Automatic Recognition of Type III Solar Radio Bursts Using Machine Learning

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This study use deep learning to automatically detect the burst information in the solar radio spectrum, which can automatically identify burst type III in the spectrum and mark the bounding box at the corresponding position, giving characteristic parameters such as the burst duration, frequency bandwidth, start and stop frequency, start and stop time, center frequency, frequency drift rate and shape profile.

As the solar radio observation crosses into the new era of high-resolution, high-precision, multi-band and time-domain observation, solar radio observation data also steps into the era of big data. Facing the massive solar radio spectrum, the main task in the next stage is to extract various parameters of solar radio bursts for burst event analysis and related scientific research. The urgent problem is how to quickly, accurately and automatically detect the burst information in solar radio spectrum, identify their types, and extract their burst parameters? This is a major need for solar physics and space weather research, and also poses a major challenge for data processing.

Traditional detection methods cannot meet the needs of massive data processing, so the research on solar radio spectrum detection based on deep learning has started to emerge in recent years. Y.C. Hou[1] et al. used an improved Faster R-CNN deep learning network for automatic detection of spike bursts in solar radio spectrum maps with an accuracy of 91%; Changlin Gao[2] used RetinaNet for automatic detection of type III bursts with an accuracy of 91.8%; Jeremiah Scully[3] used the deep learning network YOLOv2 for automatic identification of real-time type III bursts, achieving 82.63% accuracy. Combining the characteristics of solar radio spectrum burst information and the effects of deep learning target detection network models used by previous authors, we propose to select a deep learning network architecture based on Mask R-CNN for solar radio spectrum burst information detection research.

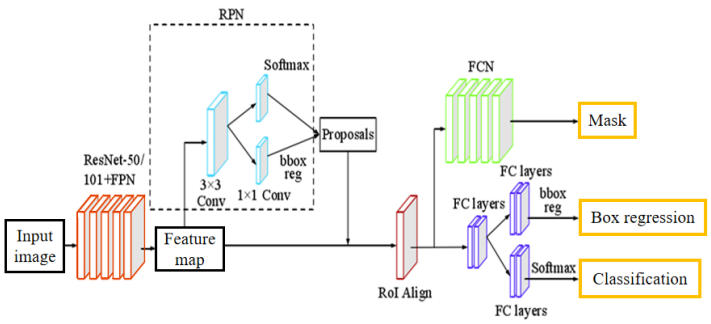

Figure 1. Block diagram of Mask R-CNN based solar radio burst information detection.

This research will further improve the identification accuracy of type III solar radio spectrum, the accuracy and efficiency of parameter extraction, promote the construction of solar radio burst event and parameter libraries, and finally promote the resolution of major scientific problems such as the occurrence of solar burst activities and solar predictions.

References

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