Local descriptor for retinal fundus image registration

ABSTRACT

A feature-based retinal image registration (RIR) technique aligns multiple fundus images and composed of pre-processing, feature point extraction, feature descriptor, matching and geometrical transformation. Challenges in RIR include difference in scaling, intensity and rotation between images. The scale and intensity differences can be minimised with consistent imaging setup and image enhancement during the pre-processing, respectively. The rotation can be addressed with feature descriptor method that robust to varying rotation. Therefore, a feature descriptor method is proposed based on statistical properties (FiSP) to describe the circular region surrounding the feature point. From the experiments on public Fundus Image Registration dataset, FiSP established 99.227% average correct matches for rotations between 0° and 180°. Then, FiSP is paired with Harris corner, scale-invariant feature transform (SIFT), speeded-up robust feature (SURF), Ghassabi's and D-Saddle feature point extraction methods to assess its registration performance and compare with the existing feature-based RIR techniques, namely generalised dual-bootstrap iterative closet point (GDB-ICP), Harris-partial intensity invariant feature descriptor (PIIFD), Ghassabi's-SIFT, H-M 16, H-M 17 and D-Saddle-histogram of oriented gradients (HOG). The combination of SIFT-FiSP registered 64.179% of the image pairs and significantly outperformed other techniques with mean difference between 25.373 and 60.448% ($p = <;0.001*$).