Operational challenges for collision avoidance operations

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Abstract. The growth in launch traffic and the emergence of large constellations, the continuing occurrence of fragmentations, and the improved capabilities of surveillance systems increases the number of detected close approaches in space and consequently also the need for automated collision avoidance manoeuvre planning, coordination, and execution. The main objectives of the "Collision Risk Estimation and Automated Mitigation" cornerstone in ESA's Space Safety programme are the reduction of operator and analyst efforts by automating the decision process, shortening the time between manoeuvre decision and close approach, and decreasing the number of false alerts.

Multiple research and development activities have been started in the framework of the programme cornerstone in the past two years to investigate the different aspects of collision avoidance automation. These activities cover topics such as robust design of trajectories avoiding multiple encounters; early identification of events that require mitigation; collision probability computation under large uncertainties; data fusion of multiple catalogues; efficient on-board computations, early identification of manoeuvrable spacecraft.

An important challenge is the impact of the improved detection performance of new space surveillance systems on operations, i.e. the increase of the number of tracked small debris pieces and consequently the number of actionable close approaches. These events may be difficult to assess as the state uncertainty for these currently not catalogued objects can be large depending on the number of observations used for the orbit determination. The presentation outlines astrodynamical and operational challenges due to this changing environment, summarises first findings from the currently running activities, and presents initial analysis results on the avoidance manoeuvres increase in relation to the state uncertainty and detection performance.