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Characterization of a Talbot-Lau X-ray phase contrast system at the Wits Micro-CT Facility

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Grating-based X-ray phase contrast imaging using a Talbot-Lau interferometer has emerged as an effective laboratory-based method to visualize specimens with low absorption contrast [1]. This technique enables simultaneous extraction of absorption, phase contrast, and dark-field images from a single dataset. Characterization studies were undertaken to validate and optimize the performance of the Talint-EDU [2]. phase contrast imaging system installed at the Wits Micro-CT laboratory. Firstly, visibility [3] measurements were conducted through phase-stepping experiments enabling the quantification of fringe contrast across the imaging field. A maximum visibility of 30% was achieved at 40 keV, however, a reduction in visibility was observed towards the grating edges, attributed to minor grating misalignments. Secondly, sensitivity [4] evaluations were performed by varying the sample position relative to the phase grating. The results demonstrated enhanced phase contrast detail when the sample was positioned closer to the phase grating, highlighting the importance of sample-grating proximity in achieving optimal imaging performance. Finally, system stability [2] was assessed through repeated phase-stepping measurements, confirming high reproducibility and consistent imaging performance under identical experimental conditions. Validation experiments were carried out on two biological specimens: a ground beetle and a preserved Myosorex varius foetus. The imaging results successfully illustrated enhanced visibility of delicate skeletal structures and soft tissues via phase and dark-field modalities, surpassing traditional absorption-based imaging capabilities. This study demonstrates the imaging capabilities and identifies the limitations of the Talint-EDU phase contrast imaging system at the Wits X-ray CT laboratory, providing a basis for future applications and system improvements.

References

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