IAF SPACE EXPLORATION SYMPOSIUM (A3)
Interactive Presentations - IAF SPACE EXPLORATION SYMPOSIUM (IP)

Author: Dr. Jérémy Lebreton
Airbus Defence & Space, France

Mr. Roland Brochard
Airbus Defence & Space, France

HIGH PERFORMANCE LUNAR LANDING SIMULATIONS

Abstract

Airbus is participating in a worldwide effort led by space agencies to take the next steps to the Moon. The new generation of spacecraft will embed vision-based navigation (VBN), which offers a reliable and efficient solution for autonomous precision landing. The development and validation of algorithms is based on simulated images generated from real terrain models. Absolute navigation requires particularly representative simulations because the navigation is performed relative to a terrain database. Therefore terrain models accuracy is a performance driver for the mission. For this reason Airbus decided to develop a global image simulator of the Moon targeting unprecedented spatial resolution and real time. The simulator uses Airbus high performance rendering engine (SurRender® software) and open source datasets from past Lunar missions. Our first approach is to analyze lunar topographic data from NASA (Lunar Reconnaissance Orbiter). LRO (Narrow Angle Camera) offers global coverage with multiple image pairs. This opens the possibility of stereo reconstruction using NASA (Solar System Treks Mosaic Pipeline). We assess the achievable image quality targeting at least 5m accuracy on selected sites. In a parallel approach we download datasets from China Chang'e-2 mission, consisting of a high quality DEMs (Digital Elevation Models) with native resolution of 20m and albedo maps at 7m resolution. The 188 (DEM) + 750 (albedo) tiles map the sphere using several projection systems representing over 1 TByte. We assemble the mosaic using SurRender highly efficient build conemap algorithm which guarantees physical correctness of the results. The next step is to simulate synthetic views taking profit of the unique performances of SurRender raytracer. Because it faces challenging requirements (gigantic datasets, physical realism, etc.), SurRender implementation competes with the state-of-the art of the computer graphics industry. Major optimizations were introduced for these demanding simulations, as well as new tools, interfaces and extended support of data standards (Planetary Data System, GeoTIFF, geomapping). We achieve the goal of simulating full-field 1024x1024 images in raytracing at 10Hz on a 16core CPU without compromising on quality. Furthermore simulations can be augmented with synthetic features - procedural textures, rocks and craters - to artificially increase the DEM resolution. The Lunar simulator is now used in a real time closed-loop GNC simulation environment to validate the navigation chain of future missions. This high performance simulator will be one of the backbones of Airbus ambition to contribute to a new era of Lunar exploration.