High resolution point-sensing using template matching to extract phase from spectral interferograms

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Abstract

Dispersed reference interferometry (DRI) is a variant of spectral interferometry and has potential to improve on existing commercial single point measurement techniques such as chromatic confocal (CC) sensors by improving dynamic range. The DRI has previously been demonstrated with a resolution of only 250 nm over a range of 300 µm. However, because DRI is an interferometric technique, phase information is inherent in the generated spectral interferograms and nanometre resolution could be achieved if that information can be extracted efficiently from a single interferogram. This talk describes a method of phase calculation using template matching which is a technique commonly used in image processing. Template matching is used to extract high resolution phase information from an experimental DRI apparatus. Spectral interferogram templates, representing axial measurement positions are generated using a simple simulation of the optical apparatus. These templates are cross-correlated against a spectral interferogram generated from the DRI apparatus. The peak of the resulting correlogram indicates the closest matching template interferogram and allows the inference of a measured position with high resolution. The template matching phase extraction method is evaluated in terms of linearity, resolution and operating range. The computational requirements and avenues for optimisation in this area are also considered.