**CHAPTER 2**

**LITERATURE REVIEW**

Within the last two decades, the downstream services provided by space-based assets have become a ubiquitous component of everyday life within the European Union and internationally, from satellite television and navigation to environmental monitoring. The European Space Agency (ESA) and European national space agencies currently rely on information from outside sources to form an awareness of these assets and the environment in which they operate. In the near future, this awareness will be provided by a European space situational awareness (SSA) system, which will provide a comprehensive knowledge, understanding and maintained awareness of the population of space objects, the space environment, and the existing threats and risks.

Through its SSA Programme (and its Preparatory Programme), ESA aims to provide key services and information regarding the space environment. The SSA system will comprise three main segments: Space surveillance and tracking (SST) of man-made space objects, Space weather (SWE) monitoring and forecasting and Near-Earth object (NEO) surveillance and tracking The provision of timely, high quality data via the space surveillance and tracking segment is required to maintain an awareness of operational space assets as well as the population of debris objects in Earth orbit. This awareness provides key knowledge that supports space missions and includes the detection of conjunction events, the detection and characterisation of in-orbit fragmentations and the re-entry of risk objects. In addition, knowledge of overall space traffic is required to understand the evolution of the space (debris) environment and to support space debris mitigation and remediation activities.

Space debris represents a significant risk to satellite operations, particularly in the low Earth orbit (LEO) region. Approximately 19,000 objects larger than 10 cm are known to exist, with around 500,000 larger than 1 cm. The number of smaller particles likely exceeds tens of millions. Conjunctions between satellite payloads and other catalogued objects occur at an average rate of 2,400 per day, with operators having to perform collision avoidance manoeuvres in cases where the risk cannot be reduced to an acceptable level by dedicated tracking campaigns. Whilst mitigation guidelines have been adopted and measures implemented by space-faring nations, predictions made by computer models of the space debris environment indicate that the population of orbiting objects will continue to grow even in the absence of future space launches. The remediation of the near Earth space environment is now widely accepted as a requirement for the long-term, sustainable use of this vital resource. A reliable and robust SSA infrastructure will be essential for the development and operation of any remediation technology.

The computational and data-intensive challenges presented by the requirements of a SSA system can be met using a cloud-based computational approach in establishing the applicability of a cloud-based architecture for space surveillance and tracking, algorithm development and comparison.