

Reference Governor in the Zonotopic Framework applied to a Quadrotor under an INDI Control Strategy

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1 Introduction

We investigate the combination of incremental nonlinear dynamic inversion (INDI) control with a reference governor scheme, i.e., a specific control scheme that enables constraint and limit protection handling, developed in a zonotopic framework. The zonotopic representation of the safe flight envelope is simple and computationally efficient for real-time implementation. The global scheme consisting of INDI and reference governor ensures safe flight under disturbances and constraints, as illustrated with numerical tests using the Parrot Mambo simulator provided in the Mathworks Simulink environment.

2 Incremental nonlinear dynamic inversion

The Incremental Nonlinear Dynamic Inversion (INDI) controller is a feedback linearization controller [1] which uses derivatives of the system states as an input. It allows to create a closed-loop linear systems (Fig. 1).

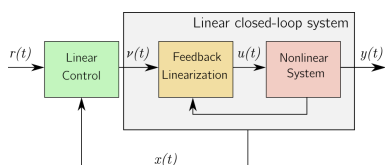


Figure 1: Feedback linearization principle

3 Reference governor

The reference governor [2] is an intermediary system that transforms a reference $r(t)$ generated by a high-level guidance system into a new reference $v(t)$ which is more suitable with respect to the dynamics of the closed-loop system and the constraints imposed on the system (Fig. 2).

Zonotopes and constrained zonotopes are selected for the

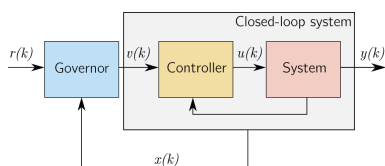


Figure 2: Reference governor structure

convex set representation in the reference governor, as they have been proven suitable even for high-dimensional systems. Moreover, efficient algorithms are available for their computation, [3].

4 Results

A resulting trajectory under constraint on position is shown on Fig. 3.

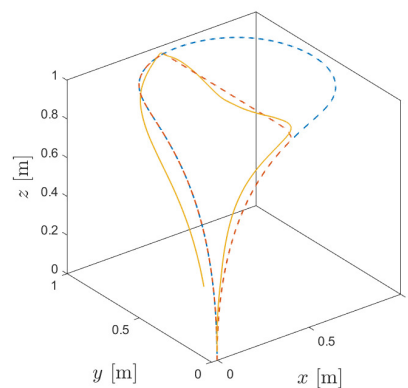


Figure 3: Constrained response (constraint $x < 0.5$) of the Mambo mini drone

References

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