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DEVELOPING A TOOLKIT FOR EFFICIENT ANALYSIS OF CADI IONOSONDE DATA

Abstract

The ionosphere is a region of the Earth's upper atmosphere where solar radiation ionizes it. It plays a crucial role in various applications, including radio communication, navigation, and satellite systems. The Canadian Advanced Digital Ionosonde (CADI) is a valuable tool for studying the Earth's ionosphere. However, the CADI system was developed in the early 1990s when computer architecture was limited, and processing power and disk storage were not as powerful as they are today. This has made it challenging for researchers to work with the data and has limited the potential for further analysis.

To gain more valuable insights into the properties and behavior of the ionosphere, providing more efficient and automated methods of analyzing the ionosonde data is needed. The CADI system only provides access to the ionospheric data through ionograms, which provide very limited information (frequency, virtual height, intensity, and time of the start of recording). To effectively provide monitoring and modeling of the local ionosphere, it would be very helpful to have access to the entire information from the ionosonde raw data. This includes the configuration of the transmitter, receiver, and pulses, post-processing methods, the number of active receivers, the exact components of the received signal of each receiver, the exact time of the reception of backscatter, and other raw data.

This paper presents the design of Ionosonde Analysis Toolkit (IAT), consisting of four programs to make it easier for researchers to interact effectively with non-digisonde systems like CADI. IAT includes programs for converting "mdl" files to readable text-based files, extracting key features such as power, frequency, and height to comma-separated values for easy analysis, and two different programs to visualize the data by plotting ionograms. The programs are designed and written in Python. In addition, IAT makes monitoring the CADI system's health easier. By providing a more efficient and automated way of analyzing the data, system-related issues can be quickly identified and resolved. This will help ensure that the CADI system continues to provide reliable data without interruption.

This information will enable new analysis methods such as autoscaling of the ionograms using machine learning. This, in turn, will contribute to improving radio communication and navigation systems, which rely heavily on the ionosphere. In conclusion, IAT provides a significant improvement in the way researchers can work with mdl-based ionosonde data.