The State of the Art of Neurodynamic Optimization:

Past, Present, and Prospect

Jun Wang

Department of Computer Science
City University of Hong Kong,
Kowloon Tong, Kowloon, Hong Kong

Abstract – As an important tool for science research and engineering applications, optimization is omnipresent in a wide variety of settings. 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. New paradigms are needed. 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. This talk will present the state of the art of neurodynamic optimization models and selected applications. Specifically, starting with the idea and motivation of neurodynamic optimization, I will review the historic review and present the state of the art of neurodynamic optimization with many individual models for convex and generalized convex optimization. In addition, I will present a multiple-time-scale neurodynamic approach to selected constrained optimization. Finally, I will introduce population-based collaborative neurodynamic approaches to constrained distributed and global optimization. By deploying a population of individual neurodynamic models with diversified initial states at a lower level coordinated by using some global search and information exchange rules based on swarm intelligence at a upper level, it will be shown that constrained global, combinatorial, and multi-objective optimization problems can be solved effectively and efficiently by means of neurodynamic optimization.

Jun Wang is the Chair Professor Computational Intelligence in the Department of Computer Science and School of Data Science at City University of Hong Kong. Prior to this position, he held various academic positions at Dalian University of Technology, Case Western Reserve University, University of North Dakota, and the Chinese University of Hong Kong. He also held various short-term visiting positions at USAF Armstrong Laboratory, RIKEN Brain Science Institute, Dalian University of Technology, Huazhong University of Science and Technology, and Shanghai Jiao Tong University (Changjiang Chair Professor). He received a B.S. degree in electrical engineering and an M.S. degree in systems engineering from Dalian University of Technology and his Ph.D. degree in systems engineering from Case Western Reserve University. His current research interests include neural networks and their applications. He published over 200 journal papers, 15 book chapters, 11 edited books, and numerous conference papers in these areas. He is the Editor-in-Chief of the *IEEE Transactions on Cybernetics*. He also served as an Associate Editor of the *IEEE Transactions on Neural Networks* (1999-2009), *IEEE Transactions*

on Cybernetics and its predecessor (2003-2013), and *IEEE Transactions on Systems, Man, and Cybernetics – Part C* (2002–2005), as a member of the editorial board of *Neural Networks* (2012-2014), editorial advisory board of *International Journal of Neural Systems* (2006-2013. 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, and a Program Chair of the IEEE International Conference on Systems, Man, and Cybernetics (2012). He is an IEEE Fellow, IAPR Fellow, and an IEEE Systems, Man and Cybernetics Society Distinguished Lecturer (2017-2018), and was an IEEE Computational Intelligence Society Distinguished Lecturer (2010-2012, 2014-2016). In addition, he served as President of Asia Pacific Neural Network Assembly (APNNA) in 2006 and many organizations such as IEEE Fellow Committee; IEEE Computational Intelligence Society Awards Committee; IEEE Systems, Man, and Cybernetics Society Board of Governors, He is a recipient of an *IEEE Transactions on Neural Networks* Outstanding Paper Award and APNNA Outstanding Achievement Award in 2011, Neural Networks Pioneer Award from IEEE Computational Intelligence Society in 2014, and Norbert Wiener Award from IEEE Systems, Man and Cybernetics Society in 2019, among others.