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SimOpt: A new simulation optimization system based virtual simulation for manufacturing system

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Abstract

Through combined with advanced technologies and considered simulation optimization technology development, based on a principle separating the simulation model from optimization algorithm, a new framework of simulation optimization is constructed. According to object-oriented modeling technique, a virtual simulation modeling subsystem is put forward. At the same time, as a kernel of the system, an optimization subsystem is also described, which uses a new hybrid optimization algorithm and an optimization engine based Runtime Automat. Finally, SimOpt, a simulation optimization system oriented to manufacturing system, is developed.
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Keywords: Simulation optimization; Virtual simulation subsystem; Optimization subsystem; SimOpt system

1. Introduction

Computer simulation technology has been applied to complex system analysis more and more widely, however, as a test and validation tool, it could but evaluate a given design, not provide more assistant decision-making function. Recently, the simulation optimization technology growing in simulation technology is to overcome the limitation. Combining the simulation analysis and the optimal decision-making mechanism, the simulation optimization technology could not only enhance intelligent decision-making of the simulation, but also build the complex system model easily that is more difficult by traditional optimization methods. On the one hand, the simulation optimization can provide a uniform description for different problems by the virtual simulation model, i.e., it is possible that solves different problems by the same simulation model, e.g., manufacturing plan optimization, job shop scheduling and so on, but mathematical analytics needs to build more mathematical models for the above problems; on the other hand, because simulation modeling are based

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on object-oriented technology, by which a simulation model of complex manufacturing system can be presented more easily by resource object templates than by mathematical methods.

Today, most of research on the domain is focused on merely the simulation optimization algorithms. However, how to build a whole simulation optimization system and united the algorithm with optimization models is still scarcely considered. Although there is a small quantity of simulation optimization software, their performances on practical projects are still not satisfied, and their development lack of an impetus yet. The most important factor is that software are developed without advanced theory basis, so their frameworks are short of openness [1,2].

In the International Winter Simulation Conference' 2001, five famous experts on simulation optimization wrote jointly a paper, "Future of Simulation Optimization", in which a new and synthetic collectivity framework for simulation optimization was put forward, which extended and classified the domain of simulation optimization, via importing interface, method, intelligence, issue, strategy, classify field and etc., the framework could describe fully the development trend of simulation optimization [3]. SimOpt system, a simulation optimization system developed in the paper, is just abided by the idea.

2. The framework of simulation optimization system

According to a principle of separating the simulation model from optimization algorithm, and taking the manufacturing system as subject investigated, the paper puts forward a simulation optimization framework based on virtual simulation modeling environment, which consists of two relatively unattached subsystems: optimization subsystem and virtual simulation subsystem, they could not only complete optimization and simulation functions respectively, but also work jointly on an optimization of simulation model. A compound data interface that can transmit data information, control information and signal information is used as a linker to integrated the two subsystems (Fig. 1).

When a dynamic manufacturing system needs to be optimized in practical, firstly, its simulation model must be built in the virtual simulation subsystem by man–machine interaction. In the model, all design variables and optimization objects are attributes of various objects or functions of these attributes, e.g., speed of conveyor, utilization of machine and so on, user can use configure engine to map these variables and objects to a parameter manager of the optimization subsystem for constructing optimal model (or function). Simulation driver can run the simulation model and output simulation results; in succession, a primary optimal model would automatically be created by the parameter manager. User may add constraint relations and set limitation on these design variables in the optimization subsystem. As optimization subsystem running, optimization algorithm would create a set of initial feasible design variables, and transfer them to the virtual

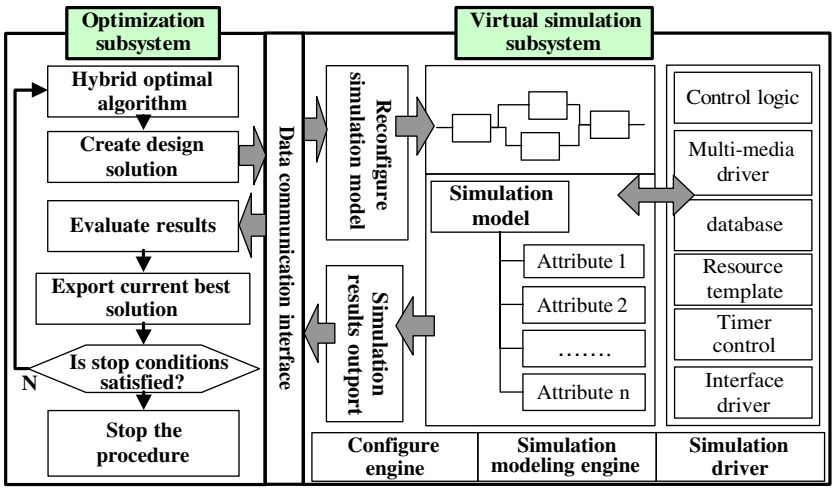

Fig. 1. Simulation optimization system framework.

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