Notice of the Final Oral Examination
for the Degree of Doctor of Philosophy

of

CUIYING FENG
BSc (Northeast Forest University, 2014)

“Concentrated Network Tomography
and Bound-based Network Tomography”

Department of Computer Science

Wednesday, August 26, 2020
1:00 P.M.
Remote Defence

Supervisory Committee:
Dr. Kui Wu, Department of Computer Science, University of Victoria (Supervisor)
Dr. Venkatesh Srinivasan, Department of Computer Science, UVic (Member)
Dr. Yang Shi, Department of Mechanical Engineering, UVic (Outside Member)

External Examiner:
Dr. Di Niu, Department of Electrical and Computer Engineering, University of Alberta

Chair of Oral Examination:
Dr. Francis Zwiers, Department of Mathematics and Statistics, UVic

Dr. Stephen Evans, Acting Dean, Faculty of Graduate Studies
Abstract

Modern computer networks pose a great challenge for monitoring the network performance due to their large scale and high complexity. Directly measuring the performance of internal network elements is prohibitive due to the tremendous overhead. Alternatively, network tomography, a technique that infers the unobserved network characteristics (e.g., link delays) from a small number of measurements (e.g., end-to-end path delays), is a promising solution for monitoring the internal network state in an efficient and effective manner.

This thesis initiates two variants of network tomography: concentrated network tomography and bound-based network tomography. The former is motivated by the practical needs that network operators normally concentrate on the performance of critical paths; the latter is due to the need of estimating performance bounds whenever exact performance values cannot be determined. This thesis tackles core technical difficulties in concentrated network tomography and bound-based network tomography, including (1) the path identifiability problem and the monitor deployment strategy for identifying a set of target paths, (2) strategies for controlling the total error bound as well as the maximum error bound over all network links, and (3) methods of constructing measurement paths to obtain the tightest total error bound. We evaluate all the solutions with real-world Internet service provider (ISP) networks. The theoretical results and the algorithms developed in this thesis are directly applicable to network performance management in various types of networks, where directly measuring all links is practically impossible.