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SARAS: NEW CONCEPT OF ACQUISITION AID AYSTEM FOR THE FAST LOCALIZATION AND TRACKING OF SATELLITES AND LAUNCHERS

Abstract

Ground stations which are to receive or transmit data from/to orbiting satellites and other spatial vehicles need to know their angular location with increasing precision and accuracy as the beamwidth of the receiving antenna decreases. In many situations, the problem can be solved through complex mathematical models of the vehicle trajectory.

However, those techniques are generally designed for stable or final orbits, with decreasing precision in some critical scenarios where too much inherent uncertainty makes the estimation system less reliable. Thus the initial estimate of the vehicle DoA (Direction of Arrival) must be improved with additional means. Such scenarios include the LEOP (Launch and Early Orbit Phase) of satellites, critical manoeuvres, malfunctioning or anomalies in the nominal orbit and, of course, any complex trajectory which cannot be fitted into the mentioned mathematical models where TTC becomes critical.

An obvious solution to this problem is the reduction of the size of the ground station, in order to increase its beamwidth. When this is not possible, due to link budget considerations, an auxiliary antenna can be included, thus retaining the high gain of the main antenna, and allowing an increased angular search window with the smaller one. This solution, though, has a number of impairments, such as white noise vulnerability, mechanical impact on main antenna or absence of interferer discrimination capabilities.

A fast and robust system for the localisation and tracking of space-borne vehicles in scenarios with great angular uncertainty and highly dynamical characteristics is thus needed. In the frame of SARAS (Fast Satellite Acquisition System) project, co-funded by ESA (European Space Agency) under a GSTP-A (General Support Technical Programme), a new concept of acquisition aid system based on arrays has been developed by ISDEFE. The system is able to estimate the DoA of the desired signal with great precision and accuracy even in very noisy scenarios accomplished through dual super-resolution space and frequency filters; fast localisation using array electronic scan; tracking and prediction features, along with interferer discrimination.

We will be mainly concerned about system and subsystems design including each antenna and the corresponding receiving chain, the Multichannel Digital Processor, Frequency and Time, and the Station Computer. Special emphasis is laid on the calibration system for proper performance. SARAS Test Results are presented after the validation of SARAS on ESA-ESAC Station with VIL-1 antenna and fast moving satellites.