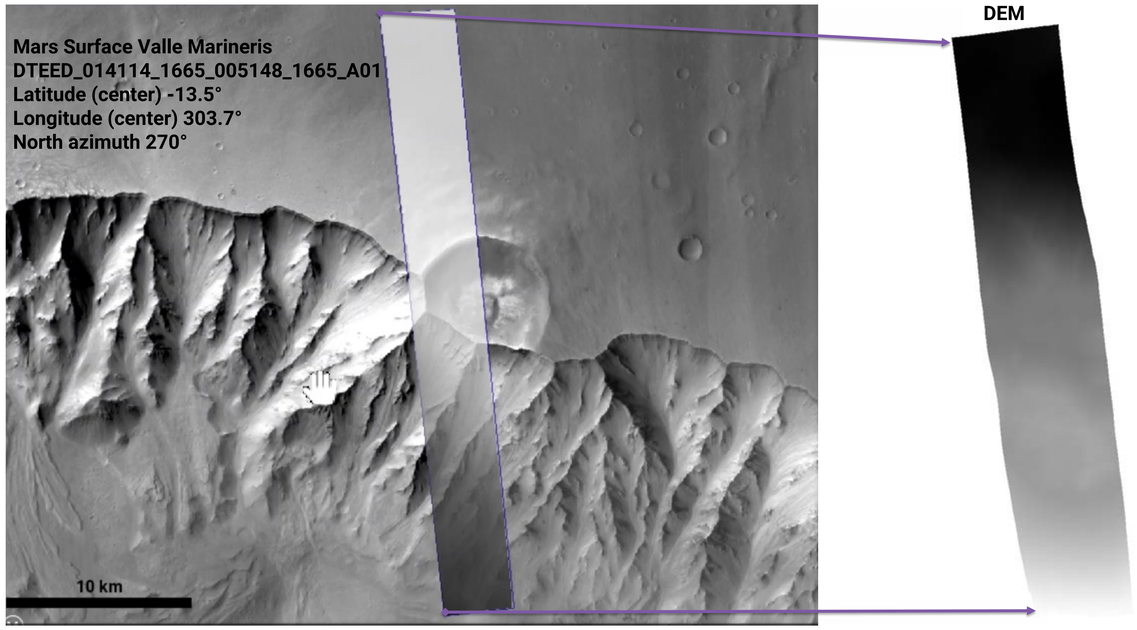
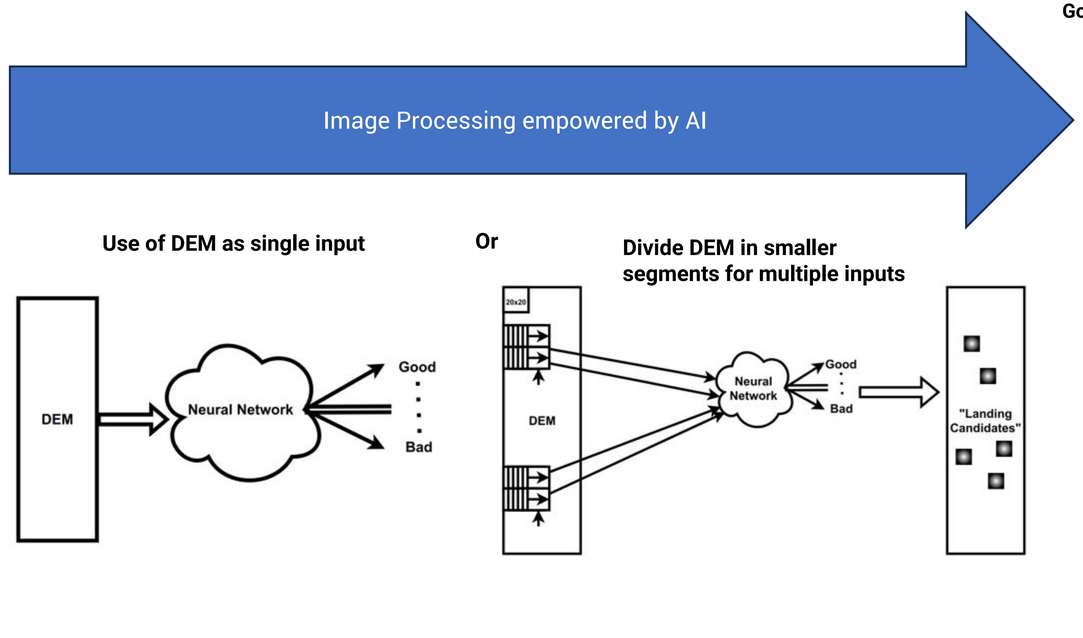
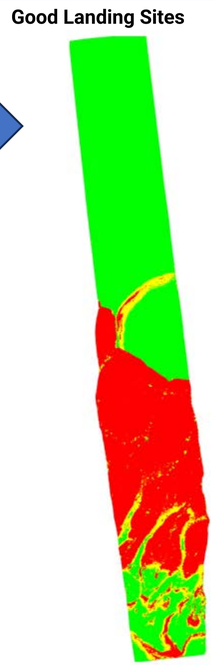
AUTONOMY RESEARCH CENTER FOR STEAHM

Trustable Autonomy

Mars Science Helicopter: Image Processing







Synopsis

- Project focuses on automating the process of selecting potential landing sites on Mars.
- Traditionally, experts manually scrutinize Martian terrain to identify landing sites.
- The project leverages machine learning algorithms to predict and suggest suitable landing locations.

Research Objective

- Develop a neural network capable of utilizing Digital Elevation Models (DEM) for accurate site predictions.
- Prioritize selecting landing sites that minimize risks like rough terrain or steep slopes to increase the safety of Mars missions. By offering data-driven recommendations, it will help ensure successful landings.
- Automate the landing site selection to reduce the time and costs associated with manual decision-making processes. This will allow mission planners to allocate resources more efficiently, leading to faster planning cycles.

Research Approach

- Utilize Digital Elevation Models (DEM) to obtain detailed topographical data of the Martian surface.
- Enhance the collection of DEMs and improve labeling processes to create a robust dataset for neural network training.
- Select the most suitable neural network architecture for the task, such as convolutional neural networks (CNNs) for spatial data analysis.

Research Results and Products

- Ongoing efforts to expand the DEM dataset and improve data management.
- The methodology from Posada et al. (2022), using MobileNetV2 and SSD/FPN architectures, is being considered and tested for this project to enhance hazard detection and terrain analysis. These architectures have shown effectiveness in similar space exploration applications, providing fast and accurate object detection and segmentation in computationally constrained environments.

Commercialization and/or Societal Impact Opportunities

- Potential to offer automated landing site selection tools for Mars missions to space agencies and private space exploration companies.
- Expand applications into Earth-based missions requiring advanced topographical data analysis.

Team Names & Collaborators

ARCS Fellows:

- Eduardo Kestler, MS Computer Engineering

Project Participants:

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- Edwin Lee, High School

ARCS Faculty Advisor:

- Dr. Cho Myung, Professor in Electrical and Computer Engineering Department
- Dr. Bingbing Li, Professor in Manufacturing Systems Engineering Department

Citations

Bapst, J., & MSH Team. (2023, September 11). *NASA mission concept*. [Image]. NASA.

Posada, D., Jordan, J., Radulovic, A., Hong, L., Malik, A., & Henderson, T. (2022). Detection and initial assessment of lunar landing sites using neural networks. arXiv. https://arxiv.org/abs/2207.11413:contentReference[oaicite:4]{index=4}.

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Updated 10/2024