Forensic Analysis of Debris-Generating Events: Orbcomm FM 16

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On December 22, 2018, the Orbcomm FM 16 satellite experienced a debris generating event. Numerous pieces of debris were cataloged, and a forensic analysis of the observed debris was performed. The Aerospace Corporation has developed various techniques to evaluate debris-generating events and determine various characteristics of those events such as spread velocity of the debris pieces, energy of the event, and area/mass estimates of the individual objects. These techniques were applied to the Orbcomm FM 16 event.

Analysis indicates the event occurred at ~05:16:55 UT on 12/22 when the satellite was over the Pacific Ocean headed southwards. It was found that the average velocity imparted to the debris was ~91.2 m/sec. Nearly all of the resulting orbits had higher apogees than the main satellite. Two pieces of debris experienced only a small change in the main orbit when compared to all of the others. Figure 1 shows the delta-V solution arising from the Orbcomm investigation. The plane in the right-hand plot is perpendicular to the arrow in the left-hand plot. Each dot represents one piece of debris. What makes this event highly unusual is the strong linear correlation in the radial/along-track plane. Coupled with the dominance of the normal component in a single direction (except for one extraneous object), indicates that the debris was given off in a distinct fan-shape. This fan-shape of debris does not fall into the normal behavior observed in previous explosions or collisions. Orbcomm satellites have a distinctive disk shape which might have influenced the debris genration. The source of the event is currently unknown, with battery explosions typically showing more spherical distributions of debris while collisions are typically conical in distribution. Mass and area estimates await further accumulation of data.

The full paper will provide an update on the methodology and further examine this event. It will include estimates of the collision energy and area-to-mass ratio of the individual pieces and an attempt to identify possible causes. Other recent debris generating events will be included for comparison purposes.

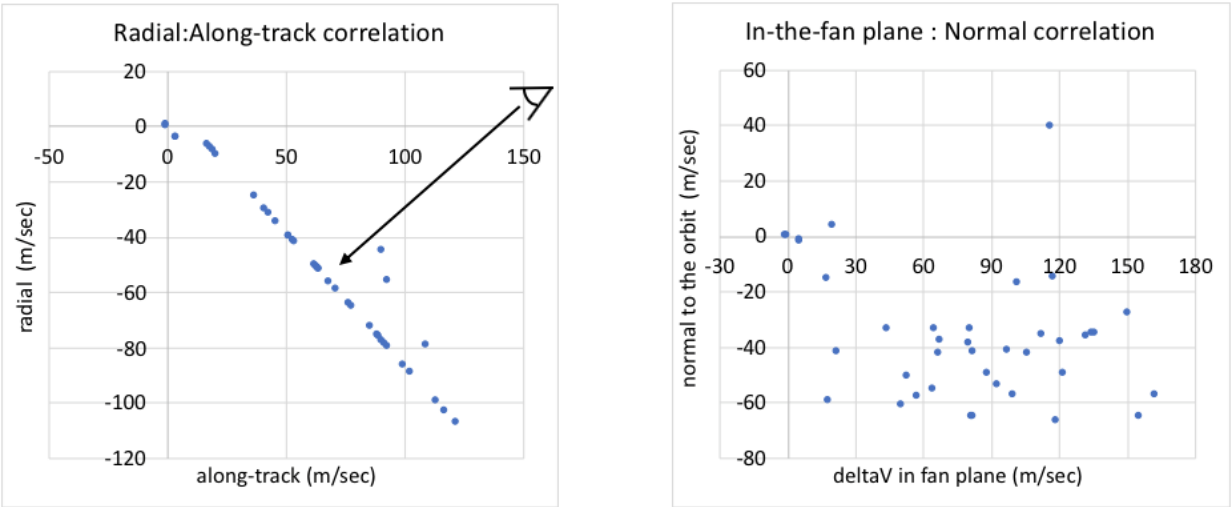

Figure 1: Delta-V of debris from Orbcomm FM 16 event