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DEVELOPMENT OF VIRGO, A MULTISPECTRAL NAVIGATION SOLUTION FOR IN-ORBIT  
SERVICING VEHICLES

**Abstract**

Flight ready rendezvous technology for guidance and navigation and In-Orbit Servicing (IOS) capability will be critical in the near future to the space transportation logistics ecosystem to satisfy the growing institutional and commercial transportation needs. Furthermore, the recent ESA IOS industrial workshop (2022) showed that an estimate of 245 GEO satellites are approaching EOL by 2035, so they would require servicing, life extension or removal to achieve the agency Zero Debris Approach targets for 2030.

To address this critical need, MDA UK together with City University of London are developing VIRGO (Visible and InfraRed Guidance Optics), this is a multispectral camera for guidance and navigation, targeting IOS mission scenarios; the development is funded under the ESA GSTP framework. VIRGO combines two spectral bands, long wave infrared (LWIR) and visible (VIS), with complementary capabilities and matched fields of views, into a single compact architecture together with relative navigation algorithms using sensor data fusion and pose estimation.

This paper will focus on the target scenario applications, present key capabilities and advantages offered by the VIRGO camera solution, and show preliminary test results of the engineering model (EM).

VIRGO's baseline design is targeting mid- to short-range cooperative rendezvous and docking, and so it utilises a bespoke pose estimation algorithm which assures effectiveness from 250 m down to 5 m distance to the target. The system is designed with modularity in mind with flexibility to expand functionality with inclusion of additional visible subsystem for wide-angle inspection and docking (< 15 m) or long range (> 250 m) instead.

VIRGO offers numerous benefits that would not be attainable from a separated combination of cameras. The end-user could acquire an infrared and visible cameras and use these concurrently but VIRGO is sensitive to both these wavebands on one common optical axis, with impacts of parallax, offsetting and calibration minimised. The navigation algorithm provides regular updates of position and attitude of the target to allow safe guidance of the chaser spacecraft; with the additional benefit of the multispectral sys-

tem allowing operation in a multitude of illumination conditions and providing more robust information to the algorithm than separate optical systems could.

VIRGO EM is being manufactured and is expected to reach TRL 6 within the current calendar year, this will be achieved by verifying critical functions of the unit in relevant environment.