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THE NIGHTPOD – AN ORBITAL MOTION COMPENSATION MECHANISM FOR ISS BASED IMAGING

Abstract

In support of ISS Expedition 31 and André Kuipers' long term PromISSe mission, ESA decided to upload a state-of-the-art electro-mechanical system supporting the Astronaut in taking pictures of the Earth at Night from inside the ISS Cupola. In particular, the NightPod will be used for observation of human settlements (e.g. cities, roads, sea establishments), vegetation fires and volcano activities, with an unprecedented resolution of <15m/pixel. The NightPod is a state-of-the-art electro-mechanical system which accommodates commercial optical cameras and compensates for the orbital motion and non-nominal attitude of the ISS. The compensation is achieved by a non-linear motorized rotation of the camera with arcsecond accuracy. The NightPod computer directly controls the camera and synchronizes the non-linear rotation of the pointing axis and the integration time of the camera. The NightPod allows rotation in 4 axes. Two axes are used to align the NightPod to the ISS local nadir direction. The third motorized axis rotates during operation keeping the desired target steady in the camera's field of view for the several seconds integration period. The fourth axis is used to manually point at off-track targets. The NightPod is stowed disassembled and can be easily mounted in Cupola before operation. When assembled, the NightPod interfaces to Cupola via custom made, easy to use locking mechanisms. In this paper the system engineering approach to fulfil the strict technical, safety and programmatic requirements for the development of the NightPod is presented. The NightPod is the first payload installed by ESA in the Cupola. The lesson learned from this project will be beneficial to the development of future payloads for Earth Observation from ISS. The challenging flight hardware design and development process, together with a full Proto-Flight testing campaign, was successfully concluded in only five months in order to be on time for the launch of the Soyuz 29S to the ISS, on the 21th of December 2011. Commissioning has been successfully completed on the 24th of February 2012. The NightPod is part of the Crew standard training

and will be operated by all Crew Members flying to the ISS in the next years. The NightPod is the result of an efficient collaboration between cosine (NL) as prime contractor, Astro-und Feinwerktechnik (DE) as subcontractor, and the directorate of Human Space Flight and Operations (ESA)- HSO. The project is funded by ESA under the GSTP programme, with the support of the Dutch and German delegates.