Stony Brook University
The Graduate School

Doctoral Defense Announcement

Abstract

Design and Optimization Architecture for Target Specific Multi-hop Wireless Networks

By

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This thesis addresses a design and optimization architecture for target specific applications under multi-hop wireless networks.

In the first study, we propose a profile-based network and hardware co-simulation architecture to characterize the overall network performance and real-timing behaviors of Wireless Mesh Networks (WMN) equipped by a dedicated hardware platform. For the target algorithms underlying the hardware configuration, RObust Header Compression (ROHC) and packet aggregation algorithms are adopted. The co-simulation method integrates the network level simulator, NS-2 and hardware level simulator, SystemC. In this approach, we first insert the modules of the target algorithms into the network simulator hierarchy, and measure the packet arrival times. Then, the corresponding hardware architecture is designed by SystemC for profiling the hardware delay appeared in encoding and decoding packets. Finally, the traced hardware delays are applied into NS-2 to extract real-timing WMN behaviors changed by the hardware operations in each mesh router. Additionally, to accurately predict the capacity of the hardware design, we propose a numerical analysis method by using Open Jackson network composed of G/M/1, $M^{[K]}$/M/1, M/M/1, and M/M/∞ queue systems. The modeled queue systems are one-to-one mapped into the constructed hardware components to characterize the concurrent operations and interactional relationship between encoding and decoding paths.

The second study focuses on design and analysis of object tracking system. In this study, we develop a multiple sensor-based tracking model where acoustic sensors mainly track the objects and visual sensors compensate the tracking errors. We find a network synchronization problem caused by the different location and traffic characteristics of multiple sensors and non-synchronized arrival of the captured sensor data at a processing Server. We show the improved tracking accuracy from visual compensation in ideal case is severely degraded when the synchronization problem is involved in real situations. For the possible solution of the problem, we differentiate the service level of sensor traffic based on a Delay-based Weight Allocation (DWA) algorithm. In addition, we numerically predict the number of successful visual compensation by using Successful compensation rate Estimation Algorithm (SEA). Additionally, we propose an on-line

version of the SEA called Statistical Estimation and Adaptation Algorithm (SEA^2), in which the acoustic sensor's object sampling interval is automatically adjusted to meet the target visual compensation required in a specific tracking system environment.

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