

BCWS Seminar Series

Asymptotic Performance Analysis of Optimum Combining for Dense Multiple Antenna Reception Under Rayleigh Fading

by

Professor Norman C. Beaulieu
University of Alberta

Time: Tuesday, July 13, 1:30 - 2:30 pm
Place: Room 4356, Mackenzie Building, Carleton University

Abstract: Using an asymptotic analysis of the eigenvalues of dense correlation matrices, the asymptotic average output signal-to-interference-plus-noise ratio performance of optimum combining is evaluated as the number of the antennas in the receiver array increases while the total physical size of the array is fixed. As a result of the constraint imposed on the total physical dimensions of the array, the array output signals become more and more spatially correlated as more antennas are introduced to the array. A Rayleigh fading channel model is considered and the desired signal is assumed to be corrupted by a single co-channel interferer and thermal noise. Two different scenarios are investigated, namely, fixed average received power per antenna and fixed total average received power. It is shown that in the former scenario, the average output signal-to-interference-plus-noise ratio is asymptotically a linear function of the number of the antennas, while in the latter scenario it eventually saturates at a certain value. The slope of the asymptote in the former scenario and the value of the saturation limit in the latter scenario are derived in terms of the point spectrum of the underlying array correlation function. The case of multiple interferers is examined by simulation and is shown to exhibit similar asymptotic behavior to the case of one interferer for both power constraint scenarios. Numerical examples show that the receiver exhibits its asymptotic behavior for a practically small number of antennas.

Biography: Norm Beaulieu received the B.A.Sc. degree, the M.A.Sc. degree and the Ph.D. degree, all in electrical engineering from the University of British Columbia in Canada. He also studied at McGill University and the Technical University of Denmark. Professor Beaulieu was appointed Queen's National Scholar Assistant Professor at Queen's University, and subsequently Associate Professor and Full Professor at Queen's. Dr. Beaulieu then held two research chairs at the University of Alberta, the iCORE Research Chair in Broadband Wireless Communications and the Canada Research Chair in Broadband Wireless Communications. Dr. Beaulieu is the recipient of the J Gordin Kaplan Award for Excellence in Research of the University of Alberta, the Royal Society of Canada Thomas W. Eadie Medal, "in recognition of major contributions to Engineering or Applied Science", and the Engineering Institute of Canada Médaille K.Y. Lo Medal, "for significant engineering contributions at the international level". Professor Beaulieu served as the Editor-in-Chief of the IEEE Transactions on Communications, in the period January 2000 to December 2003. He is a Fellow of The Royal Society of Canada, an NSERC E.W.R. Steacie Memorial Fellow, a Fellow of the Institute of Electrical and Electronics Engineers (IEEE), a Fellow of the Engineering Institute of Canada (EIC), and a Fellow of the Canadian Academy of Engineering. In the years 2007/2008, Dr. Beaulieu served as IEEE Communications Society Distinguished Lecturer. In November 2007, he was the recipient of the IEEE Communications Society Edwin Howard Armstrong Achievement Award for outstanding contributions to telecommunications over a period of years.