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Computer vision techniques for automated solar magnetic tornado identification

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1 Extended Abstract

Deep learning models become increasingly popular in various fields of astrophysics and science, including the development of so-called special Physics Informed Neural networks (e. g. [1, 2]). Despite the widespread adoption of traditional algorithms in solar physics for identifying magneto-plasma structures on the Sun, such as pixel intensity, optical flow, and pixel gradient-based techniques, a development in this area is slower in comparison with other astronomy branches. In many cases, simplified approaches are sufficient. Several publicly available databases of coronal holes, sunspots, etc. have been developed and widely used. However, when it comes to solar magnetic tornadoes, there is still no proposed algorithm for automated identification of such structures, although a method for detecting chromospheric swirls was proposed [3]. Magnetic tornadoes are defined as magneto-plasma objects in the solar corona in which a magnetic field is twisted independently of the origin. In most cases, a whole magnetic tornado rotates resembling tornadoes in the terrestrial atmosphere. The lack of the methods automatically identifying such structures is one of many problems that prevent studying properties of magnetic tornadoes and processes associated with their formation and evolution. In particular, the filamentary rotating structures are well detectable only at the limb, while one can only assume their existence at the solar disk.

We present two different approaches for automated detection of magnetic tornadoes using deep learning models. The events previously discussed in the literature and found by eye are used as training objects. Examples of the results obtained using different neural networks architectures are shown and discussed.

References

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