# DOCTOR OF PHILOSOPHY

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**A LAYERED SOFTWARE ARCHITECTURE FOR HARD REAL TIME (HRT) EMBEDDED SYSTEMS**

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The current state of the art techniques to describe and implement a hard real time embedded software architecture for missile systems range from inadequate to totally non-existent. Most of the existing software implementations within such systems consist of hand-coded functionality, optimized for speed, with little or no thought to long term maintainability, and extensibility. Utilizing current state of the art software development technology, the first ever software architecture for hard real time missile software has been designed and successfully demonstrated. This component based layered abstraction pattern approach to software architecture revolutionizes reduced development time, cost, provides an order of magnitude decrease in error, and is the first such software architecture to function within the hard time constraints of the most extreme cases related to missile systems. Additionally, componentization of functionality allows for porting of software developed for one missile to any other missile with no modification. Hardware obsolescence is overcome by software abstraction layers which isolate the hardware instance from the software functionality providing a rapid, low cost transition of software from one instance of missile hardware to another. The end result of this research is a software architecture demonstrating the capability of managing complex functionality in an accurate, quantifiable, and cost effective manner.

**KEYWORDS:** Embedded Software Architecture Hard Real Time

**SOFTWARE TECHNOLOGY TRANSITION ENTROPY BASED ENGINEERING MODEL**

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This research considers an engineering model and the relationships of various controlling parameters in an evolutionary process. Cast in terms of new technology transfer models for analysis, the model is able predict and prescribe action for a research or program manager. The model developed addresses macro level trends of a technology at the community level. The model, is based on non-linear control theory. It established the relationships of an information "temperature" with other variables, entropy, pressure, volume (nodes) and the conserved property – information in terms of messages. The research includes a comprehensive review of the state-of-the-art in software technology transfer. The summary focuses on the elements of technology transfer required to model the technology transfer process. This research specifically develops the fundamentals for a rigorous software technology transfer model. This ties together for the first time information theory, control of dynamic systems, statistical mechanics and software engineering.

**KEYWORDS:** Software Engineering, Technology Transfer, Information Theory, Communication Theory, Statistical Mechanics, Dynamical Systems, Control Theory, Learning Curves, Entropy, Information Temperature, Temperature of Software ($^{o}$ Saboe), Technology Transfer Dynamics, Research Management, Diffusion of Innovation, Project Management, Physics of Software