All-depth dispersion cancellation in spectral domain optical coherence tomography using numerical intensity correlations

In ultra-high resolution (UHR-) optical coherence tomography (OCT) group velocity dispersion (GVD) must be corrected for in order to approach the theoretical resolution limit. One approach promises not only compensation, but complete annihilation of even order dispersion effects, and that at all sample depths. This approach has hitherto been demonstrated with an experimentally demanding 'balanced detection' configuration based on using two detectors. We demonstrate intensity correlation (IC) OCT using a conventional spectral domain (SD) UHR-OCT system with a single detector. IC-SD-OCT configurations exhibit cross term ghost images and a reduced axial range, half of that of conventional SD-OCT. We demonstrate that both shortcomings can be removed by applying a generic artefact reduction algorithm and using analytic interferograms. We show the superiority of IC-SD-OCT compared to conventional SD-OCT by showing how IC-SD-OCT is able to image spatial structures behind a strongly dispersive silicon wafer. Finally, we question the resolution enhancement of root 2 that IC-SD-OCT is often believed to have compared to SD-OCT. We show that this is simply the effect of squaring the reflectivity profile as a natural result of processing the product of two intensity spectra instead of a single spectrum.