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Optimal State Observer Design for Nonlinear Dynamical Systems

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Abstract: This paper investigates the synthesis and the performance study of the optimal state observer designed for nonlinear dynamical systems to reconstruct the unmeasurable state variables and to stabilize rapidly the observation error system. The proposed nonlinear optimal state observer is based on the determination of the optimal observation gain matrix which is derived by minimizing a quadratic criterion formulated as an output feedback control problem of the observation error system. The gradient matrix operations is applied to the Lagrangian function in order to obtain necessary and sufficient conditions, for minimizing the proposed criterion, to perform the optimal gain matrix. The necessary and sufficient conditions are presented by coupled equations which resolution, by a numerical efficient algorithm, allows the calculus of the optimal observation gain. The effectiveness and the availability of the observer design approach are illustrated through numerical simulation to reconstruct the state variables of a robot with flexible link.

Keywords: *nonlinear observer design; optimal control; output feedback control; flexible robot.*

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