Real-Time Terrain Mapping and Processing for Safe Landing via Deep Neural Networks

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Team Member:
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RESEARCH OBJECTIVES

- Objective: Real-time terrain mapping and processing.
- Innovation: Leveraging a deep neural network model trained on the ground for real-time landing zone selection.
- Improvement beyond SOA 1: Incorporating system-level parameters and realistic uncertainties into terrain map processing.
- Improvement beyond SOA 2: Accurate and explicit consideration of divert maneuvers in landing zone evaluation.
- Initial TRL: 1 (preliminary theory) Final TRL: 3 (proof-of-concept testing)

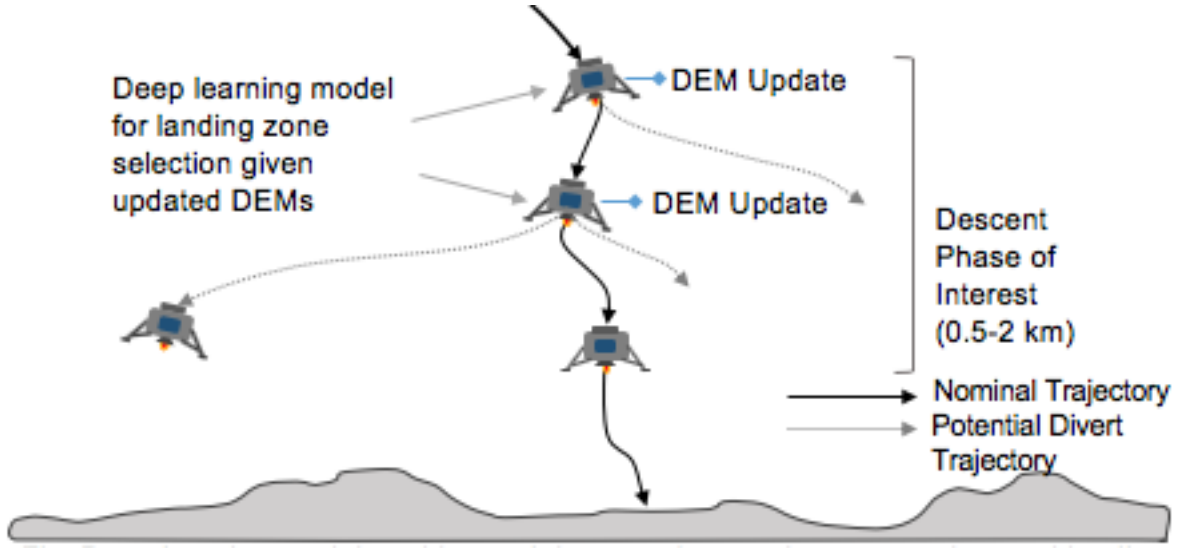

Fig. Deep learning model enables real-time terrain mapping, processing, and landing zone selection/divert decision making given digital elevation maps (DEMs).

APPROACH

- Use of Convolutional Neural Network (CNN) for extracting features from a digital elevation map (DEM) and generating a safety map.
- Formulation 1: Supervised learning for landing zone evaluation.
  - ➢ Effective for general missions with a given DEM.
- Formulation 2: Reinforcement learning for dynamic divert strategy optimization along with landing zone evaluation.
  - ➢ Effective for missions with real-time DEM updates during the descent phase.

POTENTIAL IMPACT

- The proposed approach significantly improves the real-time system-level hazard detection performance during the descent phase.
- The algorithms can be directly integrated with path planning, enabling safe autonomous landing for future aerospace missions, including NASA's lunar, Mars, and other planetary missions.