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Depressive Bangla Text Detection from Social Media Post Using Different Data Mining Techniques 237
Farzana Tasnim, Sultana Umme Habiba, Nuren Nafisa, and Afsana Ahmed

Implementation of Optimized PID Controllers in Real Time for Magnetic Levitation System 249
Soham Dey, Subrata Banerjee, and Jayati Dey

Anomalous Behavior Detection in Examination 257
Zaki Ahmed yadahalli and A. Parkavi

A Survey on DDoS Attacks from Compromised Devices to Enhance IoT Security 265
K. S. Niraja, Krishna Keerthi Chennam, and R. Madana Mohana

A Study of Glaucoma Diagnosis Using Brain–Computer Interface Technology 271
R. Geethalakshmi, R. Vani, and Meenalosini Vimal Cruz

Seafloor Habitat Mapping Using Machine Learning and Underwater Acoustic Sonar 281
Rozaimi Che Hasan, Najhan Md. Said, and Idham Khalil

Smart Irrigation for Enhanced Agriculture Production Using IoT 289
G. Saranyadevi, R. Vani, A. Jeshron Sonali, and S. Minoviya

Design and Development of Medicine Retrieval Robot for Pharmaceutical Application 301
V. G. Pratheep, T. Tamilarasi, K. Ravichandran, A. Shanmugam, S. K. Thangarasu, and A. Prenitha

Machine Learning Concept in Smart Water Purifier and Dispenser for Averting Spread of Infections 309
Arshad Mohammed, Mahabbob Shaik, and G. Sailaja

Regressors with Anova-Reduced Features for Tariff Rate Prediction Using Machine Learning 317
M. Shyamala Devi, Ganta Umamaheswar Reddy, Balla Teja Swaroop, and Rachaputi Kiran Kumar

A Theoretical Survey of Wireless Body Area Networks and Their Feasibility 327
G. Balaraju, Milindkumar, H. V. Ramachandra, and Harish Patil

Flower Pollination Algorithm for Convolutional Neural Network Training in Vibration Classification 339
Md. Fadil Md. Esa, Noorfa Haszlinna Mustaffa, Nor Haizan Mohamed Radzi, and Roselina Sallehuddin

Implementation of Optimized PID Controllers in Real Time for Magnetic Levitation System

Soham Dey, Subrata Banerjee, and Jayati Dey

Abstract This paper aims to demonstrate a tuning method for the parameters of PID controller utilizing various modern meta-heuristic and swarm-intelligence-based optimization techniques for a laboratory scaled magnetic levitation system. Owing to the fact that classical controller tuning method failed to yield satisfactory result for a highly non-linear and unstable MAGLEV system; this work focuses on tuning of PID parameters employing a new artificial-intelligence-based optimization techniques, grey wolf optimization (GWO) and performance is compared with existing algorithms. The controller parameter optimization has been carried out by incorporating various error-based performance indices as objective functions. The proposed GWO-PID controller has proven its efficacy in terms of better transient specifications, optimum stability performance, accurate reference tracking capability, and improved convergence characteristic.

Keywords Evolutionary optimization · ITSE performance index · MAGLEV system · Optimized PID controller · Real-time implementation

1 Introduction

Magnetic levitation technique basically refers to a system, wherein a ferromagnetic object is levitated and suspended in the air with the help of electromagnetic forces without any visible means of mechanical or physical support [1]. Certain interesting features of MAGLEV system like: highly non-linear dynamic behavior, inherent instability, and free from mechanical frictional loss make this system suitable for application in many industrial applications. High speed MAGLEV trains [2], magnetically suspended wind turbines, magnetic bearings [3] are some of MAGLEV system's significant applications.

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