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A carrier phase delay technique for along-track sea surface slope determination at high spatial resolution

Estel Cardellach (1) and François Soulat (2)

(1) Institut de Ciencies de l'Espai, ICE-CSIC/IEEC, Barcelona, Spain (estel@ice.cat), (2) Collecte Localisation Satellites, CLS, Toulouse, France (fsoulat@cls.fr)

This study presents a new processing technique for radar altimeter systems to retrieve the slope of the instantaneous sea surface along the specular point trajectory at high resolution (kilometer level or below). Initially, the technique has been designed as a way to improve and complement bi-static passive altimetry observation done with signals of the Global Navigation Satellite Systems (GNSS reflectometry or GNSS-R). However, its applicability is not limited to bi-static systems, and it could be extended to mono-static ones such as Doppler altimeters. The technique uses synthetic focusing techniques to obtain a simultaneous stack of reflected EM signals from a broad set of 'scatterers' along the specular point trajectory. The phase information derived from an interferometric processing should be symmetrical with respect to the central (actual) specular point when the surface does not present any along track gradient. Therefore, any surface slopes along this direction will be depicted through the phase asymmetries with respect to the central specular point. We propose an interferometric inversion scheme to retrieve the slope along the track at high spatial resolution, with estimates that are in principle free of media corrections (e.g., tropospheric delay) given the differential measurements applied within baselines of few hundreds of meters. This technique can contribute improving the resolution of fine topographic structures with low-precision group-delay altimetric systems, such as GNSS-R, and it also has potential to improve mono-static Doppler altimeter measurements over open ocean and coastal areas. We will present the technique, the theoretical frame as well as results obtained with synthetic data and preliminary results based on actual data.