IEEE SCG SECTION, CAS-SP JOINT CHAIR I ELEKTROTEHNIČKI FAKULTET UNIVERZITETA U BEOGRADU ORGANIZUJU

PREDAVANJE

Stability Analysis of TCP/RED Communication Algorithms

Predavač

Prof. Dr. Ljiljana Trajković (Fellow, IEEE)

Simon Fraser University, Vancouver, British Columbia, Canada, ljilja@cs.sfu.ca

Elektrotehnički fakultet, četvrtak, 10.07.2008, 15:00, sala 61

Abstract:

The Transmission Control Protocol (TCP) with Random Early Detection (RED) mechanism can be viewed as a feedback control system where TCP adjusts its sending rate depending on packet loss. In this talk, we first describe a simple second-order discrete-time model for the TCP/RED algorithm and investigate bifurcations and chaos in a TCP/RED system with a single TCP connection. The complex behavior observed in the system is attributed to a class of discontinuity-induced bifurcations observed in piecewise smooth systems. It has been also observed that the TCP-RED system may exhibit instability and oscillatory behavior. The stability boundary of the TCP-RED system depends on various network parameters, making the adjustment of the RED gateway a difficult task. Based on a fluid-flow model, we formulate analytical conditions that describe the stable boundary of the RED gateway depending on the number of TCP connections. The proposed model accurately generates a stability boundary surface in a four dimensional space, which facilitates the adjustment of parameters for stable operation of the RED gateway. The accuracy of the analytical results has been verified using the ns-2 network simulations.

The proposed control methods have been based on the analytical models that rely on statistical measurements of network parameters. Hence, stability of the TCP-RED system may be also analyzed using the detrended fluctuation analysis (DFA) method, which has been used for detecting long-range correlations in seemingly non-stationary noisy signals. The key indicator emanating from DFA is known as the scaling exponent. By examining the variations of the DFA scaling exponent when varying system parameters, we were able to quantify the stability of the TCP-RED system in terms of system's characteristics.

Joint work with M. Liu and H. Zhang (Simon Fraser University), A. Marciello and M. di Bernardo (University of Naples Federico II), and X. Chen, S.-C. Wong, and C. K. Tse (The Hong Kong Polytechnic University).

About speaker:

Ljiljana Trajkovic received the Dipl. Ing. degree from University of Pristina, Yugoslavia, in 1974, the M.Sc. degrees in electrical engineering and computer engineering from Syracuse University, Syracuse, NY, in 1979 and 1981, respectively, and the Ph.D. degree in electrical engineering from University of California at Los Angeles, in 1986.

She is currently a Professor in the School of Engineering Science at Simon Fraser University, Vancouver, Canada. From 1995 to 1997, she was a National Science Foundation (NSF) Visiting Professor in the Electrical Engineering and Computer Sciences Department, University of California, Berkeley. She was a Research Scientist at Bell Communications Research, Morristown, NJ, from 1990 to 1997, and a Member of the Technical Staff at AT&T BellLaboratories, Murray Hill, NJ, from 1988 to 1990.

Dr. Trajkovic is currently serving as the 2008 Past President of the IEEE Circuits and Systems Society and was a member of its Board of Governors (2004 - 2005 and 2001 - 2003). She also serve as the Vice President for Long-Range Planing and Finance of the IEEE Systems, Man, and Cybernetics Society and served on its Board of Governors (2004 - 2006). She is Chair of the IEEE Circuits and Systems Society joint Chapter of the Vancouver/Victoria Sections. She was Technical Program Co-Chair of ISCAS 2005 and Technical Program Chair and Vice General Co-Chair of ISCAS 2004. She served as an Associate Editor of the IEEE Transactions on Circuits and Systems (Part I) (2004 - 2005 and 1993 - 1995), the IEEE Transactions on Circuits and Systems (Part II) (1999 - 2001 and 2002 - 2003), and the IEEE Circuits and Systems Magazine (2001 - 2003). She is a Fellow of the IEEE.

Branimir Reljin, Senior Member IEEE, IEEE SCG CAS-SP Chair