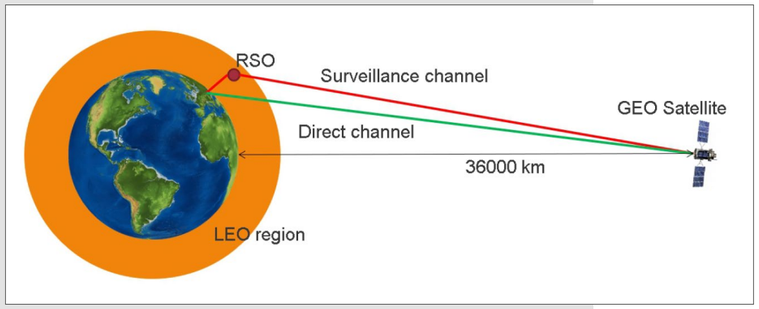
PROJECT SPIA

Passive radar system for the detection of low-Earth orbit objects

The proposed technological solution is focused on the use of a passive radar based on an array antenna that uses signals transmitted from satellite platforms (e.g.: DVB-S/DVB-S2) as illuminators of opportunity. This approach represents an opportunity of particular interest for the detection of space debris, thanks to the very wide coverage that transmitters in geostationary orbit can guarantee. The passive radar architecture allows for continuous surveillance (24 hours a day, 7 days a week), without the use of any own transmitters, thereby minimizing costs and energy consumption. In order to improve the radar detection performance, we propose the adoption of an array antenna formed by a high number of receive-only elements, therefore limiting the realization costs. Moreover, a single receiving element will be equipped with a flexible reception system capable of digitizing high-bandwidth signals. The ability to acquire broadband signals will allow the system to exploit a large part of the energy radiated by the satellite in order to improve the level of SNR. The use of an array of antennas and digital beamforming techniques can enable the achievement of a sufficient gain and the possibility to scan electronically the volume under surveillance.

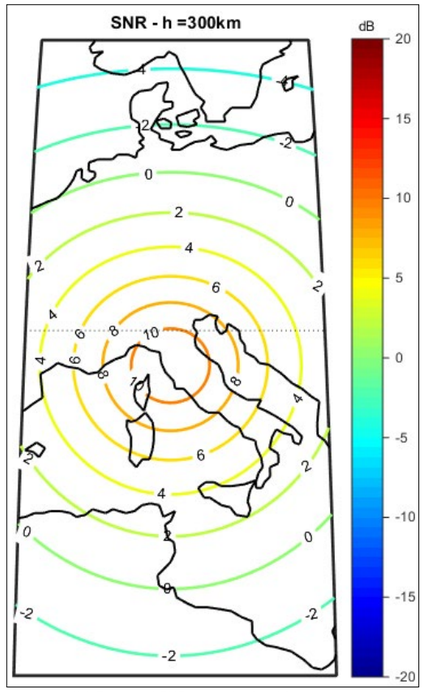


(a) Geometry of a satellite-based passive bistatic radar © [2020] IEEE. Reprinted, with permission, from [L. Gentile, A. Capria, A. L. Saverino, Z. Hajdaraj and M. Martorella, "DVB-S2 Passive Bistatic Radar for Resident Space Object detection: preliminary results," 2020 IEEE International Radar Conference (RADAR), 2020]

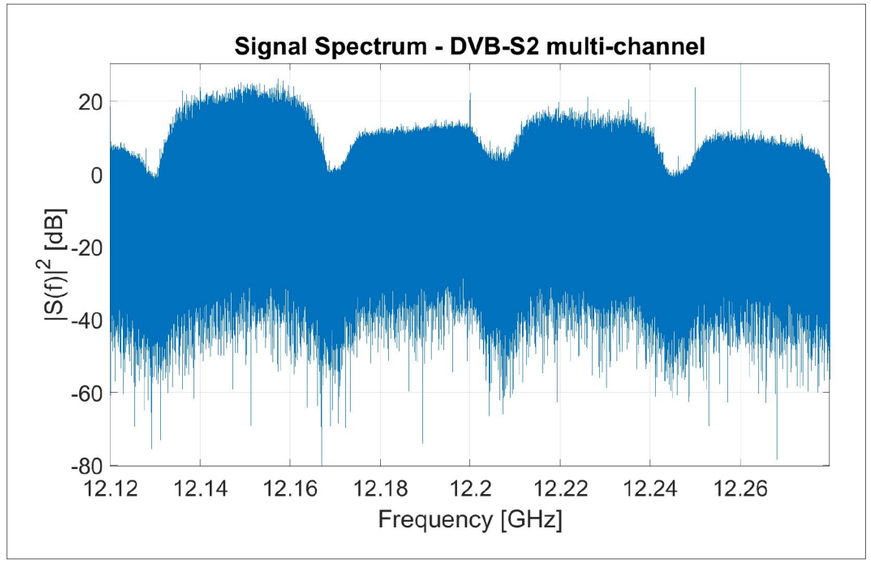
The main objectives of the Phase 1 (first year) of the project are:

- Definition of system requirements;
- Study and definition of the receiver antenna array geometry configuration;
- Study and definition of digital beamforming techniques;
- Study and definition of the signal processing system.

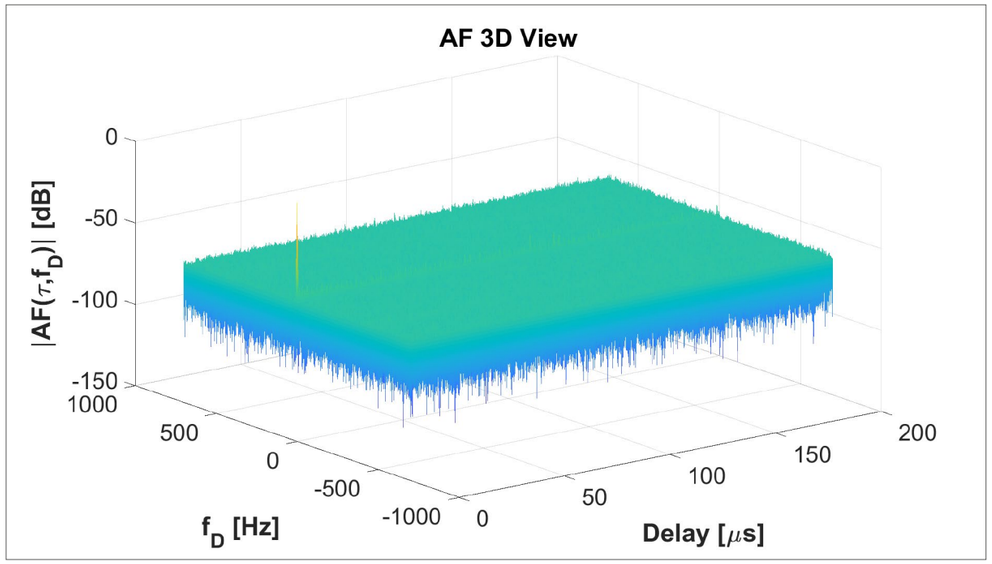
Technical Sheet
Funding institution:
Italian MoD
Project partners
ECHOES S.r.l.
Project duration
February 2020 - November 2020
Involved countries
Italy



(b) Expected SNR map obtained for a target with RCS=20 dBsm at a height=300 km



(c) Measured signal spectrum containing four transponders (Eutelsat Hotbird 13B real data)



(d) Four transponders DVBS/DVB-S2 AF as a function of time delay and Doppler frequency (Eutelsat Hotbird 13B real data)