

Agenda – Space Surveillance and Tracking

Summary of the event

This UDRC Themed meeting will investigate the challenges that are involved in Space Surveillance and Tracking in a defence context. It will also be an opportunity for the Astrodynamics Community of Interest (ACI) to attend. This meeting aims to identify synergies, share experiences and views, and to understand challenges in this important area.

Wednesday, November 23, 2016

09:00 to 09:30	Refreshments
09:30 to 09:40	Welcome and introduction, Dr Daniel Clark, Heriot-Watt University
09:40 to 10:10	High order methods for space surveillance and tracking problems <i>Dr Roberto Armellin, Surrey Space Centre, University of Surrey</i>
10:10 to 10:40	Semi-analytical techniques for long-term propagation <i>Dr Camilla Colombo, Politecnico di Milano</i>
10:40 to 11:10	Simplifying and improving Earth Observation with real time satellite tracking <i>Waldemar Franczak, Spectator</i>
11:10 to 11:40	Refreshments
11:40 to 12:10	Target detection and tracking for space situational awareness: specificities and challenges <i>Dr Emmanuel Delande, Heriot-Watt University</i>
12:10 to 12:40	The status of SSA focused R&D work with Dstl: opportunities, experiments and challenges <i>Andrew Ash, Dstl</i>
12:40 to 13:10	Advanced Radar Techniques for Space Target Detection and Classification <i>Adriano Persico University of Strathclyde</i>
13:10 to 14:00	Lunch
14:00 to 14:30	Dstl Challenges
14:30 to 15:30	Refreshments available. Split into groups to discuss solutions to the challenges
15:30 to 16:00	Findings presented and open discussion
16:00	Close

Abstracts

High order methods for space surveillance and tracking problems, Dr Roberto Armellin, Surrey Space Centre, University of Surrey

Space surveillance and tracking systems have to face the challenging problem of accurately managing uncertainties in highly nonlinear dynamical environments. Uncertainties affect all the main phases necessary for the successful realisation of an SST system; e.g. observation planning, orbit determination, collision probability computation, and re-entry predictions. Since the amount of data that must be processed is huge, efficient methods for the management of uncertainties are required. Differential algebraic techniques can represent a valuable tool to address these tasks. Differential algebra (DA) supplies the tools to compute the derivatives of functions within a computer environment and thus it enables the efficient computation of high-order expansions of the flow of ordinary differential equations (with respect to initial conditions and/or model parameters) and the approximation of the solution manifold of implicit equations in Taylor series. This presentation gives an overview on the application of DA techniques to the problems of uncertainty propagation, initial orbit determination, state estimation, and collision probability computation.

Semi-analytical techniques for long-term propagation, Dr Camilla Colombo, Politecnico di Milano (Abstract to be sent)

Simplifying and improving Earth Observation with real time satellite tracking, Waldemar Franczak

An innovative web app is being developed in order to improve and expand the possibilities for earth observation. One of the main goals of the app is to provide accurate prediction for image acquisition. The talk will focus on limitations and problems related to online image acquisition prediction over arbitrary area on earth for single and multiple satellites.

Target detection and tracking for space situational awareness: specificities and challenges, Dr Emmanuel Delande, Heriot-Watt University

The detection and tracking of objects orbiting in the near-Earth space (active or defunct man-made satellites, space debris, etc.) is an increasingly challenging problem, as the number of objects is growing steadily and many of them are unaccounted for. Applying Bayesian estimation techniques to maintain a catalogue of orbiting objects based on observations collected by space sensing assets, while being a topic of growing interest in the space tracking community, is still relatively unexplored. In this talk, we will present the specific challenges of the Bayesian detection and tracking problem applied to space orbiting objects, and present some of our recent works to adapt a generic detection/tracking filtering algorithm to the context of space situational awareness.

Advanced Radar Techniques for Space Target Detection and Classification, Adriano Rosario Persico, University of Strathclyde

The capability to recognize Ballistic Missiles (BM) by defence systems is getting great importance in the last decades. Specifically the identification of real threats in a cloud of interference factors is essential in order to optimize the use of allocate resources in terms of minimization of number of shots per hit and number of tracked targets. In this talk the work developed at the University of Strathclyde in this field is introduced. Firstly, robust models and an efficient warhead classification systems are presented. The results of different micro-Doppler based classification techniques on both simulated and real data will be then presented.

Another Space related challenge is space debris. It is a direct consequence of the space race during the “Cold War” and the consequently increasing of space activities has led to the increasing of debris orbiting around the Earth. A feasibility study for a new system for object detection and tracking based on a passive bi-static radar orbiting in low earth orbit is presented. The idea is to use one or more CubeSATS on very low earth orbits to receive radio signal(s) from any radio source(s) at higher altitude and exploit this signal to detect and track all the objects that are in the bistatic radar geometry composed by the illuminator and the receiver (CubeSAT).