Networked Control Systems Laboratory
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Control Institute

EECI DISTINGUISHED SEMINAR

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Exact Analytical Solution For End-to-End SNR of Multihop AF Relaying Systems

Abstract: In cooperative wireless networks, the source sends the same signal to one or more intermediate nodes called relays, in addition to sending the signal directly to the destination in a single hop. These relays in turn perform some distributed processing on the received signals before retransmitting the signal to the next node. The next node may be the destination (dual-hop), or it may be another relay node (multihop). The most popular and studied relaying techniques are amplify-and-forward (AF) or equivalently, non regenerative relaying and decode-and-forward(DF), called also regenerative relaying. In AF relaying systems, relays amplify the received signals before forwarding to the next node. In DF relaying systems, the relay nodes completely decode the received signals, regenerate them and forward them to the next node. DF relaying requires more processing at the relay nodes than AF and the complexity and power consumption are disadvantages. Once the destination receives all the different versions of the signal, through the direct path and the relays, they are combined together through any of the well known receiver diversity combining techniques.

Much research and publication has been focused on the performance of AF relaying systems. Yet, for multihop networks, all previous work reports approximate solutions for the performance metrics of the system because no exact solution for the end-to-end received SNR of multihop AF relaying is known. In this seminar, we use a novel approach to find the exact probability density function (PDF) of the instantaneous end-to-end received SNR in a generic multihop AF relaying system, valid for any modulation scheme, and any fading channel distribution. The new approach represents a general framework for the analysis of cooperative networks.

The talk is organized as follows. The talk begins with presenting the system model and then the generalized transformed characteristic function (GTCF) approach is explained and discussed. Numerical results are presented for performance metrics such as the average symbol error probability, ergodic capacity and outage probability for Nakagami-m fading channels to demonstrate the application of the new GTCF approach. The computational complexity of the proposed method is compared to the direct exact method. Numerical results for Nakagami-m fading channels show that there is a perfect match between results obtained from the GTCF method and simulation results, while some of the state-of-art published approximate results are very inaccurate.

TUESDAY SEPTEMBER 20TH, 2011 – 11:30 AM
AULA 2 REISS ROMOLI

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