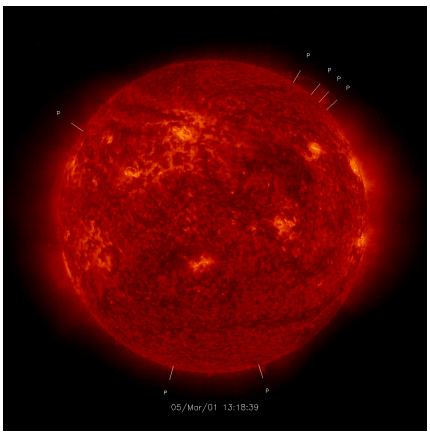
Solar image processing



Large-scale prominence properties over more than a solar cycle

A solar prominence catalogue is being developed based on automatic feature recognition and advanced image processing (Paper I). Depending on the student's interest, the goals will be one or more of: a) Assist with the prominence image reconstruction and tracking over successive frames; b) Use this catalogue covering 12 years of SOHO/EIT prominence observations to derive the evolution of the prominence main characteristics over a whole solar cycle and identify any link with flares and Coronal Mass Ejections; c) Adapt the image processing algorithm to other space-based instruments.

Theory

by Nicolas Labrosse

Although a vast amount of research has been undertaken on forms of active solar regions such as flares and coronal mass ejections (CMEs), very little is known about the evolutionary properties of solar prominences (Paper II). Constructing a solar prominence catalogue would allow the properties of a prominence from appearance to disappearance to be studied. The eruption of solar prominences can potentially result in the production of huge CMEs, which can cause large geomagnetic storms, and solar flares which can disrupt communication and reduce the lifetime of satellites in Earth orbits.

Solar prominences are 100 times denser than the corona, held in place by the Sun's magnetic field. These structures are viewed extending out beyond the limb reaching altitudes of up to 250" above the surface and can exist for several weeks before either erupting or declining.

Observations by the Extreme Ultraviolet Imaging Telescope (EIT) on the Solar and Heliospheric Observatory (SOHO) have provided tens of thousands of solar images in wavelengths of 171, 195, 284 and 304 Å covering more than one of the 11-year solar cycle. Solar prominences are best observed at 304 Å. It is possible for EIT images to contain emission lines from other ions formed in much hotter plasma at similar wavelengths such as Si XI at 303.3 Å. For this reason, 304 Å EIT images can also be used to observe active regions.

Applications

by Nicolas Labrosse

In Paper I we presented an algorithm capable of detecting solar prominences within SOHO/EIT images, with the eventual aim of assembling a solar prominence catalogue. Radial intensity profiles are taken around the limb of the Sun. Support Vector Machine (SVM) classifier analysis uses moments from these profiles to distinguish between the quiet corona, active regions and solar prominences and hence determines which feature is present at each position. If a prominence is detected, morphological opening is used to reconstruct the prominence and remove the coronal background. Physical properties of the prominence can be derived from the resulting reconstructions, permitting the evolution of prominences to be studied once compiled into a catalogue. The algorithm has been proven successful with a misclassification rate of 7%. However there remains a few areas in which it may be developed further.

The aim of this project is to further develop a new technique proposed by a former METEOR student to allow the algorithm to better identify detections and streamline image reconstructions, ensuring that only one entry of each prominence is stored and tracked over time in the catalogue.

See also

Paper I
Paper II

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