DOCTOR OF PHILOSOPHY

SPECIFYING QUALITY OF SERVICE FOR DISTRIBUTED SYSTEMS BASED UPON BEHAVIOR MODELS

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The substantial complexity and strict requirements of distributed command and control systems creates an environment that places extreme demands upon system resources. Furthermore, inconsistent resource distribution also introduces the distinct possibility of potential errors, and process failures. Many of these potential difficulties can be understood and addressed through a practical analysis of the resource management and distribution procedures employed within these systems. This analysis should include a direct focus upon the essential quality of service that is shared among the software programs that operate within this environment. However, the current approaches to this analysis are lacking in that there is no accurate method to determine precisely what quality of service based conflicts take place during program execution. This problem can be addressed through examination of specific quality of service actions during program execution. To achieve a precise analysis of quality of service actions this dissertation research has implemented an approach to examine the exact quality of service execution path during program operation.

KEYWORDS: Event Trace, Behavioral Model, Quality of Service, Command and Control

HETEROGENEOUS SOFTWARE SYSTEM INTEROPERABILITY THROUGH COMPUTER-AIDED RESOLUTION OF MODELING DIFFERENCES

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Meeting future system requirements by integrating existing stand-alone systems is attracting renewed interest. Computer communications advances, functional similarities in related systems, and enhanced information description mechanisms suggest that improved capabilities may be possible; but full realization of this potential can only be achieved if stand-alone systems are fully interoperable. Interoperability among independently developed heterogeneous systems is difficult to achieve: systems often have different architectures, different hardware platforms, different operating systems, different host languages and different data models.

The Object-Oriented Method for Interoperability (OOMI) introduced in this dissertation resolves modeling differences in a federation of independently developed heterogeneous systems, thus enabling system interoperation. First a model of the information and operations shared among systems, termed a Federation Interoperability Object Model (FIOM), is defined. Construction of the FIOM is done prior to run-time with the assistance of a specialized toolset, the OOMI Integrated Development Environment (OOMI IDE). Then at runtime OOMI translators utilize the FIOM to automatically resolve differences in exchanged information and in inter-system operation signatures.

KEYWORDS: Interoperability, Model Correlation, Heterogeneous Software Systems, XML, Data Binding, Modeling Difference Resolution

DOCTOR OF PHILOSOPHY

A MULTIDISCIPLINARY ALGORITHM FOR THE 3-D DESIGN OPTIMIZATION OF TRANSONIC AXIAL COMPRESSOR BLADES

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A new, multidisciplinary algorithm for the CFD design optimization of turbomachinery blades is presented. It departs from existing techniques in that it uses a simple, previously-developed Bezier geometry representation (BLADE-3D) that can be easily manipulated to achieve true 3-D changes in blade shape. The algorithm incorporates zero and first-order optimization techniques including sensitivity analyses and one-dimensional search methodology. It features an iterative finite element structural analysis as well as a cold shape correction procedure to ensure that the resulting blade meets steady-stress structural requirements. The process was applied to two different transonic fan designs – the Sanger rotor designed for the NPS Turbomachinery Laboratory and NASA Rotor 67, otherwise known as the 'NASA Fan.' The optimization objectives for the two designs were mass flow rate and polytropic efficiency respectively. Results for the Sanger rotor effort yielded an 8.1 % improvement in mass flow rate, a 5% improvement in total pressure ratio, and a 0.9 % increase in adiabatic efficiency. Application to the NASA Fan resulted in a 2.5 % increase in polytropic efficiency. The results validate the utility of the BLADE-3D Bezier geometry package for use in future development of automated optimization routines for turbomachinery blade design.

KEYWORDS: Design Optimization, Transonic Fan Blades, Bezier Geometry Package