



Marcelo Gomes Metello

Process-Oriented Modeling and Simulation for Serious Games

TESE DE DOUTORADO

Thesis presented to the Postgraduate Program in Informatics of the Departamento de Informática do Centro Técnico Científico da PUC-Rio, as partial fulfillment of the requirements for the degree of Doutor.

Advisor: Prof. Marco Antonio Casanova

Rio de Janeiro
September 2011



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Abstract

Metello, Marcelo G.; Casanova, Marco A., advisor. **Process-Oriented Modeling and Simulation for Serious Games**. Rio de Janeiro, 2011. 163p. DSc Thesis - Departamento de Informática, Pontifícia Universidade Católica do Rio de Janeiro.

This thesis focuses on serious games that simulate realistic situations. The objectives of such games go beyond mere entertainment to fields such as training, for example. Since other areas of Computer Science provide methods and tools for simulating and reasoning about real situations, it is highly desirable to use them in this kind of serious games. This thesis introduces a new framework on which simulation techniques from different areas, such as modeling and simulation, geographic information systems and multi-agent systems, can be integrated into a serious game architecture.

The proposed solution resulted in the conception of a novel simulation modeling paradigm, named process-oriented simulation (POS), which combines different aspects of the more traditional object-oriented simulation (OOS) and agent-oriented simulation (AOS) paradigms. The main idea of POS is the separation between state and behavior of the entities involved in the simulation. This characteristic favours the modularization of complex behaviors and the integration of different and interfering simulation models into a single simulation.

Based on the POS paradigm, a discrete-event simulation formalism named Process-DEVS was developed as an extension of the well-known DEVS simulation formalism. Some formalisms, such as workflows and cell space processes, were mapped to Process-DEVS and tested in the implementation of two systems: an emergency training game and a contingency planning system, both designed for the oil and gas industry.

Key Words

Serious games, process-oriented simulation, simulation.

Resumo

Metello, Marcelo G.; Casanova, Marco A., orientador. **Modelagem e Simulação Orientadas a Processos para Jogos Sérios**. Rio de Janeiro, 2011. 163p. Tese de Doutorado - Departamento de Informática, Pontifícia Universidade Católica do Rio de Janeiro.

Esta tese é focada em jogos sérios que simulam situações realistas. O objetivo destes jogos vai além do mero entretenimento para outras áreas, tais como treinamento, por exemplo. Como algumas áreas da Ciência da Computação já fornecem métodos e ferramentas para a simulação de situações realistas, é altamente desejável que possamos usá-los neste tipo de jogos sérios. Esta tese introduz um novo framework no qual técnicas de simulação oriundas de diferentes áreas, tais como modelagem e simulação, sistemas de informação geográfica e sistemas multi-agentes, podem ser integradas em uma arquitetura de jogos sérios.

A solução proposta resultou na concepção de um novo paradigma para modelagem de simulações chamado de simulação orientada a processos, que combina aspectos diferentes dos paradigmas mais tradicionais de simulação orientada a objetos e simulação orientada a agentes. A idéia principal da simulação orientada a processos é a separação entre o estado e o comportamento das entidades envolvidas na simulação. Esta característica favorece a modularização de comportamentos complexos e a integração em uma única simulação de diferentes modelos de simulação que interferem entre si.

Baseado no paradigma de simulação orientada a processos, foi desenvolvida uma extensão do conhecido formalismo de simulações DEVS, chamada Process-DEVS, para a modelagem de simulações baseadas em eventos discretos. Alguns formalismos, tais como workflows e processos em espaços celulares, foram mapeados para o Process-DEVS e testados na implementação de dois sistemas: um jogo de treinamento e um sistema de planejamento de contingência, ambos projetados para a indústria de gás e petróleo.

Palavras-chave

Jogos sérios, simulação orientada a processos, simulação.

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