Short CV:

Muhammad Saeed Muhammad Tolba is currently a Ph.D. Candidate in Control and Instrumentation Engineering at King Fahd University of Petroleum and Minerals (KFUPM), Saudi Arabia. His research focuses on cyber-resilient frequency control, renewable-integrated smart grids, and AI-based anomaly detection. He holds an M.Sc. in Mechatronics Engineering from E-JUST, Egypt, and a B.Sc. in Mechatronics Engineering from Helwan University, where he graduated top of his class. Muhammad has authored and co-authored multiple publications in IEEE and Elsevier venues, including works on MPC-based cascaded control for smart grids, neural-network-based system identification, and adaptive frequency regulation. He currently serves as an Instructor in the Instrumentation and Measurement Lab at KFUPM. His achievements include Best Poster Awards from the Arabian Journal for Science and Engineering Symposium (AJSE 2025) and KFUPM's Graduate Student Poster Competition (2025). His work emphasizes integrating control theory, artificial intelligence, and cybersecurity for the next generation of intelligent and secure energy systems.

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Paper's Title: Adaptive PI Control with Signal Synthesis for Robust Power System Frequency Regulation

Abstract

This paper presents an adaptive PI-based controller for load-frequency regulation in power systems, designed to satisfy the hyper-stability criterion while accommodating parameter uncertainties. The approach uses only available state and output data without explicit parameter identification. It also assumes bounded disturbances and unknown but bounded system parameters. Simulations under different conditions demonstrate the controller's effectiveness. With a 1% fixed load change, it achieved a 3.6 s settling time and negligible undershoot. Even with 50% parameter variations, stability was preserved. Under varying load scenarios, the system maintained stability with maximum overshoot and undershoot of just 0.007 Hz and 0.0035 Hz, respectively. These results confirm the proposed controller's robustness and fast dynamic response across diverse operating conditions.