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Robust Multiobjective Controllability of Complex Neuronal Networks

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Abstract

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Abstract:

This paper addresses robust multiobjective identification of driver nodes in the neuronal network of a cat's brain, in which uncertainties in determination of driver nodes and control gains are considered. A framework for robust multiobjective controllability is proposed by introducing interval uncertainties and optimization algorithms. By appropriate definitions of robust multiobjective controllability, a robust nondominated sorting adaptive differential evolution (NSJaDE) is presented by means of the nondominated sorting mechanism and the adaptive differential evolution (JaDE). The simulation experimental results illustrate the satisfactory performance of NSJaDE for robust multiobjective controllability, in comparison with six statistical methods and two multiobjective evolutionary algorithms (MOEAs): nondominated sorting genetic algorithms II (NSGA-II) and nondominated sorting composite differential evolution. It is revealed that the existence of uncertainties in choosing driver nodes and designing control gains heavily affects the controllability of neuronal networks. We also unveil that driver nodes play a more drastic role than control gains in robust controllability. The developed NSJaDE and obtained results will shed light on the understanding of robustness in controlling realistic complex networks such as transportation networks, power grid networks, biological networks, etc.

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Alerts	Authors Author image of Yang Tang Yang Tang Key Laboratory of Advanced Control and Optimization for Chemical Processes, Ministry of Education, East China University of Science and Technology, Shanghai, China Yang Tang (M'11) received the BS and PhD degrees in electrical engineering from Donghua University, Shanghai, China, in 2006 and 2010, respectively. He was a research associate with The Hong Kong Polytechnic University, Kowloon, Hong Kong, from 2008 to 2010. From 2011 to 2015, he conducted his postdoctoral research with the Humboldt University of Berlin, Berlin, Germany, and the Potsdam Institute for Climate Impact Research, Germany. Since 2015, he has been a professor at the East China University of Science and Technology, Shanghai. He has published more than 50 refereed papers in international journals. His current research interests include synchronization/consensus, networked control systems, evolutionary computation, and bioinformatics and their applications. He was the recipient of the Alexander von Humboldt Fellowship in 2011. He is an associate editor of the Journal of the Franklin Institute and Neurocomputing, and a leading guest editor of the Journal of the Franklin Institute. He is a member of the IEEE.	Footnotes Back to Top

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