Restoration of the contrast in solar images

Mats Lofdahl *(Institute for Solar Physics)*

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Solar images from the major ground-based high-resolution telescopes are routinely processed to compensate for blurring and distortion caused by turbulence in Earth's atmosphere and only partly removed by adaptive optics. When the seeing conditions are good enough, methods based on multi-frame blind deconvolution, phase diversity, and speckle interferometry deliver images with nearly diffraction limited resolution. This corresponds to good estimates of the core of the short-exposure point spread functions (PSFs). Combining many short exposures results in high-resolution images with high signal to noise ratio. This approach has been used successfully e.g., for studies of the velocity and magnetic fields of small-scale photospheric and chromospheric solar features, and for their temporal evolution.

However, the contrast and spatial power spectra of ground-based solar images are usually severely under-estimated. We know this from recent advances in space-based observations and MHD modeling of the photosphere, that until recently did not agree on the contrast of solar image data. It is now well established that synthetic data from current codes produce data with contrasts and power spectra that well represent reality. This means it is now possible to test methods for estimating the effects of various sources of reduced contrast. We have recently set out on a search for such sources present at the Swedish 1-m Solar Telescope. In this presentation I will discuss some of our findings and some of our ideas for further testing.