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Development of an optical simulation toolkit for transverse beam profile characterization

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The increasing demands for high-resolution beam diagnostics necessitate advanced simulation tools capable of modeling complex wave-optics phenomena. We present an optical simulation toolkit based on the angular spectrum propagation method, validated through comparisons with SRW. For synchrotron radiation interferometer simulations, the toolkit demonstrates excellent agreement with SRW results, showing 97.3% similarity in fringe patterns based on perceptual hashing analysis. The toolkit's unique capabilities are further demonstrated through three key applications: modeling complex mask instead of double-slit interferometers, simulating X-ray pinhole camera with more precise pinhole structure, and analyzing the impact of thermal-induced wavefront distortions on beam profile characterization. HALF's X-ray pinhole camera and interferometry-based dimension measurement subsystem require this toolkit for optimized design. Through its physics-based modeling and wave-optics simulation capabilities, the simulation toolkit provides support for both optimized hardware design and methodology research to enhance the accuracy of beam profile characterization.

Footnotes

Funding Agency

I have read and accept the Conference Policies

Yes

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