Estimating the anomalous diffusion exponent for single particle tracking data with measurement errors. FIMA approach

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The field of biophysics and biomedicine has seen an immense increase in single particle tracking techniques and experimental results [1]. Accurately characterizing the anomalous diffusion of a tracer particle has become a central issue in biophysics [2]. However, measurement errors raise difficulty in the characterization of single trajectories, which is usually performed through the time-averaged mean square displacement (TAMSD). We study a fractionally integrated moving average (FIMA) process [3] as an appropriate model for anomalous diffusion data with measurement errors. We compare FIMA and traditional TAMSD estimators for the anomalous diffusion exponent. The ability of the FIMA framework to characterize dynamics in a wide range of anomalous exponents and noise levels through the simulation of a toy model (fractional Brownian motion disturbed by Gaussian white noise) is discussed. Comparison to the TAMSD technique, shows that FIMA estimation is superior in many scenarios [4]. This is expected to enable new measurement regimes for single particle tracking (SPT) experiments even in the presence of high measurement errors.

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