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

of

SHUAI HE

MSc (University of Victoria, 2009)
BSc (Shanghai JiaoTong University, 2007)

"Asynchronous Time Difference of Arrival Positioning System and Implementation"

Department of Electrical and Computer Engineering

Thursday, July 7, 2016
4:30 P.M.
Engineering Office Wing
Room 430

Supervisory Committee:
Dr. Xiaodia Dong, Department of Electrical and Computer Engineering, University of Victoria (Supervisor)
Dr. Wu-Sheng Lu, Department of Electrical and Computer Engineering, UVic (Member)
Dr. Jianping Pan, Department of Computer Science, UVic (Outside Member)

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Dr. Holly Tuokko, Department of Psychology, UVic

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Abstract

In this thesis, a complete localization system using asynchronous time difference of arrival (A-TDOA) technique has been thoroughly studied from concept to implementation. The work spans from a proposal of a new A-TDOA system deployment and modeling, through a derivation of the achievable estimation bound, to estimation algorithms development, to a hardware realization, and ultimately to measurements conducted in realistic radio environments.

The research begins with a new deployment of an A-TDOA localization system. Compared to the conventional time of arrival (TOA) and time difference of arrival (TDOA) systems, it does not require clock synchronization within the network, which enables a flexible and fast deployment. When deployed in the simplest form, it can effectively reduce system complexity and cost, whereas if all anchor nodes are equipped with full transmit and receive capability, the A-TDOA system can achieve superior performance using a novel receiver re-selection technique.

Determining the physical position of a target node in a noisy environment is critical. In this thesis, two novel algorithms, namely, a two-step and a constrained least squares (CLS) algorithms, are proposed offering excellent accuracy and the best tradeoff between complexity and precision respectively. The two-step algorithm exploits the advantages of the semi-definite programming (SDP) and the Taylor method, i.e., global convergence and high precision, to achieve superior performance. The CLS algorithm significantly reduces the computation complexity while achieving good accuracy.