IRENI – Multi-beam feedback system

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The University of Wisconsin–Milwaukee, together with the Synchrotron Radiation Center (SRC), has designed, installed and is currently commissioning a unique mid-infrared (IR) beamline (dubbed IRENI: Infrared Environmental Imaging) equipped with a Focal Plane Array (FPA) that allows the acquisition of diffraction-limited mid-IR microspectroscopic maps (sample area: 40 × 60 µm²) in under a minute [1]. As a consequence it gives access to chemical information about dynamic processes changing in time like, for example living cells, with high spatial resolution that were previously unattainable.

The beamline is equipped with a feedback system that is designed to reduce beam motion from various sources, e.g., electron beam instabilities, mechanical vibrations due to pumps, etc. The feedback system comprises two independent loops, each consisting of a fast piezo-driven tip-tilt mirror (PZT), an IR/VIS beamsplitter (BS) and a position sensitive detector (PSD) (see Fig. 1). It acts on the entire 3 × 4 multi-beam bundle, not on individual beams. First the beam bundle reflects off of the active PZT mirror, the BS transmits part of the visible portion of the synchrotron light, which is subsequently detected and used as a position input by the PSD. The IR part of the light is reflected onward by the BS. The PSD continuously determines the centroid of the beam bundle and delivers a voltage proportional to the beam deviation from the PSD center to the feedback electronics [2]. The latter outputs a correction voltage to the piezo to counteract any beam deviation. The use of two independent feedback loops permits the compensation of both translational and angular beam deviation and effectively pins the beam bundle in space. This system should contribute to a better signal/noise ratio and reduce noise spikes.

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References