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AUTOMATIC DATA PROCESSING FOR SPACE ROBOTICS MACHINE LEARNING

Abstract

Autonomous terrain classification is an important problem in planetary navigation, whether the goal is to identify scientific sites of interest or to traverse treacherous areas safely. Past Martian rovers have relied on operators painstakingly finding a navigable path from transmitted imagery. While Perseverance has moved towards a more autonomous solution with its obstacle avoidance Enhanced AutoNav algorithm, there is still much room for improvement. Our goals on Mars in the next few decades will eventually require rovers who can autonomously move farther, faster, and through more dangerous landscapes–demonstrating a need for improved terrain classification for traversability. Autonomous navigation through dangerous extreme environments will enable the search for water on the Moon and Mars as well as preparations for human habitats. Advancements in machine learning techniques make this more achievable, but classification results are limited by the availability of training data suitable for semantic segmentation methods. This proposed project develops an automated pipeline for processing publicly available data for input to machine learning frameworks to enable learning for terrain classification. Our approach involves re-projecting pre-labeled orbital segmented images into sparse annotations of ground terrain to provide labels aligned with data collected in situ. Our method can eliminate manual image labeling of data collected in situ in order to efficiently create segmented terrain data suitable for training machine learning methods. In future work, this automated data processing pipeline will be leveraged for development of machine learning methods for terrain classification. This approach can also be applied to extreme environments on earth, demonstrating that research for space applications is additionally beneficial for solving global challenges.