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A Method for Robust, Distributed Diagnosis using Dynamic Bayes Nets

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Abstract: The proliferation of safety-critical embedded systems has created great demands for online fault diagnosis and fault-adaptive control techniques. A number of methodologies have been proposed, but the implementation of on-line schemes that integrate the fault detection, isolation, identification, and fault accommodation or reconfiguration tasks remains challenging. Moreover, model-based diagnosis methods can be computationally expensive, thus making online diagnosis schemes infeasible.

In this talk, I will present a distributed scheme using Dynamic Bayes Nets (DBNs) for robust diagnosis of dynamic systems. DBNs provide a systematic method for modeling the behavior of dynamic systems in uncertain environments that can include measurement noise and model uncertainties. The notion of structural observability applied to bond graph (BG) models of the physical system is exploited to derive DBN factors (DBN-Fs) that are independently observable, and together retain observability for the entire system. We have developed systematic methods for deriving the DBN-Fs from a BG model of the system, and we prove that these factors can be used as local diagnosers that generate globally correct results without a central coordinator, and without loss of accuracy. Running the independent factors significantly reduces the computational complexity of online diagnosis. Experimental results are presented to demonstrate the effectiveness of this scheme.

Short Bio: Gautam Biswas is a Professor of Computer Science and Computer Engineering in the EECS Department and a Senior Research Scientist at the Institute for Software Integrated Systems (ISIS) at Vanderbilt University. He has a Ph.D. degree in Computer Science from Michigan State University in E. Lansing, MI. Prof. Biswas conducts research in Intelligent Systems with primary interests in hybrid modeling, simulation, and analysis of complex embedded systems, and their applications to diagnosis and fault-adaptive control. As part of this work, he has worked on fault-adaptive control of fuel transfer systems for aircraft, and Advanced Life Support systems and the ADAPT power distribution testbed for NASA. He has also initiated new projects in distributed monitoring and diagnosis and prognosis and health management of complex systems. A second area of research is in planning and scheduling of tasks in complex applications. He has applied his planning and scheduling algorithms for robotic task planning in uncertain environments, and dynamic resource allocation in distributed real-time environments. In other research projects, he is involved in developing simulation-based environments for learning and instruction. His research has been supported by funding from NASA, NSF, DARPA, AFOSR, the US Department of Education, and Boeing Phantom Works. He has published extensively, and has over 300 publications.

Dr. Biswas is an associate editor of the new PHM journal. He has served on the Program Committee of a number of conferences, and most recently was Program co-chair of the 18th International Workshop on Principles of Diagnosis. He is a senior member of the IEEE Computer Society, ACM, AAAI, and the Sigma Xi Research Society.