Universität Basel

Research Project

Multi-modal matching of two-dimensional images with three-dimensional data in the field of biomedical engineering

Third-party funded project

Project title Multi-modal matching of two-dimensional images with three-dimensional data in the field of biomedical engineering
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Organisation / Research unit
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Department
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Multi-modal matching is understood as the automatic (elastic) alignment of data, termed regis-tration, from different imaging techniques using the characteristic anatomical features. While satisfying approaches for two-dimensional (2D) to 2D and three-dimensional (3D) to 3D data sets have been developed during the last two decades, the non-rigid 2D-3D registration belongs to the unsolved problems because of the larger degrees of freedom especially for high-resolution 'big data'. The need for 2D-3D registration, however, becomes more and more obvious, as besides the well-established histology, which highlights the functionality in tissue slices according to the selected stain, magnetic resonance (MR) and computed tomography (CT) 3D data with better and better spatial resolution and contrast have been acquired. The combination of the functional information from 2D images with the local physical quantities in 3D recorded, for example, by means of micro CT (μCT) and MR microscopy has been vital to (i) correct preparation artifacts in the histological slices applying the less detailed 3D data, to (ii) identify the issue types in 3D data using the functional information from histology in quantitative manner and to (iii) determine the optimized location and direction of histological slicing. The aim of the project is the development of algorithms for the automatic non-rigid multi-modal 2D-3D registration. Here, we will concentrate on registering histological sections with μCT-data. In a first stage, we will focus on the development of a sparse image registration approach that has the advantage of being robust and computationally efficient. The second stage uses the sparse registration as anchor points while delivering a dense multimodal registration of the two imaging modalities. Finally, the computational effort and the general usability will be optimized to allow the processing of large data sets that are characteristic for high-resolution 3D imaging in biomedical engineering.

Keywords biomedical imaging, histology, validation, micro computed tomography, registration
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Add publication

Published results

4412426, Chicherova, Natalia; Hieber, Simone E.; Khimchenko, Anna; Bikis, Christos; Mueller, Bert; Cattin, Philippe, Automatic deformable registration of histological slides to {μCT} volume {3D}-Data, 0022-2720 ; 1365-2818, Journal of Microscopy, Publication: JournalArticle (Originalarbeit in einer wissenschaftlichen Zeitschrift)

4412465, Chicherova, Natalia; Hieber, Simone E.; Schulz, Georg; Khimchenko, Anna; Bikis, Christos; Cattin, Philippe C.; Mueller, Bert, Automatic histology registration in application to X-ray modalities, Publication: ConferencePaper (Artikel, die in Tagungsbänden erschienen sind)

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