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Improved estimation of propagation times of short-term IMF variations using minimum variance analysis and wavelet de-noising techniques

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Short-term variations of the Interplanetary Magnetic Field (IMF), like southward turnings for example, are often associated with disturbances in the geomagnetic field. A challenge in this connection is that solar wind measurements are usually taken at large distances from the Earth, and need to be time shifted in order to be representative for the Earth's magnetopause. Most time shifting methods are based on the assumption that the variations of the IMF are often contained in planar structures, and by using variance analysis to determine the normal of these structures, one can calculate the time delay between a solar wind monitor and a target (in our case: the magnetopause). A drawback with this approach is that the presence of Alfvenic structures or magnetic islands embedded in the solar wind plasma has a negative influence on the resulting normal. By using a wavelet de-noising technique we can minimize this influence without losing the sharp IMF variations, and without loss of time resolution (like in the usual de-noising methods). Variance analysis of the IMF is already used in time shifting studies (see NASA's OMNI-database), and we will show that the results are improved if we de-noise the IMF time series before applying the variance analysis. We will also present a comparative study of the results obtained by using different wavelet basis functions, and different threshold levels.