Descent and Landing Rock Hazard Avoidance System (ROHAS) for the Mars Exploration Program Advanced Technologies (MEPAT) Program

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One of the key problems of entry, descent and landing for planetary probes and sensors is hazard detection and avoidance. This is especially critical when a mission must target very accurately (near pinpoint landing) a scientifically interesting, possibly unique, location on the surface of a planet or other celestial object. A cushioned landing such as Mars Pathfinder's, may result in bouncing and rolling to a significant distance from the target location. This could cause difficulty and potentially thwart key mission objectives. A controlled landing using accurate navigation is required for a precisely targeted mission. Raytheon SBRS in collaboration with Arizona State University is developing a navigation aid to support a controlled landing, with terminal navigation corrections, to a rock hazard-free location as near as possible to a nominal landing site. Differences in thermal inertia between fines (dust/sand) and rocks on Mars will cause hazardous (large) rocks to have distinctive temperatures in thermal IR images. Mixtures of fine dust/sand and rocks explain the thermal inertia signatures, measured from orbit, of the three Mars landing sites prior to the Mars Exploration Rovers. (Golombek, et al, 2001) At low altitudes, during controlled descent of a lander, thermal IR images could resolve individual rock hazards and thereby support navigation corrections to touchdown in a relatively safe location.

This development has been coordinated and funded as part of the Mars Technology Program (MTP), in support of the Mars Exploration Program Advanced Technologies (MEPAT) Program with NASA JPL. Raytheon SBRS in collaboration with Arizona State University is developing a breadboard demonstration to maturity (TRL 4) miniature IR camera-based system for mapping the locations of geologic hazards, including boulders and rock outcrops. Arizona State University is developing the terminal hazard mapping algorithms to be used for real-time navigation correction during descent and landing.