World Academy of Science, Engineering and Technology
International Journal of Electrical and Computer Engineering
Vol:19, No:06, 2025

Efficient Model Order Reduction of Descriptor Systems Using Iterative Rational Krylov Algorithm

Authors : Muhammad Anwar, Ameen Ullah, Intakhab Alam Qadri

Abstract : This study presents a technique utilizing the Iterative Rational Krylov Algorithm (IRKA) to reduce the order of large-scale descriptor systems. Descriptor systems, which incorporate differential and algebraic components, pose unique challenges in Model Order Reduction (MOR). The proposed method partitions the descriptor system into polynomial and strictly proper parts to minimize approximation errors, applying IRKA exclusively to the strictly adequate component. This approach circumvents the unbounded errors that arise when IRKA is directly applied to the entire system. A comparative analysis demonstrates the high accuracy of the reduced model and a significant reduction in computational burden. The reduced model enables more efficient simulations and streamlined controller designs. The study highlights IRKA-based MOR's effectiveness in optimizing complex systems' performance across various engineering applications. The proposed methodology offers a promising solution for reducing the complexity of large-scale descriptor systems while maintaining their essential characteristics and facilitating their analysis, simulation, and control design.

Keywords : model order reduction, descriptor systems, iterative rational Krylov algorithm, interpolatory model reduction, computational efficiency, projection methods, H_2-optimal model reduction
Conference Title : ICCAR 2025 : International Conference on Control, Automation and Robotics
Conference Location : New York, United States
Conference Dates : June 03-04, 2025