ERS orbit and attitude modelling for interferometric applications

Giancarlo Rufino and Antonio Moccia
Dipartimento di Scienza e Ingegneria dello Spazio "L.G. Napolitano", Università di Napoli "Federico II", Piazzale Tecchio 80, 80125 Napoli, Italy
rufino@unina.it

Abstract

This paper presents a procedure for the reconstruction of ERS-1 and ERS-2 orbital and attitude dynamics. The orbital motion of the satellite centre of mass is obtained by means of polynomial least square approximation of position and velocity vectors, which are supplied along with radar data. The satellite attitude history is computed on the basis of the estimated Doppler centroid frequencies. The clutterlock algorithm is applied to the radar echoes to extract the near and far range Doppler centroid frequencies. The computed values are filtered in order to reduce the effects of noise and non-homogeneity of the scene. Then a simulation of spacecraft dynamics is carried out. First of all the satellite is considered orbiting along the previously computed path at its nominal attitude, which consists of geodetic nadir pointing and yaw-steering. The corresponding near and far range Doppler centroid frequencies are computed and compared to the previously estimated values. An iterative method is applied to determine the perturbed attitude. The procedure ends when the frequencies output of simulation and the ones extracted by clutterlock are coincident. Since the Doppler centroid frequencies are insensitive to roll rotations, provided that they are negligible with respect to the antenna elevation main lobe, only yaw and pitch perturbation can be modelled. This activity aims at the computation of the SAR bidimensional impulse response, which takes account of the satellite real dynamics during acquisition and is adopted for raw data focusing. Finally, to validate the procedure ERS tandem raw data are processed and the correlation coefficients are computed.

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