ReCAS Resilient Control Architectures and Systems

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Select Resilience Papers

A Resilient Condition Assessment Monitoring System
www.inl.gov/icis/assessmentmonitoring

Anomaly Detection for Resilient Control Systems Using Fuzzy-Neural Data Fusion Engine
www.inl.gov/icis/anomalydetection

Deception Used for Cyber Defense of Control Systems
www.inl.gov/icis/deception

Human Factors and Data Fusion as Part of Control Systems Resilience
www.inl.gov/icis/humanfactors

Improving Cyber-Security of Smart Grid Systems Via Anomaly Detection and Linguistic Domain Knowledge
www.inl.gov/icis/improvingcybersecurity

'Known Secure Sensor Measurements' for Critical Infrastructure Systems: Detecting Falsification of System State
www.inl.gov/icis/knownsecure

Resilient Control Systems: Next Generation Design Research
www.inl.gov/icis/controlsystems

5th International Symposium on Resilient Control Systems (ISRCS 2012)

During the second week of August, a symposium on resilient control systems was held in Salt Lake City, USA. The symposium was sponsored by the Idaho National Laboratory, Boise State University, Idaho State University, the University of Idaho, the University of Utah and Utah State University. Technical co-sponsorship was also received from the IEEE Industrial Electronics Society (IES).

The symposium is organized to extend and endorse particular concepts that will generate novel research and codify resilience in next generation control system designs. The generation of summary presentations and paper proceedings for those identified concepts will set the stage for future research strategies and task group execution.

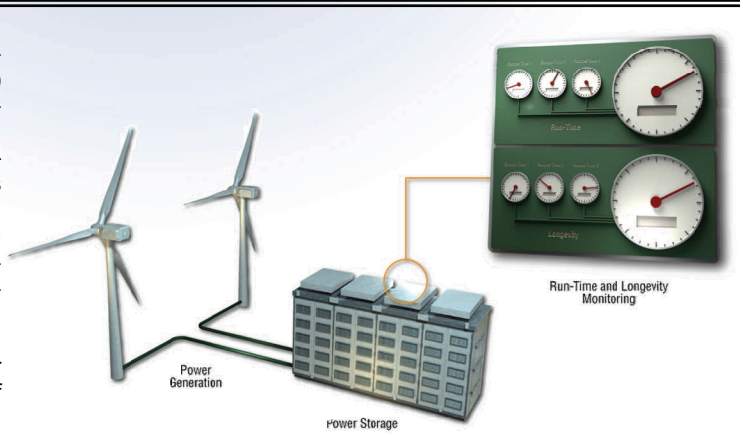
Keynote speakers included Prof. Tamer Başar from the University of Illinois who presented, "Game-Theoretic Framework for Network Resilience, Reliability, and Security (NR2S);" Prof. Yacov Haimes from the University of Virginia who presented, "Modeling the Resilience of and Risk to the Power-Grid Infrastructure and the Supportive Human and Organizations as Systems of Systems;" Chief Scientist Dr. Mark Maybury who provided an overview of the Air Force 2025 cybervision; Prof. Vojislav Kecman of Virginia Commonwealth University who presented, "From Identification to Data Mining-Handling Massive Datasets;" and, in collaboration with the 2nd Experimental Security Panoramas Workshop, Mr. Bob Osborn of the National Nuclear Security Administration who provided a presentation on the Cyber Sciences Laboratory that is evolving in the Department of Energy.

The keynotes were streamed live on the Internet, and all keynote video presentations are posted on the ISRCS website.

Next year's event will be held in San Francisco from August 13 to 15 and has expanded into Resilient Week with four separate symposia focusing on resilient systems: Control, Cyber, Cognitive, and Communications. More information can be found on the Resilience Week website.

Robert Osborn, with NNSA, discusses the developing DOE Cyber Sciences Laboratory .

Battery Resilient Monitoring and Control



The Battery Resilient Monitoring and Control project is developing a prototype battery state-of-health (SOH) metric based on a combination of passive and active measurements using novel sensor technology so as to demonstrate the ability to adapt behaviors for extended life. 2012 focused on developing the framework for the SOH assessment architecture using the in-situ rapid impedance spectrum measurement technique combined with standard battery parameters. In 2013, the SOH architecture will be further refined to enable the development of smart algorithms for directly estimating state-of-charge (SOC) based on impedance spectral measurements; these online estimations of battery parameters are in support of optimized battery life and usage under various applications. This will be accomplished by assessing new test data that include impedance spectra as a function of SOC for enhanced health and life estimations. Accurate SOC identification is a dynamic requirement for improved power management, whereas accurate health estimation is primarily for increased battery longevity and for accordingly accommodating battery aging when computing battery parameters.

INL Idaho National Laboratory

ReCAS Resilient Control Architectures and Systems

Academic & Industrial Leadership

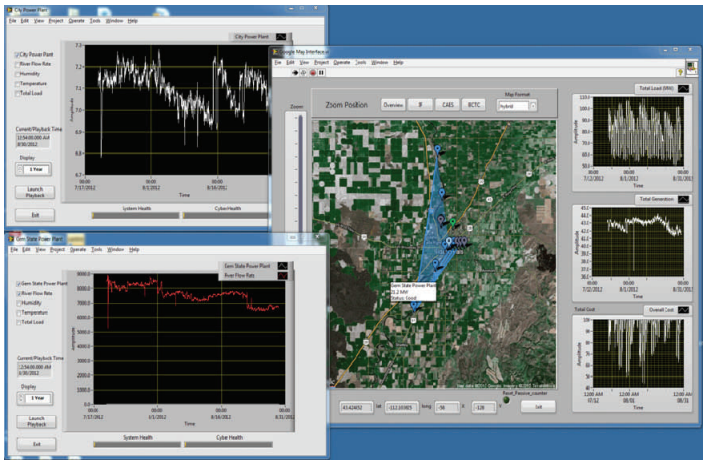
Resilient Control Systems University Challenge

Technical Committee on Resilience and Security for Industrial Applications (ReSia)

IEEE Transactions on Cybernetics—Special Issue: Resilience Control Architectures and Systems

INL Control System Situational Awareness Project Demonstration

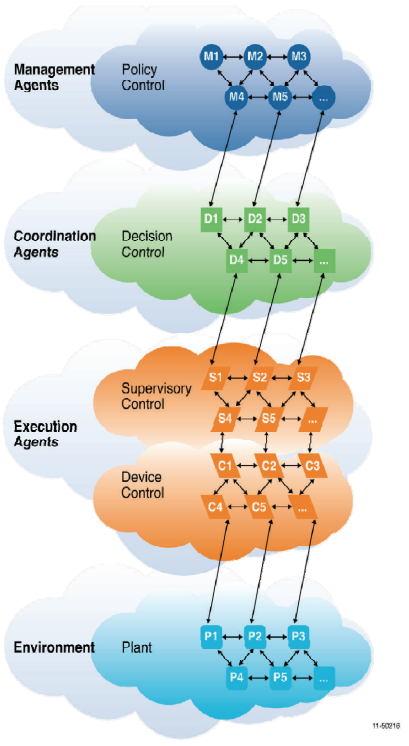
A demonstration by INL researchers highlighting the integration of components of the INL Control System Situational Awareness Project was performed in the Center for Advanced Energy Studies in late August 2012. The Data Fusion Tool (DFT) component of the project, which began within the INL Instrumentation, Control and Intelligent Systems (ICIS) distinctive signature LDRD on Data Fusion of Cyber-Physical data, was matured by the Department of Energy—Office of Electricity Reliability and Energy Reliability R&D program. The project is a collaboration of researchers at INL and the University of Idaho. DFT collected input from Physical and Cyber components to provide better overall situational awareness. Cyber components provided information on the health of the computation and communication components. For example, if a sensor subsystem was compromised though a cyber attack the data provided has a discounted value to an operator making a decision. In this situation, the visualization interface shown in the figure above would enable the operator to choose alternate but associated data sets. Association of data variables is determined through data mining methods. The cyber security health alerts were provided through a server interface from SOPHIA and Intelligent Cyber Sensor. The geographical association of related data sets and affected area cyber attack are presented on the map and a detailed display at the time the alert message is received. The system was built on platforms that are extensible to other system appliances through a standard server interface and the architecture implementation for the dynamic visualization interface.



Multi-agent Hierarchy

A timely understanding of critical infrastructure interdependencies can alleviate the impact of unrecognized failures that jeopardize mission success. The human aspect is perhaps one of the most complex attributes to characterize, as quantitative results are far from definitive. Even within highly automated facilities, a complex chain of management, engineering and regulatory individuals affect the philosophy of operation for a facility and its associated industrial control system(s) (ICS). The INL hypothesis is that multi-agent analysis provides a worthy approach to decompose these complex relationships, which can then be optimized for mission assurance. To provide a real world application as a basis, we are partnering with researchers at the Department of Defense (DoD) for the purposes of targeting this research.

Multi-agent design, originating from the computer science artificial intelligence movement of 20+ years ago, is now being discussed in the context of ICS. However, the complexities of ICS are much different, as the control system design is tied to plant assets, such as valves and transmitters, and therefore is not as amenable to concepts such as platform independence. Within the control system literature, specifically for power systems, a number of papers and texts have been written that discuss the idea of how to codify the dynamics within a multi-agent design. However, a conceptual breakdown of the human and control/cyber elements must be performed on real world examples to demonstrate how these designs can applied. This research takes a proposed framework for hierarchical design, using researchers in complex systems, control systems and human systems, and applies it to a Microgrid domain for codification of design elements.



For more information

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