An empirical model of SWIM speckle noise spectrum

Xu Wang*[1], Ping Chen*[1], Hauser Daniele*[2], and Patricia Schippers*[3]

[1]Huazhong University of Science and Technology – Chine

[2]LATMOS – CNRS : UMR8190, Université de Versailles-Saint Quentin en Yvelines, Sorbonne Université – France

[3]Analytic and Computational Research, Inc. - Earth Sciences – Earth System Sciences, LLC [Houston] – France

Résumé

The accurate estimation of speckle noise spectrum is very important for the detection of wave directional spectrum. For the spaceborne SWIM, the speckle noise spectrum increases sharply close to the along-track direction, and is difficult to calculate accurately by theoretical formula. Therefore, an empirical estimation method of speckle noise spectrum around along-track direction was proposed (Hauser et al., 2021).

Compared with this method, this paper proposes an empirical model of speckle noise spectrum around the along-track direction, which is different in three aspects. Firstly, the speckle noise spectrum measurement samples are obtained by fluctuation spectrum and the modulation spectrum, this latter being estimated from empirical wave spectra calculated by the wave parameters and measured Modulation Transfer Function read by L2 (no wave impact was taken into account in Hauser et al, 2021). Secondly, according to the time-varying sea surface fluctuation spectrum model (Chen et al., 2021), the speckle noise spectrum has the dependence in wavenumber following a triangle function (or linear when restricted to the positive wavenumber domain), this was validated by the obtained shape of the speckle noise spectrum samples after removing the effect of range average procedure, so the triangle function is used here to fit the speckle noise spectrum dependence with wavenumber. By comparisons, this triangle function was used only outside the along-track direction, but a quadratic dependence was assumed close to the along-track direction (Hauser et al., 2021). Thirdly, here Gaussian function is used to model the dependence of the speckle noise density spectrum with azimuth and to fit the corresponding coefficients, whereas this dependence was assumed linear (Hauser et al., 2021).

In order to validate the presented empirical model, we used it to estimate the speckle noise spectrum, calculate the modulation spectrum and wave slope spectrum, and then calculate the wave parameters (significant wave height, dominant wavelength and dominant wave direction). These wave parameters are compared with those provided by MFWAM reanalysis data. The comparison results are under further study.

*Intervenant