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HONG KONG BAPTIST UNIVERSITY
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Distinguished Lecture Series

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Self-Learning Control of Nonlinear Systems based on Iterative Adaptive Dynamic Programming Approach

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WLB210, Wing Lung Bank Building, Shaw Campus, HKBU

Abstract: The optimal control of nonlinear systems often requires solving the nonlinear Hamilton-Jacobi-Bellman (HJB) equation instead of the Riccati equation as in the linear case. The discrete-time HJB (DTHJB) equation is more difficult to work with than the Riccati equation because it involves solving nonlinear partial difference equations. Though dynamic programming has been a useful computational technique in solving optimal control problems for many years, it is often computationally untenable to run it to obtain the optimal solution, due to the backward numerical process required for its solutions, i.e., the well-known "curse of dimensionality". A self-learning control scheme for unknown nonlinear discrete-time systems is developed for this purpose. An iterative adaptive dynamic programming algorithm via globalized dual heuristic programming technique is developed to obtain the optimal controller with convergence analysis. Neural networks are used as parametric structures to facilitate the implementation of the iterative algorithm, which will approximate at each iteration the cost function, the optimal control law, and the unknown nonlinear system, respectively. Simulation examples are provided to verify the effectiveness of the present self-learning control approach.

Biography: Derong Liu received the Ph.D. degree in electrical engineering from the University of Notre Dame in 1994. He was a Staff Fellow with General Motors Research and Development Center, Warren, MI, from 1993 to 1995. He was an Assistant Professor in the Department of Electrical and Computer Engineering, Stevens Institute of Technology, Hoboken, NJ, from 1995 to 1999. He joined the University of Illinois at Chicago in 1999, and became a Full Professor of electrical and computer engineering and of computer science in 2006. He was selected for the "100 Talents Program" by the Chinese Academy of Sciences in 2008. He has published 14 books (six research monographs and eight edited volumes). Currently, he is the Editor-in-Chief of the IEEE Transactions on Neural Networks and Learning Systems. He received the Faculty Early Career Development (CAREER) award from the National Science Foundation (1999), the University Scholar Award from University of Illinois (2006-2009), and the Overseas Outstanding Young Scholar Award from the National Natural Science Foundation of China (2008). He is a Fellow of the IEEE and a Fellow of the INNS.

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