Measuring the Pitch of CryoSat-2, Using the SAR Mode of the SIRAL Altimeter

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When CryoSat-2 is flying pitched, asymmetrical weighting of echo power in the forward and backward-looking beams resulting from the along-track antenna gain pattern can be used to measure its pitch.

Starting with FBR SAR mode ocean data, we form beams at forward and backward look angles with respect to the nadir direction. In SAR mode, because the echoes within a burst are phase coherent with respect to each other, using an FFT across the burst, the so-called ‘azimuthal’ FFT, we locate scatterers in the along-track direction.

Figs. 2 and 3 show the power distribution within and between beams in an average of 1000 bursts of FBR SAR mode echoes.

This method depends on accurate knowledge of the orbit and the altimeter echoes only.

Hence, we are able to compare the results with contemporaneous pitch values measured by the on-board star trackers, and determine a bias in the star tracker pitch measurements.

Because that the star tracker attitude information is used to inform the on-board control system, this bias implies that CryoSat-2 is flying nose up with an average pitch of some 0.055 degrees.

We find the star trackers’ pitch measurement biased by: 0.055 ± 0.0073°.

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