5. Conclusion

We have presented an RPTII as a single-shot, high-precision, single-wavelength method for measuring long-range stepped objects without numerical unwrapping algorithms. The technique improves the precision of the reduced-phase dual-illumination interferometer by recording selected phases and phase difference of the three beams simultaneously. The experimental results demonstrate the feasibility of our proposed technique. The maximum measurement range of a conventional interferometric method without numerical unwrapping is the wavelength of the laser used in interferometry. Unlike previous methods, the measurement range of our RPTII can be varied without limit by changing the diffraction orders of the multiple beams projected on a detector array, as long as the noise in the interference pattern is sufficiently small. The measurement range of the RPTII is mostly limited in practice by speckle noises in the interference pattern. The maximum measurement range we can obtain is 3.5 mm, which is 2100 times larger than the wavelength of the laser. Since the noise level of our RPTII can be reduced further by using speckle noise reduction methods, we believe that the maximum measurement range can be significantly improved in future studies. We expect that this method can be used in other phase imaging, digital holography, and interferometry techniques.

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