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GLOBAL ROBUST OUTPUT REGULATION WITH GENERALIZED IMMERSION

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Abstract. The global robust output regulation problem is solved in this paper for classes of nonlinear systems that do not satisfy the standard conditions for the existence of a linear 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 or the necessity to construct a nonlinear internal model can be overcome by resorting to a recently developed framework for time-varying adaptive internal model design.

Keywords. Nonlinear Systems, Output Regulation, Internal Model, System Immersion, Adaptive Control.

AMS (MOS) subject classification: 93B52, 93C10, 93C40, 93D15, 93D21.

1 Introduction

Among many a fundamental contribution given by Prof. Hassan Khalil to the discipline of nonlinear control theory, his work on the nonlinear servomechanism problem stands out as a true milestone, marking the emergence of a methodology for non-local robust nonlinear regulation that has shaped the field for at least a decade. In a series of papers [17, 18, 20, 21] Khalil and coworkers, building on their newly developed method for robust stabilization by dynamic output feedback [10, 19], significantly extended the state of the art by providing the first systematic design of servocompensators achieving semiglobal regulation by error feedback for nonlinear plant models characterized by large parametric uncertainty. Khalil was among the first to realize, together with Delli Priscoli [6] and Huang and Lin [13], that in order to provide robustness against parameter variations, the internal model incorporated in the controller must be able to produce, together with the trajectories of the exosystem, a certain number of higher harmonics. The ideas developed in this series of papers proved to have a longstanding influence, and are still found, in different shapes, in the most recent contribution to the field.