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Information Science and Technology Seminar Series

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"On the Critical Transmission Range in One-dimensional Random Networks under Non-uniform Node Placement"

Wednesday, February 29, 2012
3:00 - 4:00 PM
TA-3, Bldg. 1690, Room 102 (CNLS Conference Room)

Abstract: We consider n points, say $X_1, \ldots , X_n$, placed independently on the unit interval $[0,1]$ according to some probability distribution function F. Two nodes communicate with each other if their distance is less than some given transmission range $\rho >0$. We define the critical transmission range R_n as the smallest transmission range such that the nodes $X_1, \ldots , X_n$ form a connected graph (under the notion of adjacency implied by the ability of nodes to communicate). Since the distribution of R_n is usually not tractable, we are interested in developing an asymptotic theory for R_n as n becomes large: We seek a deterministic sequence $\rho^\star: \mathbb{N}_0 \rightarrow \mathbb{R}_+$ such that the ratio $R_n / \rho^\star_n$ converges to some non-trivial limit L in an appropriate sense. When available, such results suggest $\rho^\star_n L$ as a proxy or approximation for R_n.

We carry out the discussion under the assumption that F admits a continuous density f. We identify two qualitatively different cases, namely $f_\star > 0$ and $f_\star = 0$ with $f_\star = \inf \left (f(x), \ x \in [0,1] \right)$. In each case, we present results on the form of $\rho^\star_n$ and L. In the process we make contact with the existence and nature of critical thresholds for the property of graph connectivity in the underlying geometric random graph, identify the critical thresholds and give exact asymptotics for the width of the associated phase transition. Engineering implications for power allocation are discussed.

This is joint work with former Ph.D. student Guang Han (now with Nokia Siemens).

Biography: Armand M. Makowski received the Licence en Sciences Math\'ematiques from the Universit\'e Libre de Bruxelles in 1975, the M.S. degree in Engineering-Systems Science from U.C.L.A. in 1976 and the Ph.D. degree in Applied Mathematics from the University of Kentucky in 1981. In August 1981, he joined the faculty of the Electrical Engineering Department at the University of Maryland College Park, where he is Professor of Electrical and Computer Engineering. He has held a joint appointment with the Institute for Systems Research since its establishment in 1985.

Armand Makowski was a C.R.B. Fellow of the Belgian-American Educational Foundation (BAEF) for the academic year 1975-76; he is also a 1984 recipient of the NSF Presidential Young Investigator Award and became an IEEE Fellow in 2006.

His research interests lie in applying advanced methods from the theory of stochastic processes to the modeling, design and performance evaluation of engineering systems, with particular emphasis on communication systems and networks.

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