# Relative navigation challenges and solutions for autonomous orbital rendezvous

In the past few years, new mission concepts, such as Mars Sample Return (MSR) and Active Debris Removal (ADR), have led to new challenges regarding orbital rendezvous in general and relative navigation in particular. Navigation must indeed be able to provide relative state estimates over a very wide range of relative distances, from early detection until target capture, with an increased autonomy level, while being robust to environment effects that may degrade measurements accuracy, as well as to uncertainties regarding the target trajectory, its shape, rotation state, inertia characteristics, etc. Moreover in some cases (e.g. ADR), the navigation function must be compatible with uncooperative targets, bearing no navigation aid whatsoever. In order to address these challenges, several navigation solutions have been designed by Airbus Defence and Space and will be described in this paper. They address both far range and short range relative navigation, and both 3-DoF and 6-DoF navigation. Based on standard as well as innovative sensors, these navigation solutions have been extensively tested and validated in high-fidelity simulation environments. As a natural next step in order to prepare future operational missions, these technologies are now foreseen to be demonstrated on demonstration missions in space, covering both MSR and ADR mission cases. These demonstrations will considerably raise the Technology Readiness Level (TRL) of the navigation solutions proposed by Airbus Defence and Space and demonstrate their performances and robustness in a flight context.