Lab 1: Spatial Filtering — Executive Summary

Sessions 1–7 — Ahilan & Nathan

Repository: `https://github.com/Ahilan-Bucket/phys332W-sfu/tree/main/Lab1-SpatialFiltering`

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Summary

Sessions 1–3 established the Köhler illumination optical train, diagnosed and corrected lens orientation errors causing non-uniform illumination, and verified 12.5 lp/mm resolution with $M \approx 1.6$ magnification. Sessions 4–5 completed Setup 2 by adding beam splitter and secondary Fourier camera arm, resolved image doubling through condenser lens realignment, and measured $f_{\text{eff}} = 139$ mm with resolution tests on 26 and 50 lp/mm gratings. Sessions 6–7 demonstrated spatial filtering techniques including low-pass, high-pass, dark-field, and Schlieren filtering on amplitude and phase objects; calibrated the grating period ($a = 100 \pm 3\,\mu$m) with χ^2/DoF analysis confirming model validity; quantified Gibbs ringing ($\Lambda_{\text{ring}} = a/m_{\text{max}}$, overshoot 10–23%); and confirmed dark-field (contrast = 0.84) as optimal for phase object imaging.