185ª DEFESA DE DISSERTAÇÃO EM ENGENHARIA INDUSTRIAL

PROGRAMA DE PÓS-GRADUAÇÃO EM ENGENHARIA INDUSTRIAL - PEI

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Título: Simple model predictive control strategies coupled to artificial intelligence-based disturbance modeling for microgrid energy management system .

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Resumo:
Electricity generation still depends largely on fossil fuels, but growing concerns over climate change, resource depletion, and rising energy demand have accelerated the shift to cleaner alternatives. Renewable Energy Resources (RERs) offer advantages such as low emissions, abundance, and diversity, yet their intermittency and variability demand advanced control strategies. Microgrids have emerged as a promising solution by integrating generation, storage, and loads in modular systems that can operate in grid-connected or islanded modes. This dissertation proposes optimized strategies for microgrid Energy Management Systems (EMSs) based on Model Predictive Control (MPC), focusing on grid-connected operation. The first contribution presents a two-layer QP-based MPC controller, improving numerical robustness and lowering computational costs compared to traditional NLP approaches. The second introduces Artificial Neural Networks (ANNs) to forecast renewable generation and load demand—treated as disturbances—using real data from Guanambi, Bahia, which are embedded into the control framework to enable proactive actions. The third contribution proposes a single-layer, zone-based MPC strategy that operates within economically viable control regions defined by the operator. This approach is supported by a Lyapunov-based stability analysis, ensuring recursive feasibility and nominal convergence. Overall, this work advances scalable and adaptive QPbased MPC strategies enhanced by AI forecasting for efficient microgrid control.

Palavras-chave: Microgrid, EMS, Economic MPC, Zone-MPC