AIRBUS

Call for pitches – Guidelines for R&T topics

Topic of interest: Space Surveillance and Tracking (SST)

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Short description of research topic:

SST: On-board Data Processing and Compression with Space Based Surveillance System.

Detailed areas of research proposed:

LEO debris population is an increasing threat for operational systems with an estimated risk of $20M/year for the currently deployed fleet of assets in orbit according to a study released in 2020. This trend and value of the related Bayesian risk will increase tremendously in the coming years due to the augmentation of assets to be deployed in the LEO domain (incl. mega constellations) on one hand and to the permanent increase of debris population on the other hand.

Ground based surveillance systems, typically based on radar, can track debris down to 10cm and very soon to 5cm. Unfortunately, debris down to 2 to 4mm are a lethal threat to operational satellites in LEO and cannot be monitored by ground based systems due to the constraints of the laws of physics. This gap in surveillance has to be filled, especially with respect to distribution of debris in LEO, which follows a power law versus the inverse of their size.

In addition, surveillance of LEO resident debris requires accurate cataloguing performance (i.e. accuracy of the components of their state vector such as osculating Keplerian parameters, ballistic coefficient, solar radiation pressure coefficient,..) in order to enable efficient operational collision avoidance services (whereas poor state vector covariance results in unacceptable collision false alarm rates).

An alternative concept to ground based surveillance systems, currently considered by various commercial and governmental players to fill the observation gap, consists of deploying small satellite constellations for in-situ optical detection and tracking of LEO objects (i.e. Space Based Surveillance Systems – aka SBSS). However, due to the observation concept (i.e. short arcs observation, due to optical instruments' narrow field of view), several challenges have to be tackled so as to enable emergence of operational SBSS.

Two of these challenges are identified as potential R&D topics with Australia & NZ.

Target results foreseen (e.g. maturity level to reach, deliverables to produce, estimated timing, etc.):

- Challenge 2

On board observations processing and data volume reduction:

An optical observation SBSS constellation, based on large matrix focal plane, and close to 100% observation duty cycle results in a tremendous volume of raw data. Due to the usual bottle neck in the RF downlink, on board image processing has to be considered in order to reduce the data volume to useful information.

The related R&D stream would consist of assessing the various image processing techniques:

- for PSF deconvolution; snapshots, astrometric registration using stars in the field of view, stars and background suppression,
- debris relative motion deconvolution/registration, and/or

• use of transforms such as Radon or Hough, (so as to increase the SNR above the required detection threshold and determine relative angular positions and velocities of detected debris), • to optimize related algorithms for on-board implementation, and • to benchmark related performances.
Other relevant aspects to consider (e.g. previous experience required working in Defence and Space sector, access to specific facilities or laboratories, etc.) A clear expertise in the technological area and possibilities to bring to the consortia material, laboratories, test-facilities and workforce would be of high interest.