# ML-driven analysis of anomalous diffusion

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In recent years, Single Particle Tracking (SPT) has become a popular method for quantifying the motion of individual particles in living matter with high spatial and temporal resolution. In a typical SPT measurement, the molecules of interest are tagged with fluorescent dye particles. When illuminated by a laser, the tags emit light and their positions can be determined using a microscope. By using lasers that flash at short intervals, the movement of the molecules can be tracked over time. The recorded positions are used to reconstruct the trajectories of individual molecules. These trajectories are then analysed to extract local physical properties of the molecules and their environment, such as velocity, diffusion coefficient (or tensor) and confinement (local density of obstacles).

The analysis of SPT trajectories is not a trivial task due to the stochastic nature of the molecules' motion. It usually starts with the detection of an appropriate motion type of a molecule, as this information may already provide insight into the mechanical properties of its environment. In this talk, several methods for identifying motion types will be presented, starting with the very popular technique based on the mean square displacement of particles, through statistical hypothesis testing and feature-based machine learning, and ending with deep learning classification methods.