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Contents

Design of 1-DOF Integer and Fractional-Order PID Controllers Using an Ensemble Differential Evolution for a Magnetic Levitation System

Mou Das Mahapatra, Shibendu Mahata, Ritu Rani De, Rajani Kanta Mudi, and Chanchal Dey

Abstract A time-domain-based metaheuristic design approach employing a high-level ensemble of three variants of differential evolution algorithms is presented for an optimal control of magnetic levitation system. Traditional and fractional-order proportional-integral-derivative (FOPID) controllers of one degree-of-freedom, that optimally minimizes the step response error, are designed. Comparisons with the published models highlight the improved transient behavior for both the proposed controllers. Results also demonstrate a significantly smaller settling time for the designed FOPID-based-controlled system compared to the classical one.

Keywords Ensemble differential evolution · Fractional order PID controller · Magnetic levitation · Metaheuristic optimization

1 Introduction

The idea of fractional calculus (FC), the generalized version of classical calculus, germinated around the end of seventeenth century. However, the first comprehensive compendium on FC was available only around the 1970s [1]. The application domains of FC have subsequently proliferated and now encompass diverse fields such as circuit

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