

# Foreword

## Space Sensors and Space Situational Awareness

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Satellites are needed to monitor local and remote environments, and are equipped with a vast array of different sensors, often as part of a sensor network. They are used for communication, command and control, navigation, intelligence, surveillance and reconnaissance, and are an important asset supporting military operations. NATO operations depend heavily on such support systems in space. Therefore, it is in NATO's interest to ensure that space-based infrastructures are preserved, maintained and improved.

Vice versa, Space Situational Awareness (SSA) is fundamental to understanding all activities in space that may help or endanger missions. NATO aims to make space a full operational domain—alongside land, sea, air and cyber—so the topic of Space Sensors and SSA is of great importance in the context of NATO's "Strategy for Space."

Sensor networks provide critical information with sufficient accuracy and timeliness to support the manoeuvre of military forces and the targeting of their weapons. In addition to existing sensor networks, the advent of small satellites—that can be produced at comparably low cost and launched in great numbers—may help to build up new types of sensor networks with enhanced sensitivity and imaging capability for future Intelligence, Surveillance, and Reconnaissance (ISR) missions.

Supporting the field of SSA is key to ensure independent space access and utilization through timely and accurate delivery of information on the space environment, particularly on hazards to in-orbit and ground infrastructure. A key element in this scenario is represented by Space Surveillance and Tracking (SST), which ensures that Resident Space Objects (RSOs) are continuously detected and tracked. Correct RSO localization ensures that collision avoidance is performed effectively with minimum risk of loss of system functionality. Moreover, awareness about satellite position, attitude, payload and behaviour represents a tactical and strategic advantage for military operations.

In this context, a workshop on "Space Sensors and Space Situational Awareness" was organized in Interlaken (Switzerland) on 10 – 11 October 2022. It brought together different stakeholders (Space Experts, Military Operators and Users), and experts from various fields of research, to discuss recent developments and future requirements in Space Sensors and Space Situational Awareness. The results of related research activities were presented, and the discussion identified technology gaps and recommendations for future research directions, bearing in mind the following research objectives:

- Improving Spaceborne ISR sensor networks and SSA for future military operations and mission support;
- Improving the robustness and resilience of spaceborne military infrastructure through suppression or reduction of potential attack possibilities; and
- Safeguarding essential and vital functions for support of military operations.

The two top contributions to this workshop are now published in the *Journal of the NATO Science and Technology Organization*: “Long Baseline Bistatic Radar for Space Situational Awareness,” by Sarah Welch et al., which looks at a way of countering the loss in sensitivity of radars; and “Future Radar-Based SSA Capabilities Facing the New Space Race,” by Peichl et al., looking at the possibilities for SSA and new radar concepts.