Investigation of meridional flow pattern from mangetic elements motion

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Meridional flow, which is considered a persistent flow pattern along North-South direction, is important for solar dynamo problem. Despite its importance, observation of the meridional flow pattern is difficult because the amplitude is just ~10 m/s, which is just a few percent of that of convective flow pattern covering the solar surface. Hathaway and Lightmire (2010) succeeded in detecting the meridional flow pattern as an advection of magnetic region patterns between consecutive magnetograms obtained by SoHO/MDI. However, their study is limited to investigate the averaged pattern of magnetic region, not each magnetic element. Hence we try detecting the meridional flow pattern in the magnetic elements' motion in this study, which is more direct detection and enable us to investigate deeper character of the flow.

North-south anisotropy in magnetic elements' motion is invetigated in the magnetograms obtained by Helioseismic and Magnetic Imager (HMI) onboard Solar Dynamics Observatory (SDO). The magnetic elements are tracked by feature-tracking method of magnetic concentrations which is developed by the author. Our feature-tracking method and one-month magnetograms of SDO/HMI enable us to analyze huge number of magnetic elements' motion. More than 5,000 elements are recegnized in one magnetogram with our detecting threshold and 10^8 displacements are obtained as total in our analysis. We found a small anisotropy along north-south direction and it shows similar latitudinal dependence obtained in Hathaway and Lightmire (2010), namely its amplitude increases up to ~14 m/s from the equator to ~60 degree in north and south hemisphere. Further we investigate the dependence of flow strength on magnetic elements character and newly found that larger elements have larger flow strength.

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