Coronal Loop Mapping to Infer the Best Magnetic Field Models for Active Region Prominences.

Gilmer Gary*†[1], Qiang Hu[1], and Jong Lee[2]

[1]The University of Alabama in Huntsville (UAHuntsville) – Center for Space Plasma and Aeronomic Research The University of Alabama in Huntsville Huntsville, AL 35899, United States
[2]Bowling Green State University (BGSU) – Department of Computer Science Bowling Green State University Bowling Green, OH 43403, United States

Abstract

Imaging has always played a pivotal role in acquiring an understanding of the physics of the solar corona - from the first photographic images of the solar eclipse in 1860 by Secchi, to the coronograph images in 1931 by Lyot, to the Solar Maximum Mission's UVSP images in 1982 by Tandberg-Hanssen, and to today's Solar Dynamics Observatory's images. We will discuss a new, rapid, and flexible manual method to map on-disk individual coronal loops of a two-dimensional EUV image into a three-dimensional coronal loop. This method employs cubic Bezier (*) splines to map an entire coronal loop using only four free parameters per loop. Using the coronal loops as surrogates of magnetic field lines, the set of 2D splines for an active region is transformed to the best 3D magnetic fields for a particular coronal model. The results restrict the magnetic field models derived from extrapolations of magnetograms to those admissible and inadmissible via a fitness parameter. This method is an important tool in determining the fitness of magnetic field models for the solar corona. We outline explicitly how the coronal loops can be employed in constraining competing magnetic field models using the transformed 3D coronal splines. This method uses the minimization of the misalignment angles between the magnetic field model and the best set of 3D field lines that match a set of closed coronal loops. For active region AR 11117, the fitness parameter for potential, Minimum Dissipation Rate, and data-driven MHD models are compared and we also discuss the fitness parameter connection to the magnetic energy. (*) Pierre Étienne Bézier (1910–1999) was a French engineer at Renault and professor at the Conservatoire National des Arts et Métiers, Paris. He patented and popularized, but did not invent, the Bézier curves and surfaces that are now used in most computer-aided design software.

Keywords: magnetic fields, magnetic configuration, coronal loops, active regions, prominences, corona

*Speaker
†Corresponding author: gag0002@uah.edu