

ASTRODYNAMICS SYMPOSIUM (C1)  
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DE-ORBITING AND RE-ENTRY ANALYSIS WITH GENERALISED INTRUSIVE POLYNOMIAL  
EXPANSIONS**Abstract**

Generalised Intrusive Polynomial Expansion (GIPE) is a novel method for the propagation of multidimensional compact sets through dynamical systems. It generalises the more widely-known Taylor Differential Algebra in that it allows the use of generic polynomial representations of a multi-dimensional set. In particular the paper proposes the use of truncated Tchebycheff series. Unlike Taylor expansions, that are not generally convergent, Tchebycheff expansions provide fast uniform convergence with relaxed continuity and smoothness requirements, guaranteeing near-minimax approximation.

This methodology has proven to be competitive for uncertainty propagation in orbital dynamics, especially when dealing with a large number of uncertain variables. Moreover, it provides the user with a complete polynomial representation of the uncertain region at any point of the propagation, allowing remarkable gain of insight into the underlying properties of the uncertain dynamics.

The paper presents the application of the GIPE approach to the end-of-life analysis of Low Earth Orbit satellites, with special emphasis on the case of the de-orbiting and re-entry of GOCE and the de-orbiting of objects with high area to mass ratio. The effect of various sources of uncertainty on the end-of-life dynamics is thus analysed, such as the drag model or the accuracy of the initial orbit determination.