

Selected research topics in Biomedical Engineering

Location: Lecture room 14.03.002, Gewerbestrasse 14, Allschwil

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## Image-based supercomputing in biomedicine

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**Abstract.** Biomedicine and life sciences are experiencing a tremendous boost of imaging information. At the present time, the production of multiple terabyte (multi-TB) footprint images is common. As these images are too large to be examined by commercial soft- and hardware, there is a pressing need for a radical paradigm shift towards supercomputing. Although supercomputers provide us with high speed parallel file systems, abundant aggregate system memory, and exceptional compute power, none of the European biomedical research groups seem to use them to deal with TB images. The successful adoption of supercomputing in biomedical image analysis is hindered by the required know-how, as it involves outstanding cross-disciplinary competences in computer microarchitectures, networking, storage schemes, signal processing, data science, computational sciences, and visualization. This talk will summarize specific challenges that already been successfully mastered towards this goal. Among other techniques, the presentation will deal with a segmentation strategy based on “few-shot learning”, a machine learning approach that relies on extremely small training sets. For the segmentation of glomeruli on TB murine images, a positive precision of 99.9% was achieved on three images by relying on a training set covering less than 2% of a single image.

**Curriculum.** In 2006, Diego Rossinelli received his master in Computer Sciences at ETH Zurich, where he obtained the doctoral title in 2011 for his research in the context of computational flow mechanics. He was acknowledged with the ETH Medal, the Euro-Par Distinguished Paper Award, the ABB Research Prize, and the ETH nomination for the ACM Doctoral Dissertation Award. After the postdoc, he became senior researcher and lecturer at ETH Zurich. He worked on computational approaches in flow mechanics for biomedical applications, and was the recipient of the APS Milton van Dyke Award in 2012, the ACM Gordon Bell Prize in 2013, and finalist of the ACM Gordon Bell Prize in 2015. In 2016, he left academia for a multi-year industry experience. In 2018 was appointed as CTO of Lucid Concepts AG. Since 2020 he is back completely in academia as a supercomputing specialist both for Kantonsspital Aarau and the Faculty of Medicine at the University of Zurich, working on high-risk/high-gain biomedical projects dealing with multi-TB images.