Tutorial T-14: Resource Allocation for Full-Duplex Communication and Networks

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Tutorial Overview

The recent significant progress in realizing full-duplex (FD) systems has opened up another promising avenue for increasing the capacity of future wireless networks. In addition to the self-interference cancelation signal processing algorithms, network protocols such as resource management are also essential in the practical design and implementation of FD wireless networks. This tutorial aims to present the latest development and future directions of resource allocation in different full duplex systems by exploring the network resources in different domains, including power, space, frequency, and device dimensions. Four representative application scenarios are considered: FD MIMO networks, FD cooperative networks, FD OFDMA cellular networks, and FD heterogeneous networks. Resource management problems and novel algorithms in these systems are presented, and key open research directions are discussed.

In this tutorial, we will concentrate on the use of resource allocation tools (such as optimization and game theory) to analyze and design FD wireless networks. There are three main objectives of presenting this tutorial. The first objective is to provide a general introduction to FD-based wireless communication and networking including from physical to MAC and network layer issues, and discuss the requirements for FD communication and networks. The second objective is to illustrate how such FD paradigm will affect the design of other layers for radio resource management (RRM) with distributed solutions. The third objective is to present the state-of-the-art of FD communications and networking schemes along with possible other applications, such as heterogeneous networks, cognitive radio networks, D2D networks, small cell networks, etc.

The detailed outline of the tutorial is:

Basic of FD Communication – presents the basics and recent progress in applying signal processing techniques to design FD communication systems.
1) Overview
2) Physical-layer transmission technologies, signal model, self-interference cancellation
3) Key working and application scenarios
4) Implementation issues

Resource Allocation – discusses the use of optimization and distributed resource allocation such as game theory to analyze and design FD cellular networks.
1) RRM in FD MIMO networks
2) RRM in FD OFDMA networks
3) RRM in FD cooperative networks
4) RRM in FD heterogeneous networks

Potential Applications in FD communication networks – study possible applications of FD radios for future communications and networks.
1) Dynamic spectrum access and sharing in FD cognitive radio networks
2) Physical-layer security for FD networks

3) Frequency reuse for FD device-to-device underlay networks
4) Model selection for FD small cell networks

Presenter Biographies

Lingyang Song received his PhD from the University of York, UK, in 2007, where he receivedthe K. M. Stott Prize for excellent research. He worked as a research fellow at the University of Oslo, Norway, and Harvard University, until rejoining Philips Research UK in March 2008. In May 2009, he joined the School of Electronics Engineering and Computer Science, Peking University, China, as a full professor. His main research interests include MIMO, cognitive and cooperative communications, physical layer security, and wireless ad hoc/sensor networks.

Dr. Song is co-inventor of a number of patents (standard contributions), and published extensively. He received seven paper awards. He is currently on the Editorial Board of IEEE Transactions of Wireless Communications. He was a guest editor of Wireless Communications and Mobile Computing (Wiley Publication), Special Issues on "Emerging Techniques for Wireless Vehicular Communications", and a guest editor of Elsevier Computer Communications, Special Issue on "Adaptive Multicarrier Communications and Networks", a guest editor of EURASIP Journal on Wireless Communications and Networking, Special Issue on "OFDMA Architectures, Protocols, and Application". He is the recipient of 2012 IEEE Asia Pacific (AP) Young Researcher Award.

Dr. Song is a senior member of IEEE, and IEEE distinguished lecturer since 2015.

Zhu Han received the B.S. degree in electronic engineering from Tsinghua University, in 1997, and the M.S. and Ph.D. degrees in electrical engineering from the University of Maryland, College Park, in 1999 and 2003, respectively. From 2000 to 2002, he was an R&D Engineer of JDSU, Germantown, Maryland. From 2003 to 2006, he was a Research Associate at the University of Maryland. From 2006 to 2008, he was an assistant professor in Boise State University, Idaho. Currently, he is an Assistant Professor in Electrical and Computer Engineering Department at University of Houston, Texas. His research interests include wireless resource allocation and management, wireless communications and networking, game theory, wireless multimedia, and security.

Dr. Han is an NSF CAREER award recipient 2010. Dr. Han is an Associate Editor of IEEE Transactions on Wireless Communications since 2010. Dr. Han was the MAC Symposium vice chair of IEEE Wireless Communications and Networking Conference, 2008. Dr. Han was the Guest Editor for Special Issue on Cooperative Networking Challenges and Applications (IEEE Journal on Selected Areas in Communications) Fairness of Radio Resource Management Techniques in Wireless Networks (EURASIP Journal on Wireless Communications and Networking), and Special Issue on Game Theory (EURASIP Journal on Advances in Signal Processing). Dr. Han is the winner of the 2011 IEEE Communications Society Fred W. EllersickPrize. Dr. Han is the coauthor for the several papers that won the best paper awards in IEEE Conferences.

Dr. Han is an IEEE Fellow since 2014, and IEEE distinguished lecturer since 2015.