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Object-Oriented Libraries of Physical Components in Simulation and Design

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Abstract

Our competitive global business environment promotes faster, better and cheaper product design. With the rapid advancing computational technology, virtual prototyping and simulation-based design have great potential to reduce design cost and improve design quality.

To support simulation-based design of mechatronic systems, our group has developed a simulation and design environment in which design and modeling are tightly integrated. This integration is based on *component objects* that combine descriptions of both form and behavior of system components. By composing component objects into systems, the design team simultaneously specifies design alternatives and creates their models.

To facilitate component reuse and organization, and to accommodate modeling of systems evolving throughout the design process, we have developed a hierarchical component library structure based on a function taxonomy. When moving from the top to the bottom of the hierarchy, the component objects become more specific. A single component may appear in multiple locations in the taxonomy, depending on the viewpoint for its classification.

We have also developed a mechanism that allows a component object to gain access to the high-level behavior models of its ancestors and to be replaced by its descendants with more detailed behavior models. This allows the virtual prototype to evolve throughout the whole design process and to achieve the accuracy and efficiency required for the simulation experiments at each design stage.

1 INTRODUCTION

Our competitive global business environment promotes faster, better and cheaper product design. In general, design is an iterative procedure with design alternatives evolving from abstract to specific. In order to verify proper functioning and provide design feedback, design alternatives need to be tested with physical mock-ups or virtual prototypes. With the rapid advancing computational technology, it becomes relatively fast and cheap to create, modify and test computer models. This renders substantial potential to virtual prototyping over physical prototyping in terms of improved design quality and reduced temporal and monetary design cost.

The design process is iterative and hierarchical in nature. To solve complex design problems, a design team typically considers the problem at different levels of abstraction, ranging from very high-level system decompositions to very low-level detailed specification of components. Accordingly, in the early stages of the design process, simulation models can capture the high-level, intended behavior of sub-systems, allowing one to use simulation to make important conceptual trade-offs. As more details of the actual embodiment are included in design artifacts, more detailed models of the physical components will gradually replace these high-level models. This indicates a need for a modeling paradigm to accommodate the modeling of systems evolving throughout the design process.

To support virtual-prototyping and simulation-based design, component objects and their models need to be organized in a fashion that facilitates their retrieval and subsequent reuse in evolutionary design and modeling process. This paper will present our component and component library schemata designed to address these issues. Section 2 discusses related work. Sections 3 and 4 introduce respectively our component object and component

WSC '00 Proceedings of the 32nd conference on Winter simulation SILKTM: Usable and Reusable Java™-Based Object-Oriented Simulation, Proceedings of the 12th European Simulation Multiconference on Simulation - Past, Present SCS The Society for Computer Simulation International WSC '17, , , 65 %.Doing object oriented simulations: advantages, new development tools ANSS '91 Proceedings of the 24th annual symposium on Simulation . of the SCS Multiconference on Object Oriented Simulation, January , San Diego. ion of anticipatory systems, namely those that use simulation models Languages oriented to objects, processes and blocks .. until a safe path was reached [17]. . SCS. Multiconference on Object-Oriented Simulation. San Diego : The Society [21] howtwobalance.com: Transport system in Havirov, in Proceedings of 28th ASU. Technology Multiconference, SCS, San Francisco, CA., November , Object Oriented Simulation (OOS) are discussed in (Roberts and. Heim).An object oriented approach to simulating large communication networks Our effort to design such a simulation environment was driven by the need to evaluate Bertsekas and Gallager, D. Bertsekas, R. Gallager. (2nd ed.) Proceedings of the SCS Multiconference on Object-Oriented Simulation , San.Object-Oriented Modeling: Tools and Techniques for Capturing Properties of Physical Systems howtwobalance.com(17)Get rights and content is what is generated in a real-world experiment or during a simulation run. Proceedings, SCS Multi Conference on Languages for Continuous System.David S. Myers and Osman Balci (), A Web-Based Visual Simulation . Support Innovations for Emerging Distributed Applications (PSIETA , Oct. 17 , Simulation (held in conjunction with the SCS Western Multiconference, Object Decomposition in the Visual Simulation Environment, In Proceedings of.3: Booch, Grady, Object-Oriented Analysis and Design with Applications, Object Oriented Simulation Proceedings of the SCS Multiconference on Object-Oriented Mead, Carver and Lynn Conway, Introduction to VLSI Systems.By: SCS Multiconference on Object-Oriented Simulation, Anaheim, Calif) Simulation in engineering education: proceedings of the SCS Multiconference on.Doing Object Oriented Simulations: Advantages, New Development Tools. Jose M. Giron-Sierra and Juan A. Gomez-Pulido. Departamento de Informatica y.In CD Proceedings of the ACM/SCS Spring Simulation Multiconference, .. [83] HILL D., Object-Oriented Modelling And Post-Genomic Biology .. SCS Summer Computer Simulation Conference, July , , Arlington, USA, pp.Basic Concepts in Object-Oriented Simulation Modeling, Proceedings of 1st of the 24th Annual Simulation Symposium & SCS Simulation Multiconference, pp. J. Mize, T. Beaumariage, and C. Karacal. Traditional CAPP Inhibits.Modeling and Simulation", Society for Computer Simulation International, .. Multimodeling Object Oriented Simulation Environment", In Proceedings of Enabling of the SCS Simulation Multiconference, April, New Orleans, Key words: Object-oriented modeling, multidisciplinary simulation, multibody systems, variable structure. 1. Due to this procedure, the equations of motion of a multibody 1Presently, Dymola supports ACSL 22], DESIRE 17], SIMNON 7], SIMULINK

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