

Time-Varying Immersion Mappings for Internal-Model Control

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In extending the solvability of the output regulation problem to encompass more general classes of time-varying exogenous systems, various non-equivalent definitions of observability play a crucial role in the immersion mappings establishing the so-called “internal model property”. In this talk, we give a classification of these immersion mappings based on the underlying observability property, and describe the connections between different canonical realizations of the internal model unit that fully exploit such properties for robust and adaptive regulator design. In particular, it is shown how non-minimal realizations of the internal model unit are instrumental in dealing with parameterized families of exosystem models. As an application, the semiglobal robust output regulation problem is solved for a class of nonlinear systems that do not satisfy the standard conditions for the existence of a linear time-invariant internal model, but admit a so-called “generalized immersion”. It is shown how the obstacle given by the presence of the exosystem dynamics in the generalized immersion mapping can be overcome by resorting to the proposed framework for time-varying internal model design.



Andrea Serrani received the B.Eng. (Laurea) degree cum laude in Electrical Engineering from the University of Ancona, Italy, in 1993. He received the Ph.D. degree (Dottorato di Ricerca) in Artificial Intelligence Systems from the same institution in 1997. From 1994 to 1999, he was a Fulbright Fellow at the Department of Systems Science and Mathematics, Washington University in St. Louis, where he obtained the Doctor of Science degree in Systems Science and Mathematics in 2000. From 2000 to 2002 he held a research associate position at the Department of Electronics and Automation at the University of Ancona, Italy. From 2002 to 2008, he was an Assistant Professor with the Department of Electrical and Computer Engineering at The Ohio State University, Columbus, Ohio, where he is currently an Associate Professor. Prof. Serrani is the recipient of a 2007 Lumley Research Award and the co-recipient of the 2008 Lumley Interdisciplinary Research Award, both from the College of Engineering at OSU. He is a member of IEEE, AIAA and IFAC. He is an Associate Editor for *Automatica* and *The International Journal of Robust and Nonlinear Control*, and serves in the IEEE Conference Editorial Board as Area Editor and Associate Editor for invited and regular papers in Nonlinear, Adaptive, and Aerospace Systems. Prof. Serrani's research interests are in the field of control and systems theory, with emphasis on nonlinear and adaptive control, tracking and regulation, nonlinear dynamical systems, and application to aerospace and marine systems. He is currently involved in research projects on modeling, guidance and control of air-breathing hypersonic vehicles, and on aerodynamic flow control, supported by NASA and AFRL. He is the co-author (with A. Isidori and L. Marconi) of the book *Robust Autonomous Guidance: An Internal Model-Based Approach*, published by Springer-Verlag.