Dynamics of Continuous, Discrete and Impulsive Systems
Series **B:** *Applications & Algorithms* **17 (2010)** 825-838
 http://www.watam.org

ASYMPTOTIC REJECTION OF UNMATCHED NONLINEAR DISTURBANCES FOR A CLASS OF NONLINEAR OUTPUT-FEEDBACK SYSTEMS

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Abstract. This paper deals with asymptotic disturbance rejection for nonlinear output feedback systems with unmatched disturbances that are generated from nonlinear exosystems. Nonlinear observer design techniques are exploited for the internal model design. A new strategy for internal model design is proposed, based on a dynamic extension of an existing nonlinear observer design for the nonlinear exosystem from the nonlinear term of the exosystem state which is injected in the nonlinear system. Additional filters are used to estimate the invariant manifold in the state space subject to the nonlinear exosystem, and other parts of the desired feedforward input. The proposed design for the internal model and the control ensures that the state variable asymptotically converges to the invariant manifold, which implies that the output asymptotically converges to zero.

Keywords. Disturbance Rejection, Nonlinear Systems, Output Feedback, Nonlinear Control, Internal Model.

1 Introduction

When the disturbances are generated from linear exosystems, the asymptotic rejection problem has been addressed in [2, 1, 4, 10, 5, 6],even when the disturbance frequencies are completely unknown. The asymptotic disturbance rejection problem becomes much more difficult when the disturbances are generated from nonlinear exosystems. The difficulty is due to the internal model design and the generation of invariant manifold. Some attempts to tackle this problem have been reported in [7, 3, 11] where the nonlinear disturbances are assumed to enter the system via input channel, ie, the disturbance is matched. Even in those matched cases, it is assumed that there exists an immersion of the exosystem to a dynamic model which can be used for the internal model design. It remains a challenge to asymptotic reject a nonlinear disturbance when the match condition is not satisfied.

When the disturbances are generated from nonlinear exosystems which converge to periodic solutions or limit cycles, there exist certain invariant manifolds in the state space, and the asymptotic rejection is achieved by steering the state variables to the invariant manifolds. A common approach