

Port-Flight EDL Entry Guidance Performance of the 2011 Mars Science Laboratory Mission

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The 2011 Mars Science Laboratory was the first successful Mars mission to attempt a guided entry which safely delivered the rover to a final position approximately 2 km from its target within a touchdown ellipse of 19.1 km x 6.9 km. The Entry Terminal Point Controller guidance algorithm is derived from the final phase Apollo Command Module guidance and, like Apollo, modulates the bank angle to control the range flown. For application to Mars landers which must make use of the tenuous Martian atmosphere, it is critical to balance the lift of the vehicle to minimize the range error while still ensuring a safe deploy altitude. An overview of the process to generate optimized guidance settings is presented, discussing improvements made over the last nine years. Key dispersions driving deploy ellipse and altitude performance are identified. Performance sensitivities including attitude initialization error and the velocity of transition from range control to heading alignment are presented.

Just prior to the entry and landing of MSL in August 2012, the EDL team examined minute tuning of the reference trajectory for the selected landing site, analyzed whether adjustment of bank reversal deadbands were necessary, the heading alignment velocity trigger was in union with other parameters to balance the EDL risks, and the vertical L/D command limits. This paper details a preliminary postflight assessment of the telemetry and trajectory reconstruction that is being performed, and updates the information presented in the former paper *Entry Guidance for the 2011 Mars Science Laboratory Mission* (AIAA Atmospheric Flight Mechanics Conference; 8-11 Aug. 2011; Portland, OR; United States)

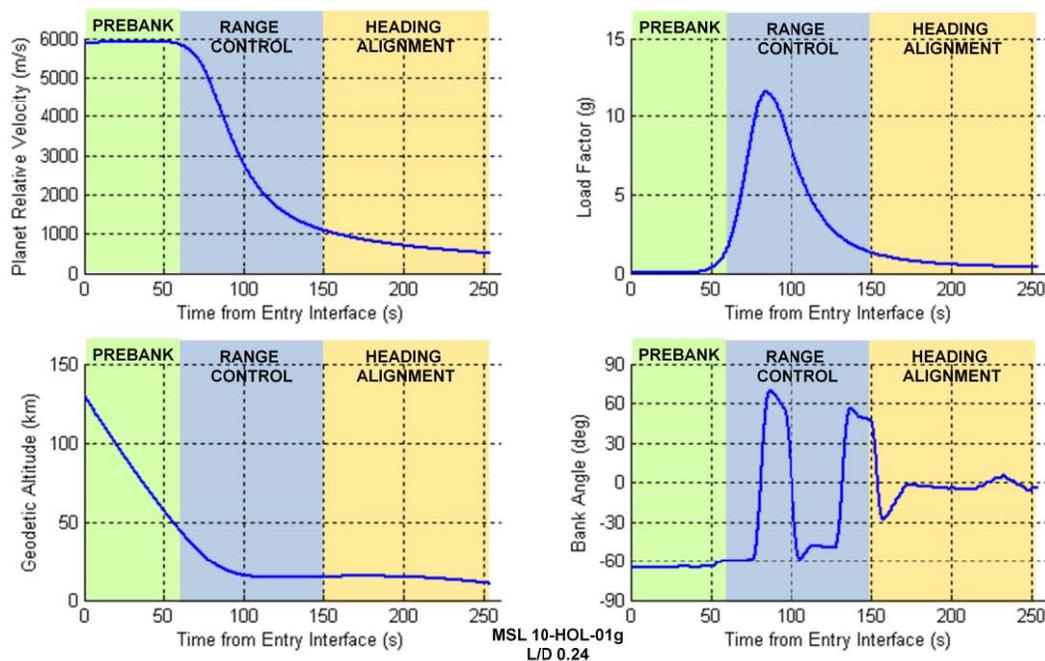


Figure 1: Nominal simulated velocity, g-load, altitude and bank angle vs time for a MSL entry trajectory to be updated with post-flight telemetry data (*Entry Guidance for the 2011 Mars Science Laboratory Mission*, Figure 8)

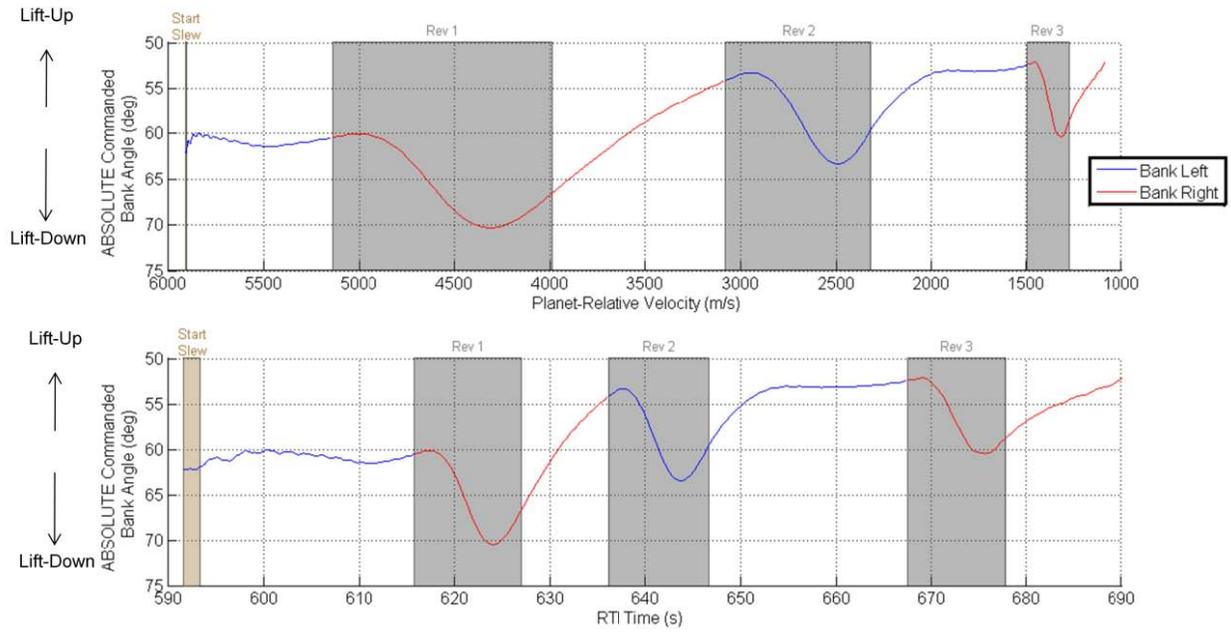


Figure 2: A nominal commanded bank profile for the MSL entry trajectory to be updated with post-flight telemetry data (*Entry Guidance for the 2011 Mars Science Laboratory Mission, Figure 9*)

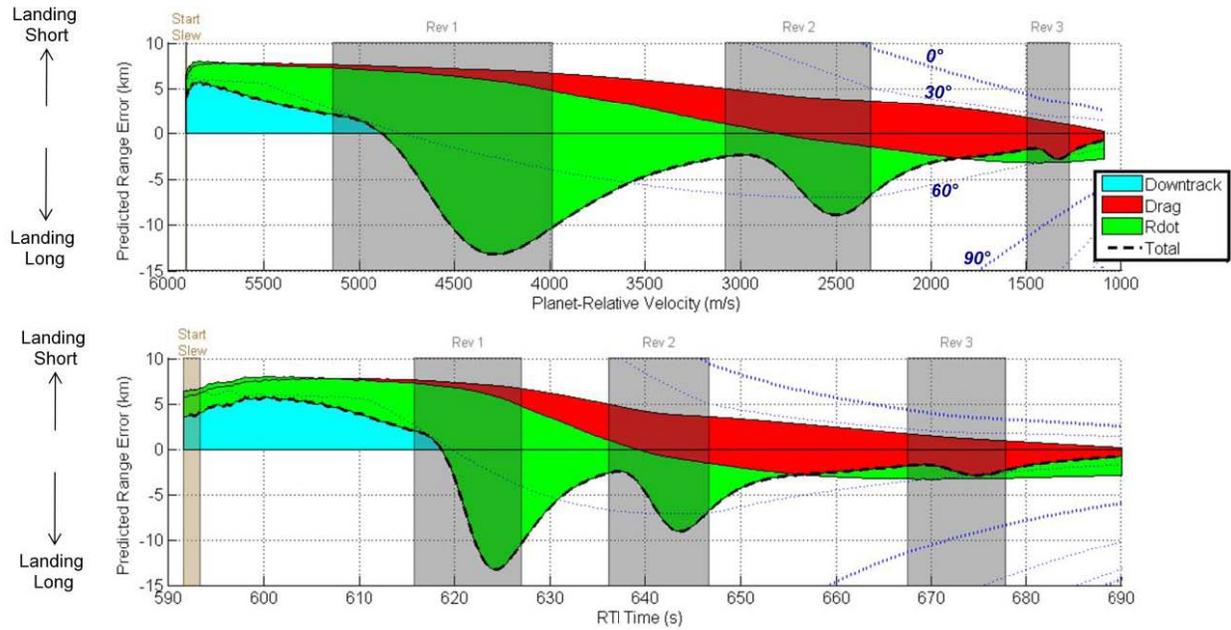


Figure 3: Summation of predicted range error components during range control of a nominal trajectory to be updated with post-flight telemetry data (*Entry Guidance for the 2011 Mars Science Laboratory Mission, Figure 10*)