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MULTI-HEIGHT PROBING OF HORIZONTAL FLOWS IN SOLAR PHOTOSPHERE USING HIGH-RESOLUTION SPECTROPOLARIMETRY

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Probing of horizontal flows refers to the ability to infer horizontal plasma motion from successive maps of photospheric intensity and/or line-of-sight magnetic field. The most commonly used method for tracking features and calculating velocities is *Local Correlation Tracking* (LCT), and its derivative FLCT (F stands for Fourier). FLCT calculates the relative displacement vector in the x, y plane between two images that makes the patterns of the two features best match each other. In this work, we test the feasibility of recovering plasma flows at multiple atmospheric heights using FLCT. Our work is based on the premise that different spectral lines probe different depths of the solar atmosphere. Namely, spectral line opacity rapidly increases as we approach the line center, with substantial changes occurring at picometer scales. Different wavelengths, experience different opacities and thus sample different layers of the solar atmosphere.

In our work, multi-height diagnostic is achieved by tracking synthetic magnetograms obtained through a robust inversion of synthetic spectropolarimetric observables in two spectral lines: Fe I 525.0 nm and Mg I b2. These two lines probe the low/mid photosphere and upper photosphere/temperature minimum, respectively. We synthesized the polarized spectra of the two lines and then obtained synthetic magnetograms using Milne-Eddington inversion for the Fe I line and weak field approximation for the Mg I line. Tracking vertical magnetic fields inferred from synthetic observations of the Fe I 525.0 nm and the Mg I b2 spectral line yields satisfactory inference for the horizontal velocities in the mid photosphere and temperature minimum ($\log \tau = -1$ to $\log \tau = -3$), respectively.