



THE CHINESE UNIVERSITY OF HONG KONG
Department of Information Engineering

Seminar

**Applications of Algebraic Topology
in Mobile Communications**
by
Professor Philippe Martins
Télécom ParisTech

Date : 29 April, 2014 (Tue.)
Time : 11:00am-12:00noon
Venue : Room 833 Ho Sin Hang Engineering Building
The Chinese University of Hong Kong

Abstract

The purpose of this presentation is to introduce the potential applications of algebraic topology in the area of mobile communications. This presentation will first introduce some theoretical background in algebraic topology, and more specifically simplicial homology. The notions of simplicial complex and Betti numbers will first be introduced. Then, two particular simplicial complex, namely the Rips and Cech complexes will be presented. Their use in addressing in the coverage hole detection problem will be developed. Applications to cellular green networking will also be outlined.

Biography

Philippe Martins is professor in the networking and computer science department, at Télécom ParisTech (previously known as ENST or Ecole Nationale Supérieure des Télécommunications, Paris, France), since 2010. Before he held a position of associate professor in the same department since 2000.

He obtained his PhD from Télécom ParisTech in 2000 for his work on the design and the performance evaluation of signaling protocols for B-ISDN networks. In 2000, he started working on cellular networks. His main research interests lie in performance evaluation, planning and protocol design. He has published several papers on different international journals and conferences. He is an IEEE senior member since 2010. He is co-author of three chapter books on UMTS and 4G systems. He is also co-author of a book on 4G systems (Springer edition) published in October 2012.

From 2000 to 2006 he worked in several national (ANR, RNRT, URC competitiveness cluster on cognitive radio) and European research programs (ITEA) in the area of cellular and wireless communications. He investigated 3G and 4G systems (scheduling, radio resources management, handover algorithms) in collaboration with several companies (Alcatel, France Telecom, SFR, Bouygues Telecom). He had also research activities with TDF (French broadcaster) on joint planning of 3G and DVB-T systems. He worked on PMR systems, in collaboration with EADS, for the design of a high data rate radio interface, in the context of APCO standardization. Between 2006 and 2008, he was involved in wireless standardization activities of CCSDS for the European Spatial Agency. He worked on the design of wireless transmission for on board satellites transmissions and control.

In 2008, he started investigations on applications of algebraic topology, stochastic geometry and point processes theories to the design and performance evaluation of wireless systems. Since then, his current investigations address mainly two issues:

1. The conception of distributed algorithms for identification and localization of holes in an abstract topological space and their applications in wireless networks. These algorithms can be applied to solve different problems. For example they can be used to address the issue of coverage holes detection and localization in a wireless network. They can also be derived to solve the problems such as energy saving in wireless systems, taking into account coverage and traffic constraints.

2. The definition of analytical models for the planning and the dimensioning of cellular systems. These models have been applied to compute analytically the number of resources required in an OFDMA network subject to traffic and radio quality constraints. Different methods have been developed. The first one proposes an upper bound of the outage probability in terms of number resource blocks required. That upper bound is obtained by using concentration inequalities. It is robust against lack of knowledge on some system parameters (propagation model parameters, user traffic constraints) but can be coarse in some situations. A second method relying on Edgeworth expansions has also been proposed. It provides an approximation of the outage probability with an upper bound of the error. Such an approximation is very accurate but is very sensitive and thus requires a good knowledge of system parameters values.

In 2008/2009, He did a sabbatical stay at NCRL (National mobile Communication Research Laboratory), in Nanjing, SEU (东南大学) for one year. He worked on cognitive radio capacity and Wireless sensor network dimensioning.

**** ALL ARE WELCOME ****