Open Invited Track proposal for IFAC 2017

Title: Modelling, identification and control of quantum systems

Organizers

Dr Daoyi Dong
Senior Lecturer, School of Engineering and Information Technology, University of New South Wales, Australia
E-mail: daoyidong@gmail.com

A/Prof Naoki Yamamoto
Associate Professor, Department of Applied Physics and Physico-informatics, Keio University, Japan
E-mail: yamamoto@appi.keio.ac.jp

A/Prof Rebing Wu
Associate Professor, Department of Automation, Tsinghua University, China
E-mail: rbwu@tsinghua.edu.cn

Abstract The emerging field of quantum technology is generating important impacts on our life. The development of theory and methods for modelling, identification and control of quantum systems is a key task for developing practical quantum technology. This open invited track provides a forum for idea exchange in the emerging research area of modelling, identification and control of quantum systems, as well as their applications to experimental quantum technologies.

The choice of an IFAC technical committee for evaluation: CC 1 – Systems and Signals --> TC 1.1. Modelling, Identification and Signal Processing

A detailed description of the topic: Quantum Technology has been recognised as one of the most promising frontier technologies. Although great progress has already been made, a lot of fundamental research is still needed for this area to become mature enough to foster wider practical applications. Much research in this area can be formulated as quantum estimation and control problems. As highlighted by Dowling and Milburn in [1]: "The development of the general principles of quantum control theory is an essential task for a future quantum technology." The rapid development of quantum technology also creates new challenges in systems control theory since the dynamics of quantum systems are fundamentally different from those of classical systems, such as quantum entanglement (a unique quantum correlation) and quantum coherence (a wave-like property of quantum systems allowing for constructive and destructive interference).

The purpose of this open invited track will be to provide an account of the state-of-the-art in this fast moving and cross-disciplinary field. Topics include but not limited to

- Modelling and analysis of quantum control systems
- State estimation of quantum systems
- Hamiltonian identification of quantum systems
- Parameter identification of open quantum systems
- Linear quantum systems theory

Proposal submitted to 20th IFAC World Congress. Received February 1, 2016.

- Quantum optimal control
- Quantum robust control
- Quantum measurement-based feedback and quantum coherent feedback
- Learning control of quantum systems
- Quantum control applications in molecular systems, quantum metrology and quantum information

[1]. Dowling J P, Milburn G J. Quantum Technology: the second quantum revolution. Philosophical Transactions of the Royal Society of London A, 2003, 361: 1655-1674.

Internet links for additional material:

1. The international workshop on Principles and Applications of Control in Quantum Systems has been held ten times. Information can be found from the following link:
   http://pracqsys2015.ee.unsw.edu.au/

2. A Special Issue on Control of Quantum Mechanical Systems has been published by IEEE Transactions on Automatic Control
   http://ieeexplore.ieee.org/xpls/icp.jsp?arnumber=6244885