A Novel Approach of Automatic Identification of Solar Type III Radio Bursts with Machine Learning Methods

Bintay Islam Fathma (1) , Zimovets Ivan (2), Sharykin Ivan (2), Koynash Grigory (2)
(1) Moscow Institute of Physics and Technology (State University), Dolgoprudnyi, Russia
(2) Space Research Institute of RAS, Moscow, Russia

Type III solar radio bursts are intense, short-duration bursts of radio waves emitted by the active Sun into the interplanetary medium. These bursts can be observed as fastly drifting stripes in dynamic radio spectrograms, such as those obtained from Solar Radio Spectropolarimeter (SRSP) observations. With the development of solar observational instruments around the world, a large amount of observational data has become available. Manual labelling of the observed data is a tedious task and requires a lot of human effort. Therefore, it has become very demanding to develop auto-classification or identification models to automatically identify Type III solar radio bursts. Recent advances in Machine Learning gives an opportunity in this field of research. In this study, a deep learning model is developed where it uses SRSP data to classify spectrogram data into two classes: Type III solar radio bursts and the background (non-Type III). The study develops and compares Convolutional Neural Network (CNN) from scratch and Transfer Learning Methods for classification of the Type III solar radio bursts. For all the methods at first, a labeled SRSP dataset was created manually. The manual dataset has Type III radio bursts that were selected from May 2025 and background from February to May 2025. The data were preprocessed by applying a natural logarithm to the positive intensity values and were saved in .npy format and resized to a 256x256 shape (grayscale spectrogram patches). In the Transfer Learning Methods, firstly a convolutional autoencoder is pretrained on a large unlabeled dataset (SRSP/ e-CALLISTO / SOLSPEL) to reconstruct and learn general spectrogram features. The pretrained encoder is then reused and fine-tuned with the manually labeled SRSP data to classify Type III solar radio bursts and background. ResNet50 was also used for Transfer Learning, where it was pretrained on ImageNet and then adapted to the SRSP classification task. The CNN model showed weaker generalization, correctly detected 83% of Type III radio bursts and 58% of the background samples. Whereas, the Transfer Learning Methods achieved stronger performance, with correct classification rate of Type III radio bursts and background samples over 90%. These results show that Transfer Learning and Self-supervised pretraining can improve Type III radio burst classification, especially when only a small labeled SRSP dataset is available.