BEAD-BASED MOSAICING OF SINGLE PLANE ILLUMINATION MICROSCOPY IMAGES USING GEOMETRIC LOCAL DESCRIPTOR MATCHING

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Single Plane Illumination Microscopy (SPIM) is an emerging microscopic technique that by imaging the biological sample from multiple angles (views) has the potential to achieve isotropic resolution throughout relatively large biological specimens. Existing *intensity-based* techniques for SPIM view registration are computationally intensive and fail to align acquisitions characterized by limited overlap of the views.

We present an alternative registration approach that relies on fluorescent sub-resolution beads added to the mounting medium. The beads serve as universal, automatically-detectable landmarks that facilitate a sample independent registration in a fraction of time necessary for intensity-based registration. For each segmented bead, we store the relative location of its *n* nearest neighbors in image space as rotation-invariant geometric local descriptors. Corresponding beads between overlapping views are identified by matching these descriptors. The bead correspondences are used to simultaneously estimate the globally optimal transformation for each individual view[1]. The final output image is created by combining all views in an angle-independent output space, using volume injection and local content-based weighting. We quantitatively assess the accuracy of the registration in terms of overall bead displacement (approx. 1 pixel) and by comparing the reconstruction with acquisition of the same specimen by an independent imaging modality. We demonstrate the performance of the approach on long term time lapse of *Drosophila* embryogenesis and a high resolution scan of fixed adult *C.elegans*. The approach has proven to be fast, precise, sample-independent, and can be performed on a standard desktop computer.

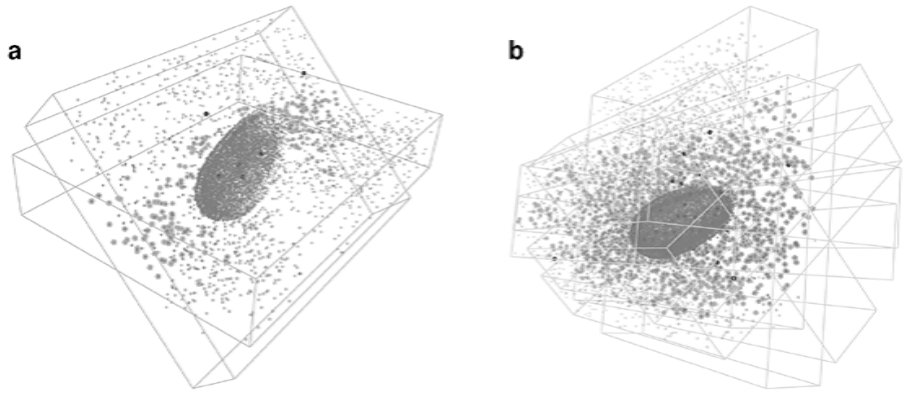

Figure 1. Shown here is a 3D visualization of the bead registration. All emphasized beads are detected as correspondences. (a) visualizes the registration for two adjacent views, (b) shows the registration for all views at once using an affine model.