14th Young Researcher Workshop on Geometry, Mechanics and Control

Mini Course on Control: "Multi-Agent Control for Safety-Critical Systems"

December 16-18, 2019

Instructor:	Dimitra Panagou	**Time:**	TBD
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Objectives: This course is primarily designed for graduate students in control, interested in recent developments on safety-critical control of single-agent and multi-agent systems. The course will focus on methods for the control synthesis under safety constraints, with applications in distributed multi-robot systems. Time permitting, the course will overview more recent developments on spatiotemporal control synthesis under safety (state) and temporal (time) constraints, and illustrate their application in multi-agent problems.

Prerequisites: An graduate-level understanding of linear and nonlinear systems, graph theory, algorithms, and convex optimization is assumed.

Main References: This is a non-inclusive list of relevant papers that will be touched during the course.

- D. Panagou, D. M. Stipanovic and P. G. Voulgaris, *Distributed coordination and control for multi-robot networks using Lyapunov-like Barrier Functions*, IEEE Transactions on Automatic Control, vol. 61, no. 3, pp. 617-632, March 2016
- D. Panagou, *A distributed feedback motion planning protocol for multiple unicycle agents of different classes*, IEEE Transactions on Automatic Control, vol. 62, no. 3, pp. 1178-1193, March 2017
- K. Garg, E. Arabi, D. Panagou, *Prescribed-time control under spatiotemporal and input constraints: A QP-based approach*, https://arxiv.org/abs/1906.10091
- S. Prajna, A. Jadbabaie, *Safety Verification of Hybrid Systems Using Barrier Certificates*, In: Alur R., Pappas G.J. (eds) Hybrid Systems: Computation and Control. HSCC 2004. Lecture Notes in Computer Science, vol 2993. Springer, Berlin, Heidelberg
- P. Wieland, F. Allgower. *Constructive safety using Control Barrier Functions*, IFAC Proceedings Volumes, Volume 40, Issue 12, 2007, Pages 462-467
- A. D. Ames, S. Coogan, M. Egerstedt, G. Notomista, K. Sreenath, P. Tabuada, *Control Barrier Functions: Theory and Applications*, https://arxiv.org/abs/1903.11199
- A. D. Ames, X. Xu, J. W. Grizzle, P. Tabuada, *Control Barrier Function Based Quadratic Programs with Application to Automotive Safety Systems*, IEEE Transactions on Automatic Control, vol. 62, no. 8, pp. 3861-3876, August 2017
- S. Bhat and D. Bernstein, *Finite-time Stability of Continuous Autonomous Systems*, SIAM Journal of Control and Optimization, Vol. 38, No. 3, pp. 751-766
- A. Polyakov, *Nonlinear feedback design for fixed-time stabilization of linear control systems*, IEEE Transactions on Automatic Control, vol. 57, no. 8, pp. 2106-2010, August 2012.