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Title: ***«Neurodynamic Optimization Approaches to Robust Pole Assignment»***

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Social Facilities Center (SFC) 3 - Room 105, University of Cyprus (New Campus)

Abstract:
Pole assignment (placement) is a basic approach for linear control system design. It is concerned with the assignment of the poles (eigenvalues) and their associated eigenvectors via feedback control laws, which can meet the various closed-loop design specifications in control systems. Given a linear system and the desired closed-loop spectrum, the robust pole assignment problem is to find the feedback gains such that the robustness of the eigensystem is optimized. The robust pole assignment problem was first formulated by means of minimizing the spectral condition number of the eigenvector matrix, as the closed-loop poles change at a rate less than the condition number per unit change in the norm of the variation of the closed-loop system matrix. As the spectral condition number is nonconvex, it is difficult to reach its global minima. Although several alternative robustness measures were developed, they are still nonconvex with limited successes by means of conventional or gradient-flow approaches.
In this talk, novel neurodynamic optimization approaches to robust pole assignment will be presented for synthesizing linear control systems via state and output feedback. The problem is formulated as a pseudoconvex optimization problem with the spectral condition number as the objective function (robustness measure) and linear matrix equality constraints for exact pole assignment. Two coupled recurrent neural networks are applied for solving the formulated problem in real time. In contrast to existing approaches, the exponential convergence of proposed neurodynamcs to global optimal solutions can be guaranteed even with lower model complexity in terms of the number of variables. Simulation results of the proposed neurodynamic approaches for eleven benchmark problems will be reported to demonstrate their superiority. In addition, the application of the proposed approach to piecewise linear systems will be delineated. The extensions of the present results based on convex reformulations will be also discussed. In addition to first-order control systems, a neurodynamic optimization approach to robust pole assignment for high-order descriptor singular systems.

Biography:

Jun Wang is a Professor and the Director of the Computational Intelligence Laboratory in the Department of Mechanical and Automation Engineering at the Chinese University of Hong Kong. Prior to this position, he held various academic positions at Dalian University of Technology, Case Western Reserve University, and University of North Dakota. He also held various short-term visiting positions at USAF Armstrong Laboratory (1995), RIKEN Brain Science Institute (2001), Universite Catholique de Louvain (2001), Chinese Academy of Sciences (2002), Huazhong University of Science and Technology (2006–2007), and Shanghai Jiao Tong University (2008-2011) as a Changjiang Chair Professor. Since 2011, he is a National Thousand-Talent Chair Professor at Dalian University of Technology on a part-time basis. He received a B.S. degree in electrical engineering and an M.S. degree in systems engineering from Dalian University of Technology, Dalian, China. He received his Ph.D. degree in systems engineering from Case Western Reserve University, Cleveland, Ohio, USA. His current research interests include neural networks and their applications. He published 160 journal papers, 13 book chapters, 10 edited books, and numerous conference papers in these areas. He has been an Associate Editor of the IEEE Transactions on Cybernetics and its predecessor for ten years and a member of the editorial board or editorial advisory board of Neural Networks and International Journal of Neural Systems. He also served as an Associate Editor of the IEEE Transactions on Neural Networks (1999-2009) and IEEE Transactions on Systems, Man, and Cybernetics – Part C (2002–2005), as a guest editor of special issues of European Journal of Operational Research (1996), International Journal of Neural Systems (2007), Neurocomputing (2008), and International Journal of Fuzzy Systems (2010, 2011). He was an organizer of several international conferences such as the General Chair of the 13th International Conference on Neural Information Processing (2006) and the 2008 IEEE World Congress on Computational Intelligence. He was an IEEE Computational Intelligence Society Distinguished Lecturer (2010-2012) and served in many standing/technical committees such as the President of Asia Pacific Neural Network Assembly (APNNA), IEEE Fellow Committee and IEEE Computational Intelligence Society Fellow and Awards Committees, and currently is on the Board of Governors of the IEEE Systems, Man and Cybernetics Society. He is an IEEE Fellow, IAPR Fellow, and a recipient of an IEEE Transactions on Neural Networks Outstanding Paper Award, APNNA Outstanding Achievement Award in 2011, and IEEE Neural Networks Pioneer Award in 2014, among other distinctions.