Project Details

ROSES ID: NRA-03-OSS-01
Selection Year: 2004
Program Element: Independent Investigation: LWS

Project Title:
Resolving the 180 degree Azimuthal Ambiguity in Solar Vector Magnetic Field Measurements

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Summary:
Measurements of the vector magnetic field at the photosphere are crucial to determining the magnetic field topology connecting the photosphere to the corona, and to advancing the understanding of the origins of solar energetic events which propagate through the heliosphere. Inherent in those measurements, however, is a 180 degree ambiguity in the direction of the transverse field in the image plane, which can render the inferred measure of the vector field incorrect if not properly resolved. Numerous algorithms exist for resolving this ambiguity in photospheric vector field data, but all fall prey to: "the answer is straightforward when the active region is simple, but problematic when it's interesting." Shortcomings in the algorithms primarily stem from a lack of information on the variation of the field with height, and rely instead upon a priori assumptions concerning the magnetic field morphology to resolve the ambiguity. Such approaches typically search for the azimuthal solution which minimizes a measure of the complexity of the resulting field over the observed area. While minimizing these quantities results in a "lowest complexity" solution, it is not clear that the Sun itself is in the minimum state. We propose to improve upon this situation in two ways. The capability of the U. Hawai`i/Mees Solar Observatory Imaging Vector Magnetograph (IVM) to obtain polarimetric data in the NaI D-2 spectral line will be exploited. The resulting magnetic field maps, obtained at a range of heights in the solar atmosphere from the photosphere through low chromosphere, will be used to impose div(B)=0 and obtain the correct solution to the azimuthal ambiguity. However, this approach is of limited utility by itself, since most vector magnetic field measurements are available at only a single height. Thus, the multi-height observations will be used in conjunction with model data derived from numerical solutions to Maxwell's equations, to test algorithms which require only single-height photospheric data. Using both multiple-height observations and simulated data, it will be possible to determine whether the Sun is indeed in a minimum state of magnetic complexity, and a quantity which measures that complexity. Then, an efficient and robust algorithm for optimizing that quantity can be determined. Although the algorithm will be developed using IVM vector field data, the code will be made available for use with other vector field data including that from upcoming NASA programs (e.g., Solar-B, SDO).

Publication References:

Summary: ''

Reference: K. D. Leka / NorthWest Research Associates, Inc. - Resolving the 180 degree Azimuthal Ambiguity in Solar Vector Magnetic Field Measurements

Summary: no summary

Reference:
Metcalf, Thomas R.; Leka, K. D.; Barnes, Graham; Lites, Bruce W.; Georgoulis, Manolis K.; Pevtsov, A. A.; Balasubramaniam, K . S.; Gary, G. Allen; Jing, Ju; Li, Jing; Liu, Y.; Wang, H. N.; Abramenko, Valentyna; Yurchyshyn, Vasyl; Moon, Y.-J.; (2006), An Overview of Existing Algorithms for Resolving the 180° Ambiguity in Vector Magnetic Fields: Quantitative Tests with Synthetic Data, Solar Physics, Volume 237, Issue 2, pp.267-296, doi: 10.1007/s11207-006-0170-x