A Study on the Performance of Invariant Feature Detectors/Descriptors in Confocal Microscopy

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Abstract :

In microscopy the detection, recognition and description of features contained in the images constitute important problems. Recently there have been developed a series of techniques for invariant feature detection/description that can provide the detection of a set of key points in one image, key points that are invariant to effects like rotation, scale changes, noise, illumination conditions and even view-point. Each of these developed techniques has its advantages and its limitations. Several comparisons have been conducted [2,4] for natural images in order to find out which of the techniques provides best performance. A conclusion was not easy to be drawn as the performance of these techniques depends of what is understood by the term of performance. Some are faster but provide less robust key points while other provides an extensive list of robust key points but demand high computational resources. The goal of this presentation is to compare and evaluate the performance in the case of confocal microscopy images of four of these techniques: SIFT – Scale Invariant Feature Transform [1], PCA- SIFT, GLOH [2] - Gradient Location and Orientation Histogram and SURF- Speed-Up Robust Features. By performance we understand invariance to acquisition parameters, and runtime efficiency. We have tried to observe which of the four techniques named above are more robust (invariant) to acquisition parameters changes. We have tested the invariance to pinhole changes, photomultiplier voltage changes, rotation, zoom, and others in three work modes: reflexion, transmission, fluorescence. Providing a set of two images, each of these algorithms output the number of detected key points (invariant features) detected for each of the two images and the number of feature matches between the two. Furthermore we apply RANSAC (Random Sample Consensus) to refine the matches. We evaluate the performance by observing the evolution of the ratio “correct matches per total matches” over acquisition parameter changes. The results are important as invariant feature detection / description techniques play a key role in object recognition and image mosaicing also known as image stitching [3].

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