Leveraging Chaos in Mission Design
by
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For years trajectory design has relied heavily on solutions of the two-body problem, where patched conics are used to generate end-to-end trajectories. While the patched conics method has served mission designers well for decades, the initial design phase fundamentally ignores more complex dynamics associated with multi-body gravitational fields. When more complete dynamical models are considered, chaos emerges and the nonlinear effects make the problem considerably more difficult to solve. However, by ignoring the dynamics of the multi-body problem, engineers have missed a family of ultra-low energy trajectories available in mission design. In recent years, advances in computing have allowed researchers to begin exploring the use of these trajectories in mission design, but the lack of multi-body design tools has prevented widespread use in mission design. Today’s presentation will highlight research conducted to remedy this problem by developing a research/design tool which leverages chaotic regions in space to construct ultra-low trajectories; and which generates the associated manifold structures to study the transport and capture phenomenon of naturally occurring bodies. A key contribution of the tool will be a method to design missions using the intersections of families of manifolds, rather than single trajectories on the manifolds. Additionally, attitude modeling will be included for higher fidelity mission design using an integrated approach that combines both the trajectory and attitude control.