

ASTRODYNAMICS SYMPOSIUM (C1)
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PANGU-4 SIMULATION TOOL FOR THE TESTING OF VISION-BASED NAVIGATION FOR
PLANETARY LANDERS**Abstract**

PANGU (Planet and Asteroid Natural scene Generation Utility) is a powerful toolset for modelling the surfaces of planetary bodies such as Mars, the Moon, Mercury and asteroids using real and synthetic data. It has the ability to generate camera, LIDAR and RADAR images from any position and orientation to support off-line and closed-loop simulations of planetary landing, surface roving and in-orbit rendezvous operations. It is designed to provide a high degree of realism while operating at near real-time speeds on current desktop PCs with graphics cards that support OpenGL and programmable GPU shaders. PANGU was developed by the University of Dundee for ESA and is currently being used on many ESA studies and development projects aimed at producing precise and robust planetary lander guidance systems.

The aim of the PANGU-4 activity is to enhance the existing PANGU planet and asteroid simulation tool so that it can be used to verify and validate vision-based navigation systems throughout the design and qualification phases of ESA space programmes, using real-time avionics hardware in the loop. The PANGU-4 tool will be used to support landing missions on the Moon, Mars and asteroids. Existing functions of PANGU are being improved, new surface analysis tools provided, new capabilities added and the performance improved to support real-time rendering and as far as possible “faster than real-time” rendering to support Monte Carlo simulation campaigns. As PANGU-4 will be used to validate flight equipment extensive verification and validation of both the PANGU-4 tool and the images generated is being carried out with strong emphasis on realism.

The paper will introduce PANGU and describe the enhancements being provided for PANGU-4. The approach being taken to verification and validation will also be described. The paper will be illustrated by images and video clips of important application scenarios.