3. Presentation Preference: Oral Presentation

4. Principal Author's Biography:

Linda Robeck Fuhrman designed robotic spacecraft for Mars (Pathfinder), Jupiter (Galileo) and Saturn (Cassini) while working at JPL for thirteen years, before returning home to Boston to join the Draper Laboratory Space Programs Office. She now manages Draper's robotic and science programs including new technology developments for space applications.

5. Abstract Text

The top-level architecture to accomplish NASA's *Vision for Space Exploration* is to use Lunar missions and systems not just as an end in themselves, but also as testbeds for the more ambitious goals of Human Mars Exploration (HME). This approach means that Lunar missions and systems are most likely going to be targeted for (Lunar) polar missions, and also for long-duration (months) surface stays. This overarching theme creates basic top-level requirements for any next-generation lander system:

- Long duration stays:
  - Multiple landers in close proximity
  - Pinpoint landings for "surface rendezvous"
  - Autonomous landing of pre-positioned assets
  - Autonomous Hazard Detection & Avoidance
- Polar and deep-crater landings (dark)
- Common / extensible systems for Moon and Mars, crew and cargo

These requirements pose challenging technology and capability needs. Compare and contrast:

- Apollo:
  - 1 km landing accuracy
  - Lunar near-side (well imaged and direct-to-Earth com possible)
  - Lunar equatorial (landing trajectories offer best navigation support from Earth)
  - Limited lighting conditions
  - Significant ground-in-the-loop operations
- Lunar Access:
  - 10 – 100m landing precision
  - "Anywhere" access includes polar (potentially poor nav support from Earth) and far side (poor gravity and imaging; no direct-to-Earth com)
  - "Anytime" access includes any lighting condition (including dark)
  - Full autonomous landing capability
  - Extensible design for tele-operation or operator-in-the-loop
  - Minimal ground support to reduce operations costs

The Lunar Access program objectives, therefore, are to

- Develop a baseline Lunar Precision Landing System (PLS) design to enable pinpoint "anywhere, anytime" landings

- Landing precision 10m – 100m
- Any LAT,LON
- Any lighting condition

This paper will characterize basic features of the next generation Lunar landing system, including trajectory types, sensor suite options and a reference system architecture.

6. Keywords: Lander, GN&C, navigation