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$\mathcal{H}_\infty$ Filtering for Uncertain Bilinear Stochastic Systems †

Huijun Gao [1*], James Lam [2], Xuerong Mao [3] and Peng Shi [4]

[1] *Space Control and Inertial Technology Center, Harbin Institute of Technology, Harbin, China*
[2] *Department of Mechanical Engineering, University of Hong Kong, Hong Kong*
[3] *Department of Statistics and Modelling Science, University of Strathclyde, Livingstone Tower, 26 Richmond Street, Glasgow, G1 1XT, Scotland, U.K.*
[4] *School of Technology, University of Glamorgan, Pontypridd, CF37 1DL, United Kingdom*

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Abstract: This paper is concerned with the problem of $\mathcal{H}_\infty$ filtering for continuous-time uncertain stochastic systems. The model under consideration contains both state-dependent stochastic noises and deterministic parameter uncertainties residing in a polytope. According to the online availability of the information on the uncertain parameters, we propose two approaches, namely robust stochastic $\mathcal{H}_\infty$ filtering and parameter-dependent stochastic $\mathcal{H}_\infty$ filtering. Both approaches solve the filtering problems based on a modified (improved) bounded real lemma for continuous-time stochastic systems, which decouples the product terms between the Lyapunov matrix and systems matrices and enables us to exploit parameter-dependent stability idea in the filter designs. Sufficient conditions for the existence of admissible robust stochastic $\mathcal{H}_\infty$ filters and parameter-dependent stochastic $\mathcal{H}_\infty$ filters are obtained in terms of linear matrix inequalities, upon which the filter designs are cast into convex optimization problems. Since the filter designs make full use of the parameter-dependent stability idea, the obtained results are less conservative than the existing one in the quadratic framework. A numerical example is provided to illustrate the effectiveness and advantage of the filter design methods proposed in this paper.

Keywords: *Linear matrix inequality; $\mathcal{H}_\infty$ filtering; parameter uncertainty; robust filtering; stochastic systems.*

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