# LOCALIZING IONOSPHERIC IRREGULARITIES IN GNSS RADIO OCCULTATION SIGNALS WITH BACK PROPAGATION METHOD: ASSESSMENT

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The presence of electron density gradients along the ray path during GNSS radio occultation (GNSS-RO) measurements may disturb the signal amplitude and phase strongly, in a phenomenon called scintillation.

Such small-scale irregularities contribute to the high-order terms of the residual ionospheric error (RIE) and are driven, for example, by the occurrence of equatorial plasma bubbles (EPB).

From the modelling perspective, spectral analysis of the sampled signal can better characterise the ionospheric irregularities compared to the intensity of disturbance quantified by scintillation indices. As a complement to the spectral analysis, the back propagation (BP) method can estimate the average location of the irregularity patches.

This approach is based on the Huygens-Fresnel diffractive integral, where the signal amplitude is backpropagated to different auxiliary planes. The diffraction effects are gradually reversed during the process, and the placement estimate is given at the auxiliary plane, where the BP amplitude has minimal fluctuation. The BP method has been previously applied in GNSS-RO measurements showing promising results in the location estimate of ionospheric irregularities but often without complementary data to validate the estimations.

In this work, a control case collocated with other remote sensing techniques was replicated in wave optics propagator (WOP) simulations to assess the capability and accuracy of the estimate obtained with the BP method. In addition, a few more test cases were designed to assess the BP method regarding size, intensity and placement of single and multiple irregularity regions.

The results indicate that the accuracy partly depends on the resolution of the auxiliary planes, the intensity of the disturbance created by the irregularities, the receiver noise level and - in the scenario of multiple bubbles - on the inter-distance between multiple bubbles.