Optimum Target Trajectory For The SAR Interferometry Repeat Observation Satellite

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The growing interest in earth observation mission equipped with space-borne optical and synthetic aperture radar (SAR) sensors drives the precise accuracy requirements with respect to orbit control. Especially SAR interferometry with its capability to resolve the velocity of on-ground objects and to determine highly precise digital elevation models is of significant interest for scientific and commercial applications. The most important orbit control requirement is to maintain the satellite osculating orbit within a maximum absolute distance of 250 m from a target orbit. For example TerraSAR-X mission, prescribed maximum distance is lowered to 10 m. This study represents the design and computation of the virtual target path, so called reference orbit. Because of the high non-linearity of the problem, previous strategies based solely on analytical calculus are not accurate enough. Thus a new method for the generation of an optimum reference orbit has been developed. The developed method consists of two main steps. First of all, an intial approximate solution is necessary. A good initial guess is found by applying YSOP (YonSei Oribt Propagator) software and eccentricity control algorithm in order to obtain a frozen orbit as stable as possible over a long-term period. Secondly, a non-linear constrained optimization problem is used by the SNOPT (Sparse Nonlinear OPTimization) software. Due to a discontinuity at the end of each repeating ground orbit cycle, the reference orbit that has been calculated by frozen orbit analysis does not satisfy completely the orbit control requirement. Since the numerical optimization technique has been adopted in order to solve a discontinuous problem at the end of orbit cycle. The combination of both numerical perturbation analysis and optimization strategy shows that lowering to 10 m of a repeat-cycle discontinuity. The result of the generation of an optimum reference orbit identifies that the orbit satisfies the requirement of deadband 10 m. Future work have to be applied to guarantee safe ground operation of KOMPSAT-5 Mission performing SAR interferometric imaging.