USC Viterbi School of Engineering
Ming Hsieh Department of Electrical and Computer Engineering

Ming Hsieh Institute Seminar Series

Center for Systems and Control – CommNetS

A Geometric Viewpoint on Dynamic Control Allocation

Andrea Serrani
Ohio State University

Monday, November 11th, 2019
2:00pm
EEB 248

Abstract: Input redundancy in a control system is typically resolved by means of (static) control allocation strategies, where the standing assumptions prescribe that one can define a virtual control input that has the same dimensionality of the regulated output. A control strategy designed on the basis of this virtual input is then "distributed" across the redundant set of actuators via on-line optimization. Essentially, this scenario confines redundancy to the null-space of the input operator, which can be factored out by projection. On the other hand, for the case of input redundancy with full-rank input operators, multiple independently controllable state-trajectories exist that are compatible with a given reference output. In this talk, a comprehensive geometric characterization of input redundant linear systems is offered. It is shown that intrinsic input redundancy can be exploited in the system inverse rather than in the plant model itself, leading to the definition of novel dynamic control allocation strategies. In the proposed scheme, the steady-state behavior of the system is shaped through dynamic optimization of selected performance criteria penalizing both the control input and the state trajectory, while maintaining invariance of the error-zeroing subspace. Illustrative examples are presented to elucidate the applicability and the significance of the method.

Bio: Andrea Serrani received the Ph.D. degree in Artificial Intelligence Systems from the University of Ancona, Italy, in 1997 and the D.Sc. degree in Systems Science and Mathematics from Washington University in Saint Louis in 2000. Since 2002, he has been with the Department of Electrical and Computer Engineering at The Ohio State University, Columbus, Ohio, where he is currently a Professor and Associate Chair. His research activity spans the fields of control and systems theory, with emphasis on nonlinear and adaptive control, tracking and regulation, and application to aerospace and automotive systems. His latest interests include modeling and control of flapping-wing micro-air vehicles, control of multi-actuated powertrain systems, and guidance and control of hypersonic vehicles. He is the author of more than 150 journal and conference publications, and the co-author (with A. Isidori and L. Marconi) of the book Robust Autonomous Guidance - An Internal Model Approach, published by Springer Verlag. Prof. Serrani serves as the Editor-in-Chief of the IEEE Transactions on Control Systems Technology, and as an Associate Editor the IEEE CSS and IFAC Conference Editorial Boards. He is a past Associate Editor for Automatica and the International Journal of Robust and Nonlinear Control. He was the Program Chair of the 2019 American Control Conference and the General Co-Chair for the 2022 IEEE Conference on Decision and Control.