A study on the application of machine learning techniques on 2D and 3D SMLM - SMLM Software Challenge -

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Machine learning techniques are successfully used in many fields, image processing and computer vision among others. Reconstruction software in super-resolution microscopy, on the other hand, are still very user dependent, leading to an error prone processing of the acquired frames; image processing techniques, when exploited, are often very basic. This though now, machine learning has proven his success with respect to intra-class variability, non-rigid geometric deformations and the presence of few training examples, to name a few.

Here, we propose a detection method based on a Support Vector Machine (SVM) approach, which derives ad hoc spatial filters. In such a way, we provide a detection module that intrinsically incorporates the usual perturbations of the fluorescence images such as noise, auto-fluorescence background and deformations from Point Spread Function (PSF). Moreover, it is an approach independent from the shape of the PSF, being then particularly appealing whenever we engineer it to embed axial information, like in 3D. We thus have a parameter-free tool that can learn from data.

The performances of our whole localization pipeline are investigated in 2D, on the synthetic dataset of the 2016 SMLM Challenge; the participation to it has given us a detailed quantitative evaluation as feedback.

Limits and hypothesis for the 3D application are also explored, in particular related to a fundamental question like the behavior in high-density scenario.