Abstract: Realistic Collimated X-ray Image Simulation Pipeline

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Collimator detection in X-ray systems has long posed a formidable challenge, particularly when information about the detector's position relative to the source is either unreliable or completely unavailable. In this paper [1], we introduce a physically motivated image processing pipeline designed to simulate the intricate characteristics of collimator shadows in X-ray images. The primary objective of this pipeline is to address the scarcity of training data for deep neural networks, which are increasingly promising for collimator detection. By applying the pipeline to deep networks initially limited by small datasets, our approach equips them with the necessary information to learn and generalize effectively. Our pipeline is a comprehensive solution that leverages several key components to generate realistic collimator images. Employing randomized labels to describe collimator shapes and their respective locations ensures diversity and representativeness. In addition, we integrate a convolution kernel based scattered radiation simulation mechanism, which is a crucial factor in real-world X-ray imaging. To complete the simulation process, we introduce Poisson noise to replicate the inherent characteristics of collimator shadows in X-ray images. Comparing the simulated data with real collimator shadows demonstrates the authenticity of our approach and its potential to bridge the gap between synthetic and real-world data. Moreover, incorporating simulated data into our deep learning framework not only serves as a valid substitute for real collimators but also significantly improves generalization in real-world applications, holding great promise for the field of collimator detection. The concepts and information presented in this paper are based on research and are not commercially available.

References

1. El-Zein B, Eckert D, Weber T, Rohleder M, Ritschl L, Kappler S et al. Realistic collimated X-ray image simulation pipeline. Proc MICCAI 2023. Springer Nature. 2023.

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