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X-ray phase contrast imaging: An alternative approach to laboratory-based sources

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1. Introduction

Conventional X-ray imaging, based on the absorption of X-rays by various materials, is the standard technique for non-destructive inspection of internal structures. This method is effective for high X-ray attenuation scenarios but encounters limitations when applied to specimens which often exhibit weak absorption contrast due to similar densities among their components [1]. To address this challenge, methods generating radiographic contrast from X-ray phase shifts and scattering have been explored. Among these, grating-based interferometric techniques, specifically the Talbot-Lau interferometer, show significant promise for laboratory-based phase contrast X-ray imaging. This technique employs a series of gratings to create an interference pattern that encodes phase information, enabling the visualization of structures with low absorption contrast [2]. This type of interferometer is particularly suited for use with polychromatic X-ray sources commonly found in laboratory settings due to the introduction of an additional source grating which introduces spatial coherence to the X-ray beam. The spatial coherence is essential for creating well-defined interference patterns downstream in the system setup [3]. In this work, we make use of the Talint-EDU system, a ready to use Talbot-Lau-Interferometer, for implementation to our already existing X-ray computed tomography imaging setup. We conducted a series of characterization experiments to evaluate the effectiveness of our system. These experiments included angular X-ray transmission measurements, system visibility measurements, phase stepping and stability tests, and an assessment of the system's sensitivity as a function of distance from the phase grating. Through these experiments, we were able to optimize the performance of the Talbot-Lau interferometer and ensure reliable imaging results

1. Results

To demonstrate the capabilities of the system, we obtained preliminary images of a pencil and a circuit board. These images showcase the system's ability to obtain phase contrast, absorption, and dark-field imaging and highlight the potential of the Talbot-Lau interferometer system to overcome the limitations of conventional X-ray imaging offering a powerful tool for applications in various research and industrial environments.

1. References

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