Name(s)
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Project Number
S1811

Project Title
Mapping the Sun's Differential Angular Velocity Using Automated Sunspot Detection and Tracking Tool

Abstract

Objectives/Goals
My objective is to create a software tool that detects and tracks sunspots from satellite images and confirm this tool by measuring the angular velocity of the Sun at different latitudes (I will compare this data with current literature).

Methods/Materials
Laptop Computer with Octave (free alternative to MatLab) installed. 5514 SOHO (Solar and Heliospheric Observatory) images.
I created a tool using Octave to process all 5514 images. The tool detects and tracks sunspots while accounting for the 3d spherical geometry of the Sun. With that, I measured the angular velocity of the Sun at different latitudes and times.

Results
As expected, the angular velocity of the Sun is faster towards the equator. The graph of angular velocity v. latitude aligns well with a second-degree function. My tool also showed that the angular velocity of the Sun at a certain latitude is not constant; it changes year to year. This is expected because the complex magnetic interactions within the sun affect the rotational velocity.

Conclusions/Discussion
My measurements of the Sun's angular velocity generally agree with current literature on the Sun, validating my tool. However, my tool still has flaws as indicated by small differences in data. If the tool becomes perfected, there will be a new potential to find new trends on the Sun's surface activity. This is because many of our ideas about the Sun come from hand-drawn images and human measurements, while my tool objectively analyzes satellite images pixel by pixel.

Summary Statement
I created a software tool that tracks sunspots and confirmed this tool by calculating the Sun's differential angular velocity.

Help Received
I received help from my mentor, Nader Satvat. He taught me how to use scientific tools like MatLab (Octave) and Excel.