ANNOUNCEMENT

Mr. Erik Fredericks
Doctoral Defense
Friday, December 19, 2014
2:00 pm
3105 Engineering Bldg.

Dissertation Title:

“Mitigating Uncertainty at Design Time and Run Time to Address Assurance for Dynamically Adaptive Systems”

Dr. Betty Cheng
Guidance Committee Chairperson

“Everyone is welcome to attend”
MITIGATING UNCERTAINTY AT DESIGN TIME AND RUN TIME TO ADDRESS ASSURANCE FOR DYNAMICALLY ADAPTIVE SYSTEMS

By

Erik M. Fredericks

A DISSERTATION

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

Computer Science - DOCTOR OF PHILOSOPHY

2014
ABSTRACT

MITIGATING UNCERTAINTY AT DESIGN TIME AND RUN TIME TO ADDRESS ASSURANCE FOR DYNAMICALLY ADAPTIVE SYSTEMS

By

Erik M. Fredericks

A dynamically adaptive system (DAS) is a software system that monitors itself and its environment at run time to identify conditions that require self-reconfiguration to ensure that the DAS continually satisfies its requirements. Self-reconfiguration enables a DAS to change its configuration while executing to mitigate unexpected changes. While it is infeasible for an engineer to enumerate all possible conditions that a DAS may experience, the DAS must still deliver acceptable behavior in all situations. This dissertation introduces a suite of techniques that addresses assurance for a DAS in the face of both system and environmental uncertainty at different levels of abstraction. We first present a technique for automatically incorporating flexibility into system requirements for different configurations of environmental conditions. Second, we describe a technique for exploring the code-level impact of uncertainty on a DAS. Third, we discuss a run-time testing feedback loop to continually assess DAS behavior. Lastly, we present two techniques for introducing adaptation into run-time testing activities. We demonstrate these techniques with applications from two different domains: an intelligent robotic vacuuming system that must clean a room safely and efficiently and a remote data mirroring network that must efficiently and effectively disseminate data throughout the network. We also provide an end-to-end example demonstrating the effectiveness of each assurance technique as applied to the remote data mirroring application.