User Guide for AIM

In our algorithm referred to as Adaptive Intersection Maximization (AIM), three parameters can potentially affect the final drift tracking performance: intersection distance (D), tracking time interval (m), and the radius of the local region (R). However, the impact of these parameters varies.
The intersection distance (D) is primarily determined by the localization precision of the dataset. Typically, its value can be set to around three times the localization precision for optimized performance. However, unlike model-based algorithms, AIM demonstrates robustness even when parameters are not set optimally. As shown in Supplementary Figure S2B, AIM can achieve sub-nanometer tracking precision with a fixed intersection distance (D=20nm) for datasets with resolutions ranging from 10nm to 40nm. This indicates that if users have limited knowledge about the localization precision of their dataset, setting D to 20nm can still yield near-optimal performance.

The radius of the local region (R) is primarily determined by the magnitude of the drift. Typically, its value can be set to around three times the magnitude of the drift to handle extreme jumps in a short period. Recognizing that users might not possess prior knowledge of the drift magnitude before conducting drift estimation, a standard value of 60 nm has been established for most practical applications of SMLM imaging systems. This predetermined value is effective for managing sudden drift changes up to 120 nm within a 0.2-second timeframe. With R = 60 nm, AIM consistently maintains its state-of-the-art performance for all numerical and biological experiments in this study.
The tracking interval (m) is primarily determined by the number of localizations per frame. Typically, it can be set to 20 to 50 frames for large datasets with a large field of view (e.g., 2048x2048 pixels), and 50 to 100 frames for datasets with a small field of view (e.g., 128x128 pixels). For users with limited knowledge of localization density, opting for m = 100 frames is generally sufficient to achieve a nanometer tracking precision for most datasets.

For less experienced users, choosing D=20nm, R=60nm, and m=100 frames should yield satisfactory results across various image sizes and imaging conditions without the need to fine-tune parameters.