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Solar Radio Bursts Pattern Recognition by Supervised Machine Learning

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Type III bursts are intense, non-thermal sporadic solar radio emissions and can be characterized by their rapid development in time and frequency in the dynamic spectrum. Produced by accelerated electron beams which propagate along open magnetic field lines during the impulsive phase of a flare via the plasma emission mechanism and generated at the local electron plasma frequency $fp \simeq 9\sqrt{n_e}$ kHz (n_e as the plasma density: number of electrons per volume cm^{-3}) and/or its harmonic $2fp$, their frequency ranges from $\sim$ 1 GHz to $\sim$ 20 kHz thus making them observable also by ground-based radio telescopes. Beside a fast drift from high to low frequencies, bursts duration increases simultaneously as the drift rate decreases at lower frequencies. These strong relations between features and type III bursts are very distinct to other bursts that are accompanying the periods of solar activities and represent an excellent candidate for pattern recognition by supervised machine learning. Convolutional Neural Networks (CNNs) enjoy a great success in large scale image and video recognition and will in the present work be used to scan as a sliding window along the time axis over a dynamic spectrum. The data are provided by accompanied large ground based low frequency radio astronomy facilities like UTR-2, URAN-2 or GURT as well as from space-borne observations like STEREO/WAVES and will be stacked along the frequency axis, covering an overall frequency range from 0.1 MHz up to 80 MHz, to extract type III features.