PROBLEM SETTING

Signals from Global Navigation Satellite System (GNSS) satellites are altered in phase and amplitude by ionospheric scintillations. These scintillations can cause a loss of spatial tracking and time information.

QUESTIONS

- Are specific structures within the visible aurora more likely to correlate with the occurrence of GNSS phase scintillations?
- Can an unsupervised approach to aurora image classification improve our understanding of this correlation?

DATA SOURCES

TIME SERIES

We measure the ionospheric phase scintillation index (e.g., the standard deviation of the detrended carrier phase, averaged over 60 s).

THEMIS IMAGE CLASSES

7700 manually annotated auroral images, classified among 6 classes

35,277 raw images from THEMIS all-sky imagers are projected onto a latitude-longitude grid. This dataset was used to train the auto-encoder.

SOLUTION

AUTOENCODER

The encoder and decoder use a U-Net like architecture in order to learn image structures at different scales.

RESULTS

Visualization of aurora images in the latent space using t-SNE (left) and UMAP (right). Unsupervised clusters typically correlate with human-annotated image classes and show similar clusters using both ISNE and UMAP.

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