Selected research topics in Biomedical Engineering:
Medically Relevant Experiments with Synchrotron Radiation
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Cutting-edge tomographic imaging at the Diamond Light Source

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Abstract. For biomedical imaging it is particularly important to preserve the natural structure and functionality of the system. Synchrotron radiation enables the acquisition of statistically relevant data across the micro- and nanometer scales with chemical, structural and dynamic information. Our research at the Diamond Light Source exploits advanced imaging modalities to explore insect navigation, lungs and the respiratory system, the auditory system, knee mechanics and brain connectivity. We characterized eye size variation within two species of drosophila to uncover the genetic architecture. Blast injured lung specimens were analyzed with respect to microstructural changes using digital volume correlation. High-frequency X-ray imaging tracked movement of cochlear soft tissue, a system that is difficult to image with other means. In situ experiments determined nanoscale strains in loaded whole joints at low doses and without destructive sample treatments. This information can reveal hierarchical changes in tissue structure and mechanics for a deeper understanding of joints in health and disease. Using high-resolution microtomography, individual cells and dendrites from a human brain were visualized and automatically quantified with a spatial resolution on the nucleolar level.

Curriculum. Christoph Rau has more than 20 years of experience in the field of tomographic X-ray imaging and microscopy with synchrotron radiation and now works as the Principal Beamline Scientist of the Diamond beamline I13L for imaging and coherence. He studied at the universities in Lyon and Berlin and completed the Ph.D. at the University of Montpellier. In the following years he worked at several major synchrotron radiation facilities including the ESRF in Grenoble and the APS near Chicago, before he has joined Diamond Light Source in Harwell, Oxfordshire, to build and operate the I13L first long beamline of the facility. Currently, he is visiting assistant professor at Northwestern University, Chicago and a honorary professor at Manchester University. These days, he is planning the upgrade of the beamline emphasizing collaborations with the biomedical community. The project includes advanced tomography upgrades for high-throughput imaging and nanotomography at cryogenic temperatures.