# Optimizing Geometric Shapes as Apertures in Single-Frame CDI: A Simulation-Based Analysis

**Adam Mukharil Bachtiar, Vu Tien-Sinh, and Dam Hieu-Chi**

*School of Knowledge Science, Japan Advanced Institute of Science and Technology, Ishikawa, Japan*

In the advancement of Ptychography, single-frame Coherent X-ray Diffraction Imaging (CDI) has emerged as a promising technique, utilizing X-ray coherence for diffraction pattern generation [1]. However, phase retrieval in single-frame CDI faces challenges like overlapping loss and phase ambiguity. This study explores the use of non-point symmetrical apertures, specifically triangles, and pentagons, to enhance image reconstruction quality in iterative phase retrieval [2,3]. We developed a simulation methodology to analyze the impact of these aperture shapes on phase retrieval. Our simulator generates diffraction images for each shape, which are processed through iterative algorithms and deep learning to reconstruct images. The effectiveness of each shape is assessed by visualizing the loss function results, providing insights into optimal aperture designs for diffraction imaging, and contributing to the resolution of phase retrieval challenges in CDI.

**References:**

[1] Nakasako, Masayoshi, et al. "Methods and application of coherent X-ray diffraction imaging of noncrystalline particles." Biophysical reviews 12 (2020): 541-567.
[2] Kang, Jungmin, et al. "Single-frame coherent diffraction imaging of extended objects using triangular aperture." Optics Express 29.2 (2021): 1441-1453.
[3] Takazawa, Shuntaro, et al. "Demonstration of single-frame coherent X-ray diffraction imaging using triangular aperture: Towards dynamic nanoimaging of extended objects." Optics Express 29.10 (2021): 14394-14402.