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Automated Chorus Element Detection: Statistics of Wave Properties

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To efficiently analyze the enormous volume of wave data returned from the Electric and Magnetic Field Instrument Suite and Integrated Science (EMFISIS) investigation [1] on NASA's Van Allen Probes, we have been developing automated methods to identify important characteristics of waves in the inner magnetosphere of the Earth. We use new types of combinations signal processing methods to implement autonomous algorithms that can analyze EMFISIS waveform observations to locate and identify the characteristics of individual chorus elements. Specifically, the techniques allow the determination of each individual chorus element and their dependence time and frequency. With this characterization, we can derive the frequency/time sweep rate of chorus elements for large numbers of events with no need for manual identification of the individual elements. This methodology enables statistical analysis of the properties of large numbers of individual chorus elements. Prior to this technique, chorus elements studies have been limited small numbers identified and analyzed by hand. We present an outline of the automated detection algorithm, showing its current level of development (see [2] for the an previous version). As part of this work we show how the deterministic algorithm can then be used to provide a robust training set for machine learning resulting in very good results. We present results of a statistical study which compares chorus power in individual elements to band averages that don't identify specific elements to show that band averages that have been used in the past can be misleading as to the power in the elements themselves.

References

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