[2]School of Engineering, The University of Tokyo, 4-6-1 Komaba, Meguro-ku, Tokyo 153-8904 Japan

E-mail: *tDaichi@mail.ecc.u-tokyo.ac.jp

Keyword: Hurst exponent, Order book, Asymmetric simple exclusion process, Langmuir kinetics

In [1], a limit order market is modeled with the asymmetric simple exclusion process (ASEP), where orders (bids and asks) are represented with particles. Order and cancellation behavior are introduced by utilizing the Langmuir kinetics (LK), i.e., attachment and detachment dynamics of particles. Price in the model shows crossover from over-diffusion (Hurst exponent $H = 2/3$ in ASEP) to diffusion ($H = 1/2$) with time evolution. Meanwhile, ASEP with LK (ASEP-LK) has been extended in [2]. The normal LK stochastically attaches and detaches a particle to vacant and occupied site, respectively, irrespective to the other conditions. By contrast, the attachment and detachment rates depend on not only the state of the selected site but also its neighboring sites in the extended ASEP-LK. The position of the domain wall, which corresponds to the price, varies with the attachment and detachment rates from that of the normal ASEP-LK. In our research, we exploit the extended ASEP-LK to develop an order-book model as in Fig. 1. The extended LK corresponds to order and cancellation behavior considering the situation of the neighboring orders. We show the Hurst exponent in the extended ASEP-LK also varies depending on the attachment and detachment rates in the model.

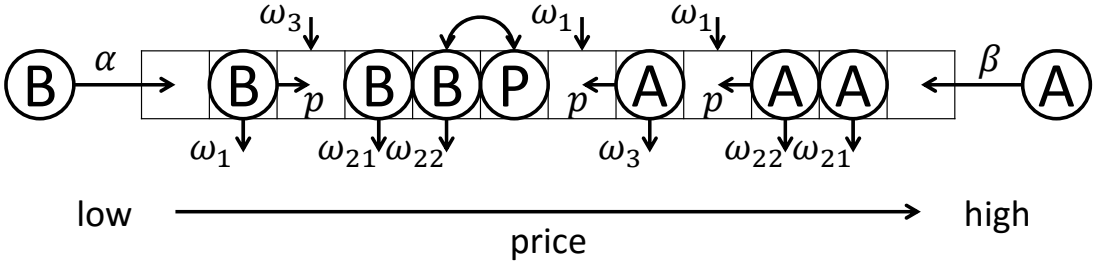

Fig. 1 Schematic view of our extended order-book model (extended ASEP-LK). The particles A, B, and P represent ask, bid, and price, respectively. The parameters $p, \alpha, \beta, \omega_1, \omega_{21}, \omega_{22},$ and ω_3 are rates.

References

[1] R.D. Willmann, G.M. Schütz, D. Challet, Physica A, vol. 316, 430 (2002).

[2] Shingo Ichiki, et. al., Journal of the Physical Society of Japan, vol. 85, 044001 (2016).