

A regularized deep convolutional general adversarial network (R-DCGAN) for total electron content map completion

*Mingwu Jin¹, Zhou Chen^{2,3}, Yue Deng¹, Yang Pan¹, Jin-Song Wang²

1. University of Texas at Arlington, 2. Institute of Space Science and Technology, Nanchang University, Nanchang, China, 3. Key Laboratory of Space Weather, National Center for Space Weather, China Meteorological Administration, Beijing, China

Observations with a complete global coverage are important for space physics research and applications. However, due to the technical limitations and costs, such a complete global coverage is often unavailable. Thus, data filling algorithms are often pursued to fill missing data gaps to create a global map from the incomplete data. In this work, a novel deep learning algorithm, regularized deep convolutional generative adversarial network (R-DCGAN), is developed by adding an extra discriminator to the conventional DCGAN to fill the missing data of total electron content (TEC) map images. R-DCGAN incorporates the knowledge from reference TEC maps of the International Global Navigation Satellite Systems Service Ionosphere Working Group to achieve much better TEC map completion performance than the conventional DCGAN as demonstrated by both synthetic and real data. The R-DCGAN framework can be extended to other fields of space sciences to address the missing observation data issues.

Keywords: Deep learning method, TEC , map completion