

Data Intensive Study of Space Weather using Advanced Observations and Machine Learning

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Abstract: I will first introduce the importance of space weather research, and the challenges of data analysis in this subject. I will then summarize some discoveries using the 1.6m Goode Solar Telescope (GST) at Big Bear Solar Observatory (BBSO), with beautiful movies. Several of these works were published in Nature Journals: E.g. (1) The small scale magnetic structure evolution leading to solar eruptions that can affect earth—so called space weather. (2) With highest resolution observations, the photospheric magnetic structure changes can be tracked from flaring polarity inversion lines (PIL) propagating outwards. These include the sudden flare-induced rotation of sunspots and the increase of transverse magnetic fields near PIL. This provides some clear clues to the so-called “Dog vs. Tail” problem. (3) We recently found extremely strong ($>5500\text{G}$) fields in PIL of flaring sunspot in the famous solar active region of September 2017. Finally, I will introduce applications of machine learning and artificial intelligence in processing the “Big Data” from our observations. These examples will include automatic feature recognition and tracking, as well as the forecasting of solar eruptions. Overall, these discoveries have motivated us to collaborate with computer scientists and statisticians.

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