Entry and Guided Landing Environment (EAGLE) Simulator

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Future European missions to Mars, the Moon and beyond will require the capability to safely land close to sites of special scientific interest. Precision landing will be enabled through the development of advanced Guidance, Navigation And Control (GNC) technologies which will reduce the inherent risks associated with landing on remote bodies such as the Moon or Mars. This paper presents the progress to date on the Entry And Guided Landing Environment, or EAGLE simulator; a multiple-fidelity, multiple-body end-to-end Entry Descent and Landing (EDL) simulator capable of supporting the complete life-cycle of the system and of simulating EDL at any target body. In parallel to this, the activity has identified technologies and areas of expertise which are critical to the success of future EDL missions.

EAGLE will simulate the entire landing scenario, from in-orbit through to the landing module coming to a complete rest on the surface. Additionally, and for the first time, EAGLE will support a mission for the entire life-cycle, from concept to flight and beyond into operational support and decommissioning. The presented solution provides the simulator with three incremental and inter-operational levels of simulation fidelity, as well as a real-time version. The use of inter-operational levels of fidelity allows the simulator to mix component model fidelity levels as required. Thus, the presented solution provides a seamless transition from a low-fidelity simulator for rapid analysis of a concept with, say, a Monte-Carlo campaign through to a high-fidelity simulator for use in, say, real-time on-board software validation and verification.

The traditional approach of creating a sequence of increasingly complex simulators as the mission progress is therefore superseded by the creation of EAGLE. Furthermore, the EAGLE architecture allows interfacing with other ad-hoc tools such as the PANGU planetary surface visualisation tool or even with actual flight hardware. A specific benefit is found in the development of the GNC system which can be developed in a low-fidelity simulator, progressed through the development life-cycle within the same simulator by increasing levels of component fidelity and then finally autocoded and subjected to hardware in-the-loop testing. Therefore, the complete EDL GNC will have been developed from a single thread traced back to the original concept and forward through to operational validation.