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ADAPTIVE REGULATION WITH ALMOST DISTURBANCE DECOUPLING FOR INTEGRATOR TRIANGULAR SYSTEMS WITH NONLINEAR PARAMETRIZATION

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Abstract. *The problem of almost disturbance decoupling for a class of nonlinear systems is considered. The controlled systems consist of a chain of integrators perturbed by a lower-triangular vector field with nonlinear parametrization. By using the completion of square and the parameter separation technique, a smooth adaptive controller is explicitly constructed to attenuate the influence of the disturbance on the output with an arbitrary degree of accuracy without imposing any extra growth condition. The designed adaptive controller is in its minimum-order property, since the order of the dynamic compensator is equal to one.*

Keywords: Almost disturbance decoupling, Nonlinear parametrization, Integrator lower-triangular systems, Parameter separation technique, Smooth adaptive controller

1. **Introduction.** One of the main objectives in control theory is to suppress unknown disturbances. In most practical situations, it is impossible to realize exact disturbance decoupling. In this case, it is reasonable to aim at almost disturbance decoupling (ADD), which means that the influence of the disturbance on the output is attenuated to an arbitrary degree via feedback control design. More precisely, the problem of ADD can be stated as: given a system and a prescribed positive scalar, find a feedback law such that the closed-loop is stable and the gain between the exogenous input and the regulated output is less than or equal to the prescribed positive number. The starting point of the problem of ADD on nonlinear system is the papers in the late 1980s [1, 2]. The solution in [2] to the ADD problem is characterized in terms of the L_∞-induced norm from the disturbance to the outputs, and is explicitly constructed by applying singular perturbation methods. However, a drawback of the result in [2] is that internal stability, which is crucial for a meaningful application or a practical implementation, is not taken into account. This problem is solved later in [3]. By applying a recursive design technique, a global solution to the ADD problem with internal stability was presented for a chain of integrators perturbed by a lower triangular vector field. It should be point out that the chain of integrators is a very useful system, and is often encountered when a feedback linearization was used [4]. The result in [3] was later generalized to a larger class of nonlinear minimum systems in [5]. These two results were further extended to a class of nonminimum-phase nonlinear systems in [6]. The proposed approach in [6] required that the unstable part of the zero-dynamics was not affected by the disturbance. Such