Institute for Data Processing and Electronics
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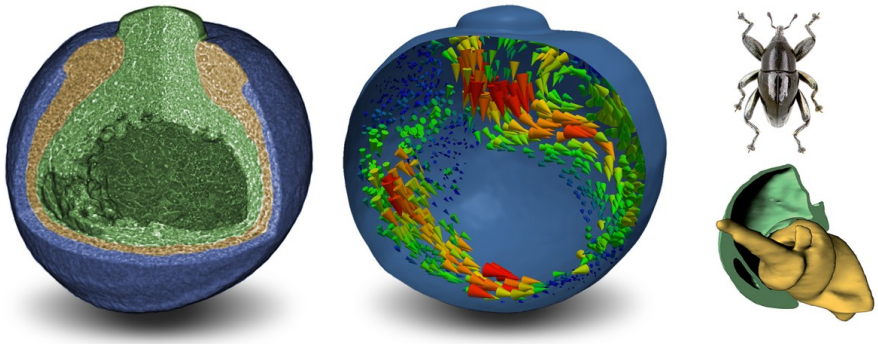
http://www.ipe.kit.edu

Segmentation of 4D X-ray Microtomography Image Sequences

Master Thesis in Computer Science

Recent developments in X-ray microtomography (SR-µCT) facilitate the investigation of internal morphology and structural changes in small living organisms in 4D (3D + time). In order to analyze internal dynamics existing instrumentation records hundreds of 3D volumes with high-resolution within a few minutes. The first step in data analysis is segmented of the functional units. Currently this is a manual task requiring months of work of highly skilled biologists.



Example datasets: 3D rendering of frog embryo in cellular resolution (left); cell and tissue motion captured by flow analysis (middle). A beetle with biological screw joint and digital reconstruction of its parts (right).

Subject Description

The aim of this work is to develop algorithms for semi-automatic segmentation of 4D tomographic volumes and to implement them. One possible solution is to use the optical-flow in sequences of 3D volumes and use it to map manual segmentations of the selected volumes to consecutive frames. The algorithms have to be optimized for the latest parallel computing architectures. The work is embedded in national and international collaborations for high data-rate processing and performed within an interdisciplinary team of computer scientists, synchrotron physicists, and biologists.

Required Skills

Strong C and Python knowledge, numerical algorithms in image processing. Experience with parallel programming is a plus.

Experience Gained

Synchrotron Imaging, 4D Tomography, Image Segmentation, Optical Flow, Parallel programming, GPU programming.

Contact

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