REAL-SPACE BASED MULTI-VIEW IMAGE FUSION

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Some of the novel fluorescence microscopy methods (SPIM - Single Plane Illumination Microscope [1]) permit rotation of the sample around an axis normal to the optical axis during the imaging. Such multi-view set of three-dimensional images acquired along different imaging directions relative to the sample provide more information about the sample than any single one of them. The main reasons are i) anisotropic optical resolution of single lens systems and ii) sample opacity (i.e. single view exposes and records different parts of an opaque sample unevenly) The most convenient way to take advantage of the information in such multi-view sets is to fuse the whole dataset into a single three dimensional image.

Recently, a method of fusing SPIM multi-view sets was proposed and it provides an outstanding resolution, especially with large specimens [2]. However, multiple steps of the algorithm were done in Fourier domain, which makes it time consuming and computationally demanding.

Multi-view fusion algorithms consist of i) extensive preprocessing (scaling, rotating, filtering), ii) image alignment and iii) final fusion, i.e. combination of the information from different views. We achieved a vastly improved performance by replacing all Fourier-space based parts of the algorithm by real-space based analogues. Image registration is now done by maximization of mutual information [3] or real-space implementation of normalized cross-correlation. The speed was increased by many orders of magnitude, enabling a large scale multi-view processing of time series. This brings us closer to the final goal: fusing multi-view sets while they are recorded. Our real-space based methods are also able to handle images that include sharp edges (e.g. when the specimen does not fit into the field of view), which often presents a problem in the Fourier-domain based methods.

The algorithm and its implementation will be presented, together with some examples of its application with different biological samples.

References: