Application of speckle and (multi-object) multi-frame blind deconvolution techniques on imaging and imaging spectropolarimetric data

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We test the effects of reconstruction techniques on 2D data to determine the best approach. We obtained a time-series of spectropolarimetric data in the Fe I line at 630.25 nm with the Goettingen Fabry-Perot Interferometer (FPI) that are accompanied by imaging data at 431.3 nm and Ca II H. We apply both speckle and (MO)MFBD techniques. We compare the spatial resolution and investigate the impact of the reconstruction on spectral characteristics. The speckle reconstruction and MFBD perform similar for our imaging data with nearly identical intensity contrasts. MFBD provides a better and more homogeneous resolution at the shortest wavelength. The MOMFBD and speckle deconvolution of the intensity spectra lead to similar results, but our choice of settings for the MOMFBD yields an intensity contrast smaller by about 2% at a comparable spatial resolution. None of the reconstruction techniques introduces artifacts in the intensity spectra. The speckle deconvolution (MOMFBD) has a rms noise in V/I of 0.32% (0.20%). The deconvolved spectra thus require a high significance threshold of about 1.0%. A comparison to spectra with a significantly higher S/N ratio and to spectra from a MHD simulation reveals that the Goettingen FPI can only detect about 30% of the polarization signal in quiet Sun. The distribution of NCP values for the speckle-deconvolved data matches that of observations with higher S/N better than MOMFBD, but shows seemingly artificially sharp boundaries and unexpected changes of the sign. For the spectropolarimetric data, the higher intensity contrast of the speckle deconvolution is balanced by the smaller amplification of the noise level in the MOMFBD at a comparable spatial resolution. The noise level prevents the detection of weak and diffuse magnetic fields.

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