Omnidirectional dark-field imaging on a table-top X-ray source

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We demonstrate the design of an omnidirectional interferometric setup suitable for a table-top source that also allows the retrieval of quantitative dark-field information without the strict constraints on the spatial coherence of the source. An analogous approach to Talbot-Lau grating interferometry is used, where a source grating G_0 is installed right in front of the incoherent source. A two-dimensional array of individually coherent but mutually incoherent pinholes is designed so that each source has enough coherence to generate a circular interference pattern on the detector plane, and that interference patterns from adjacent sources superimpose constructively.

To achieve these requirements, the diameter of the openings in G_0 has to satisfy [coherence formula for g_0, according to p_1, L and D, and the distance between the openings p_0 is constrained by $p_0/p_2 = L/D$, where p_2 is the period of the magnified pattern at the detector plane, and L is the G_0 to G_1 distance (see Figure **??**).

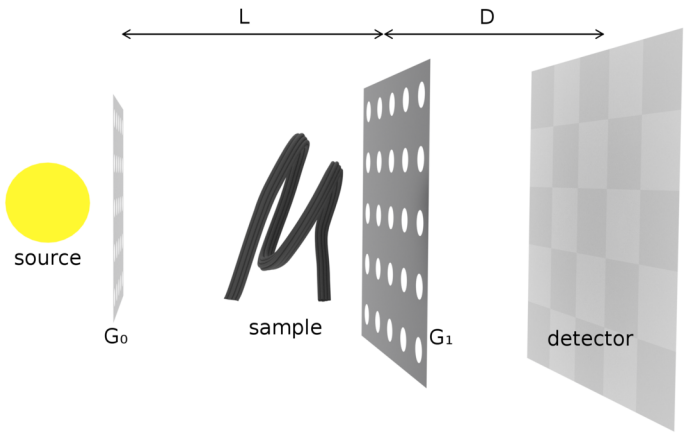

Figure 1: Schematic of the omnidirectional interferometric setup for a conventional table-top source.

The setup has a G_0 to G_1 distance of $L = 57$ cm and a G_1 to detector distance $D = 110$ cm. The source is a COMET MXR-225/26 X-ray tube, with a 1 mm source,operated at a voltage of 60 kV [or 70? which one do we use?] and a current of 10 mA. The image is an average of 20 radiographs with 100 s exposure time each. The detector is a prototype with a CdTe sensor based on the SENTIS by Dectris Ltd. The pixel size is 75 µm, with a sensor thickness of 750 µm. The quantum efficiency of the cadmium telluride sensor is greater than 90% at 60 keV, which ensures reasonable exposure times. As seen in Figure 2, the directional information on the fibers on a subpixel scale can be retrieved in a single shot image on a conventional X-ray

source.

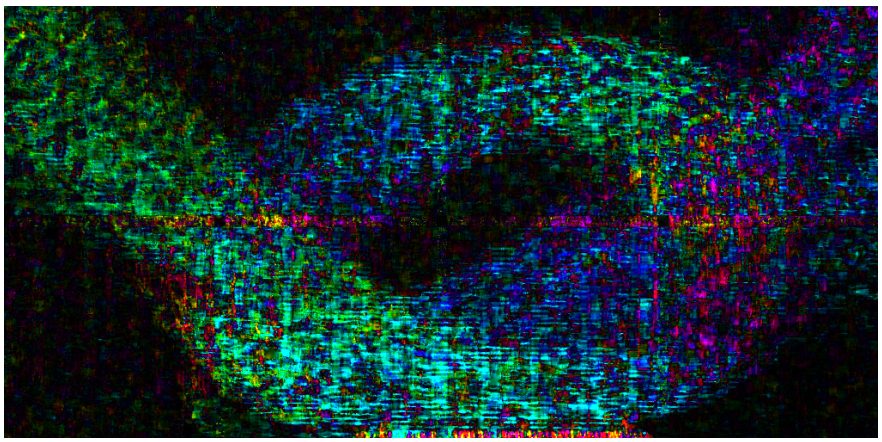

Figure 2: Color-coded image of the principal fiber orientation measured with the table-top interferometer.