3rd URSI AT-AP-RASC, Gran Canaria, 29 May – 3 June 2022

Predicting Ionospheric Dynamics At Low Latitudes Using Neural Networks: Applications to Ionogram and Spread-F Forecasting

Enrique Rojas*(1), Jhassmin Aricoche(2), Reynaldo Rojas(3), and Marco Milla(4)
(1) Cornell University, NY, USA.
(2) Universidad Nacional del Callao, Lima, Peru.
(3) Universidad de Ingenieria y Tecnologia, Lima, Peru.
(4) Pontificia Universidad Catolica del Peru, Lima, Peru.

The state parameters of the ionosphere are of fundamental importance not only for space weather studies but also for technological applications such as satellite radio communications. As with many geophysical phenomena, the dynamics of the ionosphere are governed by nonlinear processes that make ionospheric forecasting a challenging endeavor. However, we have available enormous data sets and ubiquitous experimental sources that can help us find the intricate regularities in these phenomena using versatile statistical models such as Neural Networks.

In the first part of this work we will describe a methodology to forecast ionograms for different solar activity levels, times, and database sizes with deep neural networks. Furthermore, we use an embedded recurrent neural network to estimate the frequency range of each predicted ionogram. The predictions will be compared to measurements collected with a ionosonde at the Jicamarca Radio Observatory (JRO), to a persistence model, and to estimations from the International Reference Ionosphere model. In the second part, we will describe a deep neural network model based on geophysical parameters measured at the JRO that makes predictions of the occurrence of Equatorial Spread F for different times at night. These predictions are compared to a similar model based on $h'F$ and scintillation statistics. Finally, we describe the hyper-parameter optimization of both models and outline further potential developments