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COUPLED MISSION AND GNC ANALYSIS FOR SPACE ROBOTIC MISSIONS

Abstract

Advance space missions, like orbital servicing missions, comprise a high degree of dependencies between subsystems and analysis procedures. Those dependencies are normally not very well represented by today's analysis tools as used for standard space missions. However, advanced space missions already required a high degree of confidence in early mission phases to keep the overall costs low. An efficient approach to achieve such confidence are highly flexible simulation environments, which allow coupled analysis of mission and GNC aspects at the same time already in Phase A of a project. A space robotics simulator will be presented, which combines mission analysis, GNC design and analysis, as well as realistic visualization of the scenario with OpenGL including detailed computation of environmental disturbances utilizing the geometrical knowledge within OpenGL. The ASTOS software provides the highly flexible mission analysis component and exports the real world representation to the GNC simulator, which is implemented in Simulink. The realistic visualization is done by VESTA. It computes the differential forces and moments due to solar pressure and air drag in high accuracy and faster than in real-time and feeds back this information to the GNC simulation. Moreover VESTA mimics the scenario as realistic as possible, which allows to verify the performance of visual sensors. Such sensors are essential for any rendezvous or planetary and lunar landing manoeuvres and are normally difficult to test for complete space scenarios. Finally, an interface for a manipulator arm completes the list of feature. The combination of Simulink - the most widely used software for GNC design and analysis – with the COTS software ASTOS and the open source software VESTA provides an extremely flexible and powerful solution to investigate critical flight phases of advanced mission scenarios. The Space Robotics Simulator has been applied to the German Orbital Servicing Mission and has proven its added value for future space projects. Especially for close approach manoeuvres, like berthing manoeuvres, the coupled analysis is able to give full confidence in proposed strategies or to expose its weak points. The development of the Space Robotics Simulator has been co-funding by a grant of DLR/BMWi.