

ANALYSING AND QUANTIFYING INTRACELLULAR PARTICLES MOVEMENTS IN 3D LLSM DATA

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Thanks to modern techniques such as Lattice Light Sheet Microscopy (LLSM) or asymmetrical multiangle TIRF microscopy, it is now possible to observe in detail live cell mechanisms in 3D and over long periods of time. In cell biology, analysing and quantifying intracellular dynamics with such cutting-edge microscopy set-ups is of paramount interest to understand cell mechanisms. Several approaches have been then investigated to address these issues : i/ optical flow or motion computation algorithms that allow to visualise the overall inside movements of a cell, ii/ tracking-based algorithms focusing on the motion of particles.

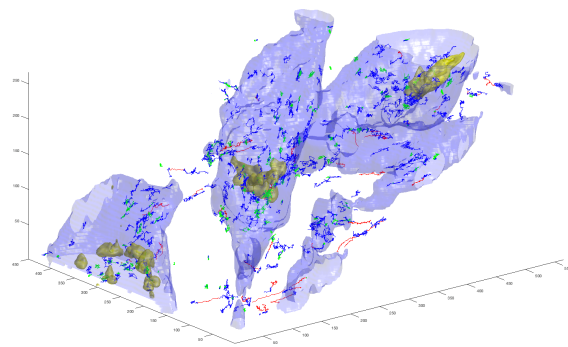


Figure 1. Movements of galectin-3 proteins in a few HeLa cells. The cell membranes are represented in blue, the golgis in yellow. Green, red and blue trajectories respectively correspond to confined, directed and free diffusion processes estimated along individual protein tracks.

In the sequel, we focus on particle tracks and assume that the motions of particles follow a certain class of random process : the diffusion process. Traditionally, confined, directed and free diffusion (namely brownian motion) are the three main types of particle motion that can be observed on cells. However, when we observe a long trajectory (longer than 100 points), it is possible that the particle switches between different motion modes over time depending on the cell environment. Consequently, fitting a single model to the trajectory, as described in [1], can be misleading. Nevertheless, trajectory type classification and change point detection methods can be combined to produce a finer particle movements analysis. We will present a statistical framework based on [1] to solve the problem of particles motion changes. The approach described in [2] is demonstrated on real LLSM images depicting moving particles/ proteins in the cell in interaction with Golgi apparatus.

- [1] Briane et al., A statistical analysis of particle trajectories in living cells, Physical Review E, 2018
- [2] Briane et al., A Sequential Algorithm to Detect Diffusion Switching along Intracellular Particle Trajectories, arXiv:1804.04977v1, 2018