



IEEE Transactions on Control Systems Technology

Special Journal Issue on
Optimization-Based Guidance and Control for Space Vehicles

Abstract

Optimization-based guidance and control methods have become central to the design, analysis, and implementation of advanced space vehicle systems across launch, ascent, on-orbit, and entry, descent, and landing (EDL). By combining dynamical models, mission constraints, performance objectives, and onboard computational capabilities, these methods offer a principled framework for autonomous decision making in highly constrained, safety-critical, and uncertain environments. Recent advances in convex optimization, nonlinear programming, model predictive control, trajectory optimization, real-time numerical methods, and embedded autonomy have enabled new capabilities for launch vehicle guidance, spacecraft rendezvous and proximity operations, precision landing, reusable vehicle recovery, and resilient mission operations. At the same time, many open research challenges remain, including real-time implementability, robustness to modeling errors and disturbances, certification of optimization-based algorithms, integration with estimation and perception systems, treatment of uncertainty and risk, and validation on flight-relevant hardware or high-fidelity experimental platforms. These challenges overlap substantially with active research in both the space vehicle and control technology communities, yet the two often remain siloed.

To encourage integration between these communities, this Special Issue of IEEE Transactions on Control Systems Technology invites contributions addressing recent advances, open research questions, and practical implementations of optimization-based guidance and control for launch, ascent, on-orbit, and EDL. Submissions should emphasize control-system technology, algorithmic innovation, computational tractability, and demonstrated relevance to realistic space missions. Contributions are especially encouraged to include high-fidelity simulation studies with clear practical significance or implementation-oriented analysis. Papers that focus solely on abstract optimization formulations or purely low-fidelity simulation-based studies without clear implications for deployable guidance and control systems are discouraged.

Application areas of interest include, but are not limited to: Optimization-based methods for launch and ascent, orbital transfer and maintenance, autonomous rendezvous, proximity operations, and docking (RPOD), space servicing/debris removal, and precision EDL. Contributions that advance the state of the art in these application areas and are relevant to the special issue include, but are not limited to:

- **Algorithmic Frameworks & Optimization Methods:** Convex, sequential convex, and lossless convexification techniques, alongside model predictive control (MPC) and handling of non-convex, mixed-integer, hybrid, or logic-based constraints.
- **Multi-Vehicle Coordination & Distributed Systems:** Cooperative guidance, distributed optimization, and control frameworks for multi-spacecraft systems, formations, and swarms.

- **Robustness, Safety, & Fault Tolerance:** Chance-constrained, risk-aware, and distributionally robust approaches capable of handling model uncertainties, disturbances, environmental variability, and off-nominal or contingency scenarios.
- **Onboard Implementation & Computational Acceleration:** Real-time algorithms for flight processors, including warm-starting, code generation, embedded implementation, and hardware acceleration.
- **System Integration, Learning, & Verification:** Integration of optimization with estimation, perception, and learning-enhanced systems; highly coupled vehicle dynamics; and formal verification, hardware-in-the-loop (HIL) testing, and flight demonstrations.

Paper Submission Guidelines

All submitted papers must be relevant to the control community and **present advances in control technology**, which are either validated in **realistic/high fidelity simulations** or in **experiments**. **Only regular papers** may be submitted to and will be considered for the special issue. Contributions should be original and not be under consideration elsewhere for publication. The authors should follow the journal guidelines, regarding the manuscript content, scope, and its format. Manuscripts submitted for inclusion in this special issue will be handled by a panel of Guest Editors (see below) and will go through a peer review process to assess their suitability in terms of technical novelty, scientific rigor, scope, and relevance. Manuscripts that are deemed unsuitable for the special issue will be returned to the authors and may not be resubmitted or considered for publication outside the special issue without approval from the Editor-in-Chief.

Authors are kindly invited to submit their manuscripts via the Transactions submission portal:

https://css.paperplaza.net/journals/tcst/scripts/login.pl

Important Dates:

- Submission Site Opens: 1 December 2026
- First Submission Deadline: 1 June 2027
- Notification of First Round Decision: 1 September 2027
- Revised Paper Submission Deadline: 15 October 2027
- Notification of Final Decision: 1 December 2027
- Final Manuscript Submission: 15 January 2028
- Tentative Publication Date (Online): May 2028

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