

## Abstract

# Design of Fuzzy Type-1 and Interval Type-2 Fuzzy-Based Harmonic Search Optimization Algorithms for Uncertain Systems: Fault-Tolerant Control Utilization <sup>†</sup>

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The purpose of this study is to enhance the efficacy of the harmonic search (HS) algorithm with dynamically changing evolutionary optimization method parameters utilizing fuzzy type-1 (FT1) and interval type-2 fuzzy systems (IT2FS). We previously examined both types of fuzzy schemes in a number of benchmark tasks and determined that combining the fuzzy logic scheme with the harmonic search method gives a prominent outcome. Many of the scientific research studies clearly show that the proposed method outperforms other algorithms statistically. In this example, the harmony memory (HMR) variable is dynamically adjusted throughout the evolution procedure using FT1 and IT2FS. The primary contribution of this work is the ability to determine the two forms of the fuzzy inference scheme used in the harmonic search approach, which delivers superior consequences via experimentation in a benchmark control problem. This is because there has been no previous research that uses and compares type-1 and interval type-2 fuzzy systems. Additionally, three types of uncertainty are used to assess the performance of both fuzzy systems in the standard coupled tank-level control system, which simulated the perturbation that may exist in reality and thus permitted statistical verification if there were significant variances among FT1 and IT2FS. The statistical results were produced and compared with other recent techniques and found that the proposed fuzzy-based technique gives superior performance under perturbation.

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