Robust Control Design of Underactuated Systems via a Family of Time-Periodic Sliding Surfaces

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The paper addresses the problem of robust control design for orbital stabilization of periodic trajectories in mechanical systems affected by parametric uncertainties and matched bounded disturbances.

Based on a feedback that stabilizes a nominal linear system with periodic coefficients (in particular, the transversal linearization), using the solution of a modified Riccati differential equation a periodic family [1] of subspaces — sliding surfaces, is derived.

A first-order sliding mode controller is then designed to ensure finite-time convergence to the selected family of surfaces in the presence of matched uncertainties and external disturbances. This choice of sliding surfaces guarantees the asymptotic orbital stability of the desired periodic trajectory.

The effectiveness of the proposed approach is demonstrated through simulation on the orbital stabilization of a periodic trajectory of a spherical robot [2], implemented using the servoconstraint approach [3, 4].

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References

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