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ITERATIVE HIGHER ORDER SLIDING MODE OBSERVER FOR NONLINEAR SYSTEMS WITH UNKNOWN INPUTS

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Abstract. This paper deals with the problem of the design of sliding mode observers for nonlinear systems subject to unknown inputs. In most approaches, sliding mode observers can be designed under the assumption that the system can be transformed into a specific canonical observable form. Then, the state and the unknown input of the system can be recovered in finite time. In this work, the class of systems for which unknown input sliding mode observers can be designed is enlarged by introducing an extended triangular observable form and a higher order sliding mode observers for which finite time convergence can be shown using Lyapunov stability arguments.

Keywords: Left invertibility, higher order sliding mode observer, nonlinear system, iterative methods, fault detection.

AMS (MOS) subject classification: 93B07, 93B11, 93C10, 93C99.

1 Introduction

In the eighties, P. Kokotovic, H Khalil and J. O'Reilly published a seminal book on singularly perturbed systems [18], which was one of the first books dealing with iterative methods applied in control theory. This book, as well as V. Utkin's one [23], have inspired many works on nonlinear control for constraining the system behaviour to evolve on a given submanifold of the state space. To the best of our knowledge, all control or observer methods able to constrain the system or observation error dynamics to a submanifold encounter some problems under sampling, because, in this case it is only guaranty to reach a neighbourhood of the submanifold. In a joint paper with Professor Khalil [5], we have also shown the necessity for systems under sampling to take care how the output measurement is realized with respect to the control setting for singularly perturbed systems or systems with fast actuators. Works of Professor Hassan Khalil also influenced strongly industrial applications and the way to teach nonlinear control. Actually, like the