Modeling ionograms with deep neural networks

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Abstract:

The use of data-driven approaches to forecast ionospheric parameters is relatively new. Most of the efforts so far are based on the use of Artificial Neural Networks (ANN) and Support Vector Machines applied to TEC measurements (Uwamahoro, 2015) and satellite data (Sai Gowtam, 2017).

As part of a project to estimate electron density profiles from ionosonde data applying machine learning techniques, we have developed a methodology to forecast ionograms using Neural Networks. Our approach runs two networks in parallel, one to model the ionograms and a second one to estimate the critical ionospheric frequency foF2. In this work, we will describe the different neural network architectures that were used to model our data. Hyperparameter tuning was applied to each training to improve the accuracy of our predictions. The models were tested for different solar activity seasons and dataset sizes. The predictions will be compared to measurements collected with the Digisonde system at the Jicamarca Radio Observatory in Lima, Peru. We will also compare our results to a persistence model, and to ionograms estimated using the SAMI2 (Huba, et. al, 2000) and IRI (Bilitza, 2018) models.

Acknowledgment: The Jicamarca Radio Observatory is a facility of the Instituto Geofisico del Peru operated with support from the NSF AGS-1732209 through Cornell University. We also thank the support of Ciencia Internacional, a peruvian non-profit civil association that supports the operation of the Jicamarca Radio Observatory.

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Session: Ionosphere and high atmosphere

Oral or Poster: Oral