Selected research topics in Biomedical Engineering:
Medically Relevant Experiments with Synchrotron Radiation
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Expanding the reach of synchrotron X-ray techniques

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Abstract. There is a large performance gap between conventional, electron-impact X-ray sources and synchrotron radiation sources. Electron-impact X-ray sources are compact, low to moderate cost, widely available and can have high total flux, but have limited tunability (broad spectrum bremsstrahlung plus fixed characteristic lines) and low brightness. By contrast, synchrotron radiation sources provide extremely high brightness (coherent flux), are tunable and can be monochromatized to a very high degree. However, they are very large and expensive, and typically operated as national user facilities with limited access. An Inverse Compton Scattering (ICS) X-ray source can bridge this gap by providing a narrow-band, high flux and tunable X-ray source that fits into a laboratory at a cost of a few percent of a large synchrotron facility. It works by colliding a high-power laser beam with a relativistic electron beam, in which case the back-scattered photons have an energy in the X-ray regime. This presentation will describe the working principle of the Lyncean Compact Light Source (CLS), a storage-ring based ICS source, and its unique beam properties. The Munich Compact Light Source (MuCLS), which combines the Lyncean CLS and a beamline with two endstations developed by researchers at the Technical University of Munich, has been operating as a user facility for several years now and has led to many publications, primarily in the area of biomedical imaging. We will discuss demonstrated and potential applications across a wide range of areas such as imaging, diffraction, scattering and spectroscopy. Furthermore, we will illustrate how such an X-ray source can be the cornerstone of a local X-ray facility that complements both conventional, locally installed X-ray instruments and national synchrotron radiation facilities.

Curriculum. Benjamin Hornberger is Director of Product Management for the Compact Light Source, a compact synchrotron X-ray source, at Lyncean Technologies, Inc. In this role, he works with users from research and industry on application needs and requirements and guides product development and roadmap with the company's R&D team. His background is in instrumentation, applications and methods for laboratory- and synchrotron-based X-ray microscopy. Previously, he worked at Carl Zeiss X-ray Microscopy (formerly Xradia, Inc.) in product management and R&D for the Xradia Ultra and Xradia Synchrotron product lines of ultra-high resolution X-ray microscopes. Ben received his M.A. and Ph.D. in Physics from Stony Brook University, where he developed a dedicated detector for phase contrast X-ray microscopy and related data analysis algorithms, software and applications for beamlines at the National Synchrotron Light Source and the Advanced Photon Source.