DISTRIBUTED COLLABORATIVE DESIGN METHOD USING STRUCTURAL AND FUNCTIONAL MODELING FOR COMPLEX CONSUMER ELECTRONICS PRODUCTS

A DISSERTATION
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DOCTOR OF PHILOSOPHY

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I certify that I have read this dissertation and that in my opinion it is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

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Abstract

Today, market demand for smaller, more powerful consumer electronics is rapidly posing a major challenge to product design. Several issues have been identified as major factors that affect the quality, cost, and delivery of product design in the so-called distributed design project.

To address these concerns, a structured design method is needed. This paper proposes a design framework that can moderate inconsistent performance of system components (modules) resulting from a lack of communication between design sites. Module-interconnection parameters at a system level are determined using the behavior coupling matrix and work distribution matrix; initial design target values (ITVs) for system-boundary conditions are provided for each module design. This dissertation shows that system decomposition using ITVs offers a suitable framework for designing a product, considering the overall system behavior where each module is independently designed at different locations.

The dissertation then describes the utilization of the product model by SysML as a joint platform for distributed design. We introduce a typical design process involving distributed design teams. In particular, this process allows a design of cavities, i.e., air space inside the enclosure, in terms of flow rate, acoustic radiation resistance and so on. Then, we investigate a module-based design optimization approach defining cavity as a module to efficiently support such processes. Author proposes structural and functional modeling as well as ITVs that enables all the distributed design sites to share the design information with the product model.

This modeling approach includes the creation and assignment of ITVs to the each module in the functional design phase, and updating ITVs appropriately in the structural design phase. Referring both a Functional and Structural model which shows physical coupling between modules and task-based DSM, we configure design task constraints for ITVs update. With these constraints, ITVs will be updated at all times and suboptimal solutions to thermal characteristic and cost restriction as the whole system can be derived. Using this design framework, it will be possible to prevent performance defects due to physical coupling between modules, and thus, reduce the iteration of work.