QCIT Meeting - 6th of July 2021

Organized
by
Andrea Conti, Lajos Hanzo, Soon-Xin Ng and Peter Mueller

Agenda

- 12:00 EDT - Welcome
- 12:05 An *Ad Hoc* QCIT Workshop
  1) Cooperative Classical and Quantum Communications by Prof. Soon-Xin Ng
  2) The Quantum 'Piggyback' Procedure by Prof. Marco Chiani
  3) 'A Cocktail of Cool Recent Results' by All
- Next QCIT-ETC Meeting & Informal Workshop: ICC'2021
- Approval of minutes of the QCIT Meeting at GC'2020
- Adjourn

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Selected Topics in Quantum Communications: An *Ad Hoc* QCIT Workshop - 6th of July 2021

I. 12:05 EDT - Prof. Soon-Xin Ng

According to Moore's law, the number of transistors on micro-chip doubles every two years. Hence, the transistor size is expected to approach atomic scale in the near future due to our quest for miniaturization and more processing power. However, atomic level behavior is governed by the laws of quantum physics, which are significantly different from those of classical physics. More explicitly, the inherent parallelism associated with quantum entities allows a quantum computer to carry out operations in parallel, unlike conventional computers. More significantly, quantum computers are capable of solving some challenging optimization problems in a fraction of the time required by a conventional computer. In other words, the inherent parallel processing capability of quantum computers can be exploited to dramatically reduce the detection complexity in future generation communications systems. However, the major impediment in the practical realization of quantum computers is the sensitivity of the quantum states, which collapse when they interact with their environment. Hence, powerful Quantum Error Correction (QEC) codes are needed for protecting the fragile quantum states from undesired influences and for facilitating the robust implementation of quantum computers. In this talk we will look at some applications and developments related to quantum communications.

Prof. Soon Xin Ng (S'99-M'03-SM'08) received the B.Eng. degree (First class) in electronic engineering and the Ph.D. degree in telecommunications from the University of Southampton, Southampton, U.K., in 1999 and 2002, respectively. From 2003 to 2006, he was a postdoctoral research fellow working on collaborative European research projects known as SCOUT, NEWCOM and PHOENIX. Since August 2006, he has been a member of academic staff in the School of Electronics and Computer Science, University of Southampton. He was involved in the OPTIMIX and CONCERTO European projects as well as the IU-ATC and UC4G projects. He was the principal investigator of an EPSRC project on "Cooperative Classical and Quantum Communications Systems". He is currently a Professor of Next Generation Communications at the University of Southampton.

II. 12:50 EDT - Prof. Marco Chiani

In classical communication networks, operations like searching a pattern of symbols in a stream (e.g., for synchronization), or putting in packets data symbols and control symbols (e.g., IP), are common practices. When thinking of quantum networks, these operations are not directly possible, as measuring may destroy quantum superposition. In this framework, we discuss the possibility of piggybacking classical information on a stream of qubits protected by a quantum error correcting code. In particular, piggybacking on quantum streams can facilitate synchronization, control and annotation for quantum systems and networks.

Prof. Marco Chiani is a Full Professor in telecommunications at the University of Bologna, and a Research Affiliate at the Massachusetts Institute of Technology (MIT). He is an IEEE Fellow, received the 2011 IEEE Abraham Prize, the 2012 IEEE Ellersick Prize, and the 2012 IEEE Rice Prize in the Field of Communications Theory. He has been the Chair (2002–2004) of the Radio Communications Committee of IEEE CommSoc. His research interests are in the areas of information theory and coding, wireless systems, statistical signal processing, and quantum information. His contributions include also exponential bounds for the Gaussian error function, and the statistical distribution of the eigenvalues of random matrices.

III. 13:30 EDT - 'A Cocktail of Cool Recent Results'