# The NAVSCIN Project: Towards High-Accuracy Navigation under Scintillation

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**SUMMARY**

The main goal of the Marie Skłodowska-Curie Action (MSCA) titled “High Accuracy Navigation under Scintillation Conditions (NAVSCIN)” is to develop an improved strategy to mitigate scintillation –a particular type of space weather perturbation– tailored for satellite-based navigation techniques, in close collaboration with users and manufacturers of these technologies. Indeed, once the scintillation effect is correctly detected and mitigated, the availability and accuracy of the Global Navigation Satellite Systems (GNSSs) receivers will dramatically improve.

Scintillation is one of the most challenging problems in GNSS. This phenomenon appears when the signal pass through ionospheric irregularities, producing rapid changes on refraction index and, depending on the size of such irregularities, also diffractive effects affecting the signal amplitude and the tracking of the carrier-phase measurements. In this work, we present the results being achieved within NAVSCIN to deal with scintillation effects on GNSS signal, exploiting the evidence that low and high latitudes present different characteristics.

At low-latitude, we observe an increase of the carrier phase noise and a fade on the signal intensity that can produce frequent cycle-slips in the GNSS signal and, in extreme conditions, it can lead to the loss of GNSS signals. The detection of these cycle-slips associated with scintillation condition is a challenging problem for precise navigation. In the current state of the art, these uncorrected discontinuities can produce meters of position error. In contrast, we show that high accuracy is still possible for dual-frequency users, if the cycle-slips are detected in a reliable way.

In high latitude, the size of the ionospheric irregularities is typically larger than the Fresnel scale. Therefore, the main effects are related with the fast change on the refractive index associated to the fast movement of the irregularities (which can reach up to several km/s). Consequently, the main

effect on the GNSS signal is a fast fluctuation of the carrier phase, but with a moderate fading in the intensity. Thus, on one hand, this rapid fluctuation of carrier phases is mostly proportional to the inverse squared frequency of the signals, being the effect quite limited (practically null) on the ionosphere-free combination. On the other hand, these fluctuations do not usually produce cycle-slips. These two characteristics make feasible the use of the dual-frequency ionospheric free combination for high accuracy navigation in high latitudes, also during high ionospheric activity.