

Open-Source Software for Single-Molecule Localization Microscopy

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Abstract

The increasing adoption of single-molecule localization microscopy techniques such as PALM and STORM has spurred the development of a number of software packages to perform the localization and rendering of the data. Each software package differs in a number of aspects, which makes the comparison of the different algorithms non-trivial. Here, we present a summary of the algorithms used in the literature and a number of open-source software packages which implement them.

The process from the raw data to the final localized particles can be divided into five steps: preprocessing, peak detection, localization, sieving and rendering. Each software package has been described according to these different steps. The performance of the different algorithms has been compared on synthetic data, highlighting specifically: precision and recall of the peak detection, localization accuracy of detected peaks, and precision and recall of the entire process.

Algorithms have been tested under selected signal-to-noise-ratio conditions, varying particle densities and sample depth. The particles have all been simulated using a Gibson and Lanni model, which gives a good balance between accuracy and speed, while taking into account optical aberrations commonly present in PALM/STORM setups.

Keywords

Super-resolution microscopy, localization, PALM

