National Aeronautics and Space Administration

ALHAT

Autonomous Landing and Hazard Avoidance Technology

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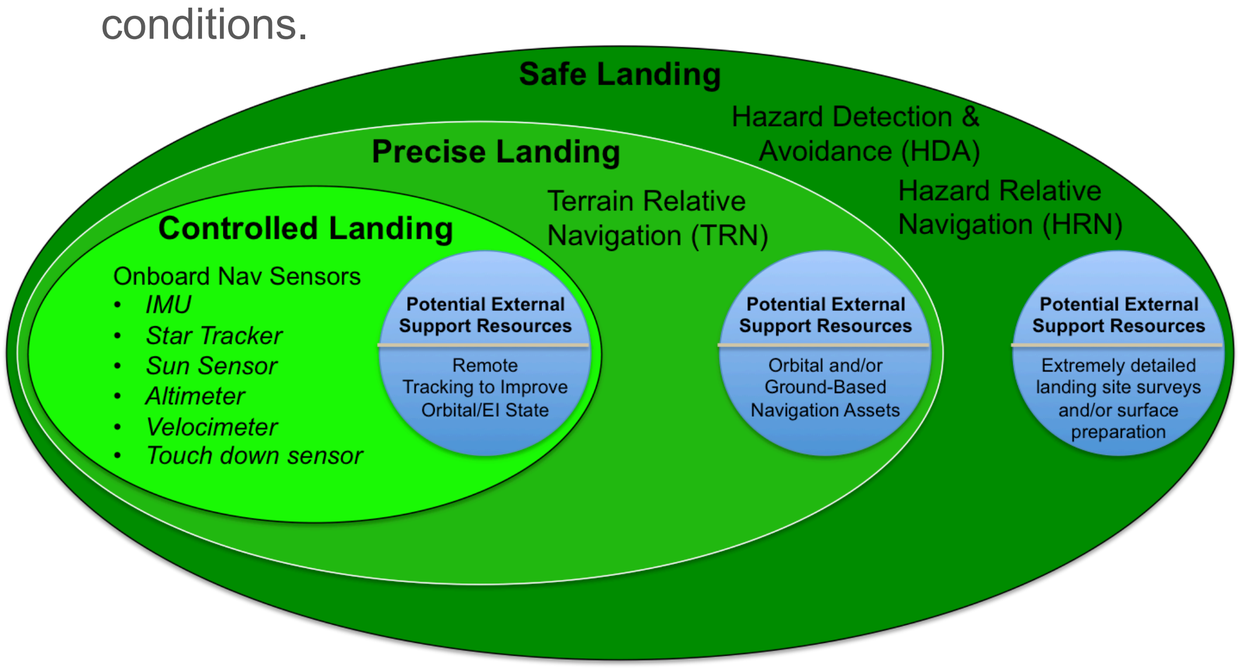
HAT: 4.1.a Precision Landing & Hazard Avoidance TA: 9 EDL Systems – ALHAT TRL: start 2 / current 5

OVERVIEW

The ALHAT project was chartered by NASA HQ in 2006 to develop and mature to TRL 6 an autonomous lunar landing GN&C and sensing system for crewed, cargo, and robotic planetary landing vehicles. The multi-center ALHAT team was tasked with providing a system capable of identifying and avoiding surface hazards in real time to enable safe precision landing to within tens of meters of a designated planetary landing site under any lighting conditions.



INNOVATION

The ALHAT system for autonomous safe, precision landing is designed to provide modularity and flexibility for application to a wide range of exploration missions.

Terrain Relative Navigation (TRN)

TRN compares onboard reconnaissance data with real-time terrain imaging data to update the S/C position estimate.

Hazard Detection and Avoidance (HDA)

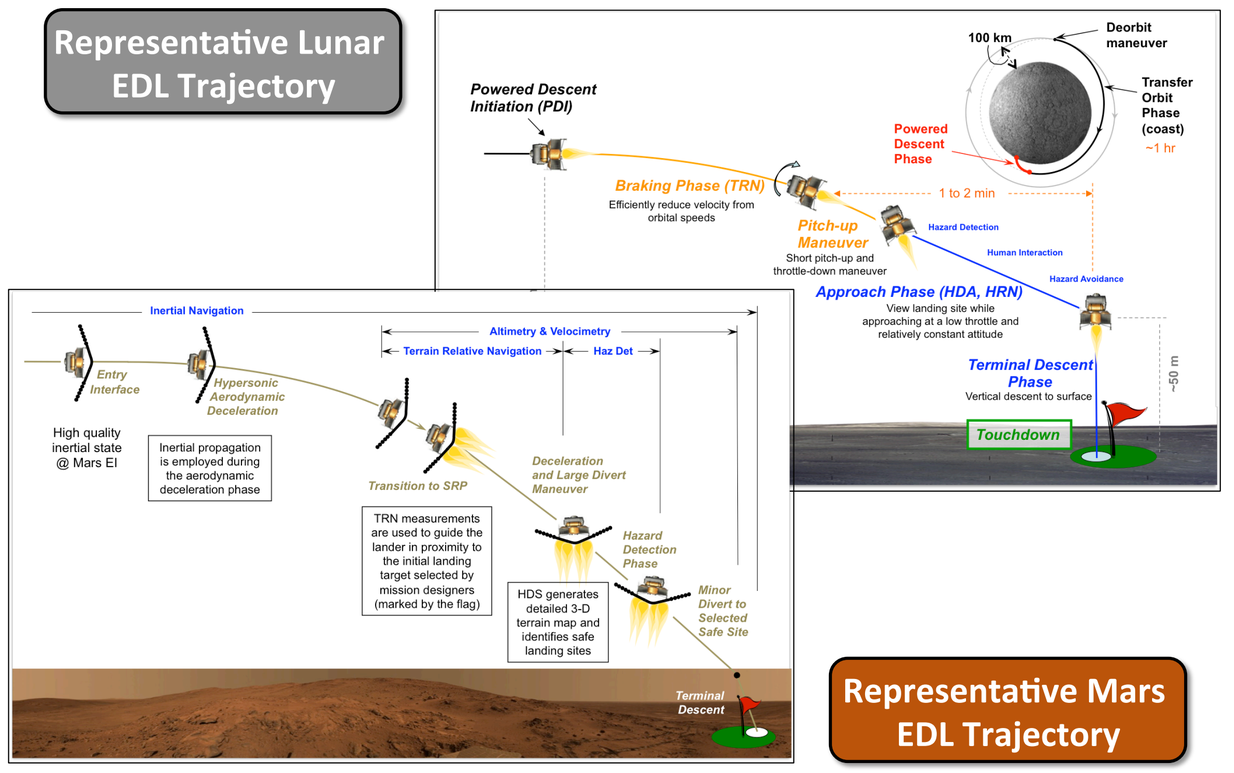
Generates a high-resolution, 3-D terrain map in real-time during the approach trajectory to identify safe landing targets.

Hazard Relative Navigation (HRN)

HRN utilizes the high-resolution terrain map developed for hazard identification with subsequent real-time terrain image data to help maintain an accurate S/C position estimate.

Inertial Navigation During Terminal Descent

High precision surface relative sensors enable accurate inertial navigation during terminal descent and a tightly controlled touchdown within meters of the selected safe landing target.



INFUSION SPACE / EARTH

In 2014, the ALHAT system was successfully demonstrated during several closed loop free flight campaigns on the Morpheus lander testbed at KSC.

Multiple organizations are pursuing the infusion of ALHAT functions and sensors on robotic landers, including Mars 2020, Resource Prospector, and several commercial landers. NASA has also identified ALHAT safe, precision landing capabilities as essential for the human exploration of Mars.

PARTNERSHIPS / COLLABORATIONS

The ALHAT project represents a long term collaboration across NASA and industry. ALHAT is currently funded by the HEOMD AES Lander Technologies Project in the pursuit of CATALYST and COBALT. The ALHAT team is comprised of engineers from JSC, JPL, and LaRC. KSC, AFRC, Draper, and APL have made significant contributions to ALHAT development and testing.

FUTURE WORK

The next logical step is the infusion of the ALHAT system on robotic and human exploration missions. The ALHAT team continues to pursue the maturation of safe, precision landing functions and sensors. The COBALT flights will demonstrate the integration of LVS/TRN with the third generation Navigation Doppler Lidar sensor.