

ABSTRACT

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Extremum seeking can be defined as a real-time optimization method, which goal is to determine the extremum point of an unknown nonlinear static map. This work presents the extremum seeking control based on Gradient and Newton algorithms under time delays. From the literature, it is known that the extremum seeking is not robust under delays and when the delays are inserted in the closed-loop system and the delays are ignored, they severely restrict the convergence rate or lead the system to instability. In Gradient algorithm, a new predictor based on unknown Hessian estimate will be presented and incorporated in the closed-loop system. In the Newton algorithm, a new predictor with stochastic sinusoidal perturbations and an average-based estimate of the Hessian's inverse is incorporated in the closed-loop system such that the convergence rate of the controller in real-time can be made user-assignable. Exponential stability and convergence to a small neighborhood of the unknown extremum point can be obtained. This result is rigorously guaranteed by using backstepping transformation and averaging in infinite dimensions. Numerical examples are shown to present the effectiveness of the proposed predictor-based stochastic extremum seeking for time-delay compensation.

Keywords: Delays; Predictor; Stochastic Extremum Seeking Control; Gradient Algorithm; Newton Algorithm; Backstepping Transformation; Averaging in Infinite Dimensions.