Nonlinear inverse models for the control of satellites with flexible structures

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Nonlinear inverse dynamic models can be utilized in various parts of advanced model-based control system design: reference trajectory optimization, feed-forward control and feedback linearization [3]. In this paper, a new synthesis approach for nonlinear inverse dynamic models of satellites with flexible structures is presented. For satellite configurations with unstable zero dynamics, a stable inverse model approximation is proposed which has been successfully applied to robots with flexible bodies [2, 1].

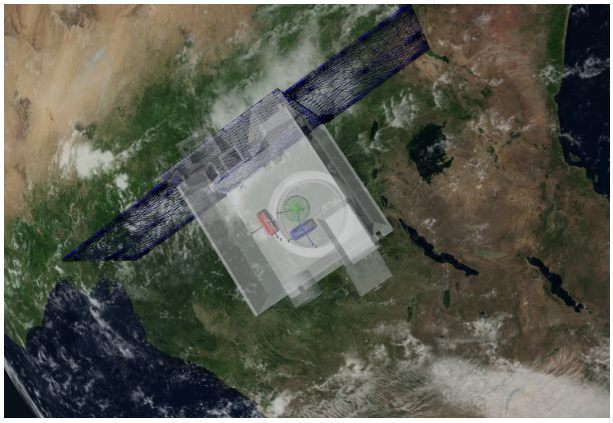

Figure 1: Animation of a satellite with the DLR Space Systems Library.

This inverse modeling approach is part of the newly developed DLR Space Systems Library for object-oriented modeling and simulation of satellites and launchers in a detailed space environment. For satellites with flexible structures, the library provides models for normal simulation mode and the necessary tools to directly generate approximate inverse models.

In this paper, trajectory optimization is shown to be an important use case for inverse dynamic models. By inversion based reformulation of the trajectory optimization problem, the optimal reference motion of the control system can be determined in a reliable and efficient way.

References

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