The University of Alabama
Department of Computer Science
Colloquium Series Speaker

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"Dynamics of Internet Transport Protocols"

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Abstract:

A number of next generation Internet applications such as computational steering, interactive visualization, and instrument control, require protocols with stable dynamics. The Additive Increase and Multiplicative Decrease (AIMD) congestion control method of the widely deployed TCP is analyzed. By utilizing analytical methods, TCP dynamics are shown to contain chaotic dynamics. Such dynamics are illustrated in simulations under very simple background traffic conditions such as a steady UDP flow. In actual Internet traces, both chaotic and stochastic components are shown to be integral components of TCP dynamics. The former is due to the high non-linearity of AIMD congestion control and the latter is due to TCP's response to the inherent stochastic nature of Internet traffic. Two new window-based transport protocols are proposed based on the stochastic approximation method, which are analytically shown to stabilize at specified throughput levels. They avoid the chaotic regions by not utilizing the AIMD method, and they explicitly account for the stochastic nature of the traffic by throttling the adjustment step sizes as per the classical Robbins-Monro conditions. In several types of network connections these protocols achieved robust dynamics in presence of different types of competing traffic. Additionally, DOE UltraScience Net and NSF CHEETAH projects, and a probabilistic quickest path algorithm are briefly described.