# ABSTRACT

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A gradient extremum seeking for compensating wave actuator dynamics in cascade with static scalar maps is proposed to address a problem inspired by a specific engineering application related to drilling of oil wells. This class of Partial Differential Equations (PDEs) - Wave equation - for extremum seeking has not been studied yet. A dynamic feedback control law based on distributed parameters is proposed by employing backstepping transformation with an appropriate target system and an adequate formulation using Neumann interconnections. Local stability and convergence to a small neighborhood of the desired (but unknown) extremum is proved by means of a Lyapunov functional and the theory of averaging in infinite dimensions. The extension for wave equations with Dirichlet actuation, antistable wave PDEs as well as the design for the delay-wave PDE cascade are also discussed. Numerical simulations illustrate the theoretical results.

Keywords: Extremum seeking Control; Backstepping; Wave Partial Differential Equation; Drilling Control