

UNIVERSITY OF MACAU
FACULTY OF SCIENCE AND TECHNOLOGY
DEPARTMENT of
ELECTROMECHANICAL ENGINEERING

Ref: FST/SEM/009/2010

*" Neurodynamic Optimization and Its
Applications in Robotics "*

by

Prof. Jun Wang

IEEE Fellow,

Chinese University of Hong Kong

Date: 29/01/2010 (FRIDAY)

Time: 04:00PM – 05:20PM

Venue: N402 (University of Macau)

Abstract

Optimization problems arise in a wide variety of scientific and engineering applications. It is computationally challenging when optimization procedures have to be performed in real time to optimize the performance of dynamical systems. For such applications, classical optimization techniques may not be competent due to the problem dimensionality and stringent requirement on computational time. One very promising approach to dynamic optimization is to apply artificial neural networks. Because of the inherent nature of parallel and distributed information processing in neural networks, the convergence rate of

the solution process is not decreasing as the size of the problem increases. Neural networks can be implemented physically in designated hardware such as ASICs where optimization is carried out in a truly parallel and distributed manner. This feature is particularly desirable for dynamic optimization in decentralized decision-making situations arising frequently in robotics and control. In this talk, I will present the historic review and the state of the art of neurodynamic optimization models and selected applications in robotics. Specifically, starting from the motivation of neurodynamic optimization, we will review various recurrent neural network models for optimization. Theoretical results about the stability and optimality of the neurodynamic optimization models will be given along with illustrative examples and simulation results. It will be shown that many fundamental problems in robotics, such as robot motion planning and obstacle avoidance, can be readily solved by using the neurodynamic optimization models.

About the Speaker: Jun Wang is a Professor 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), REKEN Brain Science Institute (2001), Universite Catholique de Louvain (2001), Chinese Academy of Sciences (2002), and Huazhong University of Science and Technology (2006–2007). He has held a Changjiang Chair Professorship in computer science and engineering at Shanghai Jiao Tong University since 2008. 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 over 140 journal papers, 11 book chapters, 8 edited books, and numerous conference papers in these areas. He has been an Associate Editor of the IEEE Transactions on Systems, Man, and Cybernetics – Part B since 2003, and a member of the Editorial Advisory Board of the International Journal of Neural System since 2006. 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) and as a guest editor of special issues of European Journal of Operational Research (1996), International Journal of Neural Systems (2007), and Neurocomputing (2008). 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 served as the President of the Asia Pacific Neural Network Assembly in 2006. He is an IEEE Fellow, an IEEE Distinguished Lecturer, and a recipient of the Research Excellence Award from the Chinese University of Hong Kong (2007-2008).

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