Title: Multi-sensor multi-target tracking techniques for Space Situational Awareness

Abstract:
The UK and its international partners face a range of new challenges and priorities for defence and national security for space situational awareness (SSA). In particular, there is increasing concern about the hazards of space debris and potential harm for satellites and its impact on future space exploration activities. Space debris has largely been caused by waste products from human activity in recent years, and there are now several hundred thousand objects that have the potential to cause significant damage.

It is becoming increasingly important to be able to accurately model and track a large number of objects in order to avoid harm to expensive space-related infrastructure. Advanced surveillance capabilities are needed to be able to identify and monitor activities in earth's orbit. It is critically important to these surveillance activities to be able to detect, estimate, and track multiple potential threats across a variety of platforms with different sensing characteristics. Multiple-target tracking algorithms have been developed since the 1970s, yet these methods can suffer from systematic failure due to heuristics introduced for track management.

A radically different approach to multiple-target tracking has attracted a lot of attention in recent years, called Finite Set Statistics, considers the multi-sensor multi-target tracking problem in a unified way. Estimating target populations holistically enables operators to estimate the correct number of targets in challenging environments where there may be many false alarms and the targets are not always observed. This approach led to principled low computational cost solutions that can be deployed on real-time systems, known as multi-object filters.

This talk will describe the statistical methodology used to develop multi-object filters and show how it can be used to address a range of problems. The methods will be illustrated on a range of applications including space surveillance, maritime surveillance, autonomous robotics, and cell biology. The talk will highlight the unique challenges in multi-sensor fusion for space situational awareness and outline a strategy for addressing them.