

Dynamic Real-Time Optimization over Infinite Horizons

Economic Nonlinear Model Predictive Control (eNMPC) is an extension of Nonlinear Model Predictive Control (NMPC) used for online dynamic real-time optimization (D-RTO) of nonlinear chemical process systems. Unlike NMPC, eNMPC solves optimization problems characterized by the use of general economic performance objective functions, rather than stage costs which track to setpoints. Both NMPC and eNMPC formulations often require problem-specific terminal constraints or terminal costs to develop an effective finite-horizon control strategy. Moreover, finite-horizon eNMPC typically requires the addition of a Lyapunov stabilizing constraint to ensure convergence to optimal steady state setpoints. Instead, this work introduces an infinite horizon eNMPC formulation that approximates the infinite sum of stage costs (from the end of the finite horizon to infinity), using a time transformation to convert the infinite horizon domain into a finite one. This transformation has been shown to enhance stability and robustness properties of standard NMPC. Extended to eNMPC, the infinite horizon eliminates short-term effects encountered in D-RTO and leads to improved economic performance, as demonstrated on several nonlinear chemical process and energy network examples.



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Lorenz T. (Larry) Biegler is the Covestro University Professor of Chemical Engineering at Carnegie Mellon University. His research interests lie in computer aided process engineering (CAPE) and include flowsheet optimization, optimization of systems of differential and algebraic equations, reactor network synthesis, nonlinear process control and real-time optimization. Contributions include development and analysis of nonlinear programming algorithms and applications to real-world chemical and energy processes. An author on over 600 archival publications and two textbooks and editor of 11 technical books, he is a Fellow of AIChE, IFAC and SIAM, and a member of the US National Academy of Engineering.



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