Final Report for AFOSR Grant No. F49620-99-1-0059 — "Verification and Validation of Embedded Knowledge-Based Software Systems"

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Our overall goal in this research effort has been to reduce the time and cost of constructing embedded knowledge-based systems that must handle uncertainty in information in a rigorous manner. Our fundamental approach actively assists subject-matter experts in organizing their knowledge inclusive of uncertainty to build such embedded systems in a consistent and correct as well as effective fashion. We pursued this by carefully examining the nature of uncertainty and information semantics and developing intelligent tools for verification and validation that provides assistance to the subject-matter expert in constructing their knowledge-based systems. We have developed a prototype environment for constructing Bayesian Knowledge-Bases called PESKI.
AFOSR Project Final Report

Project Title: Verification and Validation of Embedded Knowledge-Based Software Systems
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AFOSR Grant No. F49620-99-1-0059
AFOSR PM: Dr. Robert Herklotz

Final Project Summary

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Major Accomplishments

- Completed formulation of Bayesian Knowledge-Bases as basis of representing uncertainty and proved it’s generality through subsumption of Bayesian networks and probabilistic consistency.
- Developed a novel representation that unified probabilistic uncertainty and time.
- Defined structural incompleteness and integrated tool for managing incompleteness into PESKI.
- Developed new algorithm for reasoning under uncertainty based on randomized algorithms and reinforcement learning.
- We have developed a novel knowledge structure that can express common relationships among evidence for a conclusion via an N-of-K relation and can be constructed automatically. This relation allows the system to hide much of the structure necessary to guarantee the internal consistency of the knowledge-base. Hiding such implementation details from the expert user allows the expert to better concentrate on knowledge acquisition and validation. Our relation also captures probabilistic uncertainty in a provably correct manner.
- Formally proved the semantics of Bayesian Knowledge-Bases to provide a natural an implicit method for flexibly acquiring knowledge. By maximizing the ease with which to incorporate new knowledge in a simple if-then format while automatically maintaining consistency in the knowledge base is critical to the success of a knowledge acquisition framework.
- Finalized PESKI system for dissemination to the research community.

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[ The publications below were supported in full or in part by this project. ]


