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SYMPOSIUM ON BUILDING BLOCKS FOR FUTURE SPACE EXPLORATION AND DEVELOPMENT (D3)
Systems and Infrastructures to Implement Future Building Blocks in Space Exploration and Development (2)

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STEREO-VISION LOCALIZATION AND MAPPING ON EMBEDDED SYSTEMS FOR PLANETARY MICRO-ROVER NAVIGATION USING GPU COMPUTED CHARACTERISTIC FEATURES

Abstract

The computational power of current planetary rovers is constrained by many factors including restrictive power sources, limited mass allowances and device radiation susceptibility. These computational limits hinder the abilities of small, efficient and low-cost micro-rovers to effect autonomous navigation or other complex actions – path planning, scientific investigation and sensor fusion capabilities are all affected. The use of simultaneous localization and mapping (SLAM) for navigation is a common component of autonomous rover control. It is expensive in terms of computational and power requirements due to the volume of data processing and the demands of the sensing devices. To permit a reduction in both computational and power requirements placed upon the micro-rover, the image characteristic features are processed via the graphical processing unit (GPU) of a low-powered system-on-a-chip (SoC) computing platform. This paper will outline the methods and implementation of this system using a commercial micro-rover platform; a commercial low-power SoC with an embedded GPU; image processing for characteristic features using said GPU; a SLAM implementation based upon FastSLAM2. A working and testable SLAM implementation is created for an existing rover chassis using commercial, low-power SoCs; the computational system power demands are reduced from the baseline system; the computational performance is increased from the baseline system; a functioning, autonomous micro-rover platform is demonstrated.