

**Date:** April 10, 2014  
**Speaker:** Dr. Visa Koivunen  
Aalto University, Finland  
**Topic:** Spectrum Exploration and Exploitation: Optimal Policies  
to Identify and Access Idle Spectrum



### Abstract

Availability of radio spectrum for wireless communication purposes is becoming a serious problem as more and more wireless systems and services are being developed and operate in crowded spectrum bands. The scarcity of useful radio spectrum is mainly due to static allocation and rigid regulation of the spectrum use instead of the spectrum being actually fully in use. Flexible spectrum use and cognitive radio technologies are considered to alleviate this problem by allowing for secondary spectrum use while the spectrum is underutilized by its primary licensed users. Idle spectrum is a time-frequency-location varying resource. By obtaining awareness about the current radio environment and the other spectrum users, cognitive radios can more efficiently exploit the idle spectrum and manage interference. This requires means to explore the spectrum in order to identify such local spectral resources and access and share them among a number of users while strictly controlling the interference caused to others. Awareness about the state of the spectrum allows to optimally exploit the underutilized spectrum. In this talk we present methods that jointly optimize the identifying and accessing underutilized spectrum in multiband and multiuser environments where the state of the spectrum varies rapidly. The developed methods are based on distributed and sequential detection theory, machine learning and advanced optimization. In particular, sensing and access policy methods stemming from dynamic programming, bandit problems, reinforcement learning, and game theory are presented. Design examples are provided as well.

### Biography

Visa Koivunen (IEEE Fellow) received his D.Sc. (EE) degree with honors from the University of Oulu, Finland. From 1992 to 1995 he was a visiting researcher at the University of Pennsylvania, Philadelphia, USA. Since 1999 he has been a full Professor of Signal Processing at Aalto University, Finland. He received the Academy professor position (distinguished professor nominated by the Academy of Finland). Years 2003-2006 he was adjunct full professor at the University of Pennsylvania. He spent a sabbatical term at Princeton University in 2007. He has also been a part-time Visiting Fellow at Nokia Research Center (2006-2012). He is currently on sabbatical at Princeton University for the academic year 2013-2014. Dr. Koivunen's research interests include statistical, communications, sensor array and multichannel signal processing. He has published about 350 papers in international scientific conferences and journals. He co-authored the papers receiving the best paper award in IEEE PIMRC 2005, EUSIPCO'2006, EUCAP 2006 and COCORA 2012. He was awarded the IEEE Signal Processing Society best paper award for the year 2007. He is a member of editorial board for IEEE Signal Processing Magazine and IEEE Signal Processing Society SAMTC technical committee.