On the Unknown Input Functional Observers Design: a Polytopic Takagi-Sugeno Approach

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Abstract— In this paper, a step by step algorithm is given to design functional unknown input observer for continuous nonlinear systems under the Polytopic Takagi-Sugeno (T-S) framework. To nullify the effect of unknown input (UI), classical approach of decoupling the UI for the linear case is extended to the polytopic system. Applying the Lyapunov theory and the $\mathcal{L}_2$ attenuation, Linear Matrix Inequalities (LMI)s conditions are achieved which are solved for feasibility to obtain observer design matrices. The novelty of the proposed approach consists in solving simultaneously both structural constraints and LMIs, which ensure a mean for the efficient design of the gains of the observers. To illustrate the proposed theoretical results, simulation example of a Waste Water Treatment Plant (WWTP), which is highly nonlinear and represented in a T-S polytopic form with unmeasurable premise variables and unknown inputs, is discussed.

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