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A deep learning-based non-rigid image registration of histopathological stained images

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Image registration matches two images geometrically so that corresponding coordinate points in both images correspond to the same physical region of the scene being imaged. These images can be acquired with different sensors (multi-modal registration), at different times (multi-temporal registration), and/or from different viewpoints (multi-view registration) [1]. Image registration constitutes one of the critical research areas for medical image analysis. It finds applications [2, 3], including merging computer tomography (CT) and nuclear magnetic resonance (NMR) data to obtain more helpful information about the patient, disease diagnosis by multi-modal image analysis, monitoring tumor development, treatment verification, etc.

The registration of histopathology whole slide images (WSIs), the digital tissue slides produced by scanning conventional glass slides under microscopy, is vital for modern histopathology image analysis [4]. When preparing histopathology samples, pathologists observe various tissue properties utilizing different stains. There are two approaches to acquiring multi-stained histopathology WSIs: Distinct staining for consecutive tissue sections and multiple staining on the same tissue section. Nevertheless, deformation of the tissue section inevitably occurs, with either method, during the staining process. Digital tissue sections, i.e., histopathology WSIs, that are not aligned accurately at the cellular level pose obstacles to the diagnosis or further processing and, therefore, must be registered first.

The study aims to develop a deep learning-based registration algorithm for multi-stained histopathological WSIs. To develop the algorithm, students will benefit from the previous study [5] that has been done already.

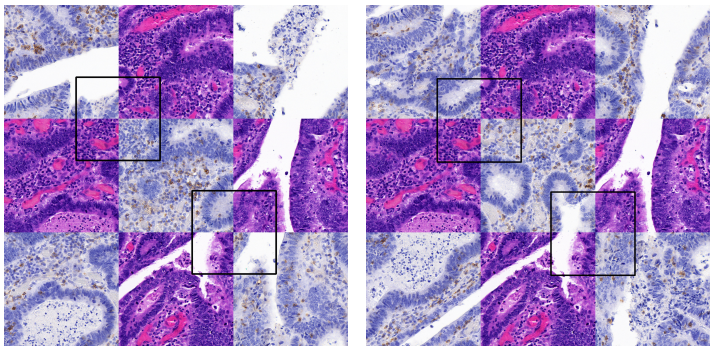

Figure 1: Checkerboard representative images of registered and unregistered H&E (pinkish) and CD8 (bluish) image patches. Unregistered image pairs are shown on the left side, while registered image pairs are seen on the right side.

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