

Orbit Determination Adaptations for the Cassini Grand Finale

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The Cassini spacecraft has been operating in orbit around Saturn since 2004, during which time it has executed over 150 satellite encounters. Over this period, there have been several papers (see reference for latest) describing the orbit determination process and performance up through 2016 [5]. In April of 2017, Cassini will enter its Grand Finale mission phase when it will traverse the gap between the D-ring and the Saturn atmosphere twenty-two times before plunging deep into the atmosphere to be burned up. Figure 1 shows the Cassini safe corridor during the Grand Finale, where each point represents a Saturn periapsis or equatorial crossing (vacant node). The lack of targeted satellite encounters during this period will necessitate updates to the nominal Cassini Orbit Determination (OD) process. This paper will describe these planned adaptations for the operation of the Grand Finale. During the Equinox and Solstice Mission Phase (2006-2016), navigation analysis has been divided into segments focused on a particular targeted satellite encounter, called an “arc”. Maneuvers in an arc were targeted to encounter B-plane position and time, so the OD state and covariance were mapped forward to the B-plane of the encounter within the arc. Trajectory dispersions during the Grand Finale will instead be mapped to equator crossings and targeted Cartesian positions. In addition, trajectory arcs have typically covered a few orbital revolutions (~2-8 weeks), in order to span the time between two encounters. However, the Grand Finale will encompass five months of time without an encounter which will necessitate an adjusted arc strategy. A modified arc strategy was developed based on OD behaviour during long multi-rev periods between encounters in the year leading up to the Grand Finale. The evolution of the Grand Finale OD covariance studies will also be examined.

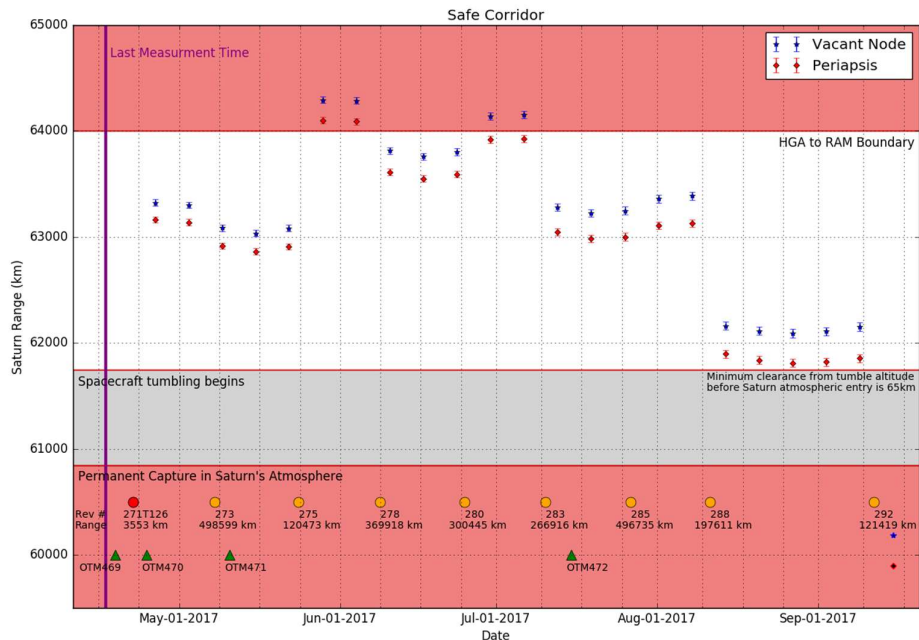


Fig. 1. Cassini Grand Finale Safe Corridor

References

[1] J. Bellerose, S. Nandi, D. Roth, Z. Tarzi, D. Boone, K. Criddle, and R. Ionasescu, “Cassini Navigation: The Road to Consistent Sub-Kilometer Accuracy Satellite Encounters”, AAS 16-142, 2016 AAS GN&C Conference, Breckinridge, CO, February 5-10 2016