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# AUTONOMOUS IMAGE PROCESSING FOR LUNAR SURFACE ANALYSIS USING CUBESAT-BASED AI

**Abstract**

CubeSats have revolutionized space exploration by providing cost-effective solutions with advanced capabilities. One of the main challenges in lunar exploration is the real-time analysis of surface images, particularly for detecting meteoroid impacts and geological features. Traditional methods rely on ground-based processing, which introduces delays and limits mission autonomy. To address this, we propose an innovative approach that integrates onboard AI-based image processing within a CubeSat, enabling autonomous lunar surface analysis and reducing dependency on Earth-based communication. This advancement enhances mission efficiency by allowing immediate decision-making for scientific observations. The proposed CubeSat system features a high-resolution camera and a low-power AI processor capable of running convolutional neural networks (CNNs) for image classification. The AI model is trained on a dataset of lunar images, including meteoroid impact flashes, craters, and other geological formations. The CubeSat captures images of the lunar surface and processes them in real time, identifying and classifying key features. Processed data is then compressed and transmitted to Earth, significantly reducing bandwidth requirements. The system is validated in a simulated lunar environment to assess its accuracy and efficiency. This study demonstrates the feasibility of integrating AI-based image processing into CubeSats for autonomous lunar surface analysis. The key innovation lies in the combination of low-power AI processing with high-resolution imaging, an approach that has not been extensively explored in previous CubeSat missions. By minimizing the need for continuous communication with Earth, this system enables faster decision-making and more efficient data management, paving the way for more autonomous and cost-effective lunar exploration missions.