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SIM ENGINE™: AN INTEGRATED SPREADSHEET BASED SIMULATION MODELLING AND ANALYSIS SYSTEM

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ABSTRACT

This paper describes the features and capabilities of a new spreadsheet based graphical simulation modelling and analysis system called Sim Engine™. Sim Engine is a design integrated approach to simulation modelling and analysis. Sim Engine incorporates a Microsoft® Excel 4.0™ data analysis module, a C++ programming module and an AutoCAD™ graphical module into one package. This allows the simulation modeler to go from raw data to completed presentation quality output reports with minimum effort. Another important feature of Sim Engine is its Microsoft® Windows™ based operation which allows it to communicate seamlessly with other Windows programs that support dynamic data exchange (DDE) and object linking and embedding (OLE).

1 INTRODUCTION

In this paper we discuss Sim Engine, a new Windows spreadsheet based simulation modelling and analysis system. Advanced new spreadsheet packages allow a wide array of built-in and programmable statistical analyses and graphical representation capabilities. The addition of powerful macro programming languages for spreadsheets, allows the simulation modeler to perform an entire simulation study within one package. The Sim Engine integrated spreadsheet based approach can utilize from one to three modules. The first is the spreadsheet package for input and output data analysis and simple simulation models. The second is a C++ programming interface for complex modelling. The third module is an AutoCAD based interface for graphical model building through DDE and OLE. Sim Engine provides fast, accurate model building and data analysis all in a Windows environment giving the modeler the ability to easily transport information between any Windows software. The paper is organized as follows. Section 2 will explore the features and capabilities of the spreadsheet module. In Section 3 we will review the C++ interface. In Section 4 we discuss the features of the AutoCAD interface. Finally, in Section 5 we present our conclusions.

2 SPREADSHEET MODULE

The spreadsheet module can perform five separate functions of the simulation study including input/output data analysis, graphical data analysis, model building, optimization methods and experimental design.

The data analysis features of Microsoft Excel 4.0 allow the modeler extensive analytical and graphing capabilities. Some of the features include: random number generation, histograms, descriptive statistics reports and 't' and 'F' tests. Furthermore, Sim Engine provides chi-square, Kolmogorov-Smirnov, and Poisson-Process hypothesis testing macros. This allows the modeler a structured and user-friendly approach to obtaining theoretical distributions for input data. The output from all of these analyses can be fed directly into a Sim Engine simulation model.

Through Excel's macro programming language, the models may actually be developed and run within the spreadsheet. This allows the modeler greater control and flexibility during the development phase. Most of the functions that are typically kept "behind the scenes" in other simulation languages can be accessed and viewed directly. For instance, the modeler can access and step through an event list from an open spreadsheet to identify any potential programming errors.

Excel macros have also allowed complex optimization routines to be coded. For instance, response surface methodologies, direct search methods and Runge Kuta methods. These functions require only

simple input from the modeler and Excel does the rest of the analysis.

A final feature of the spreadsheet module is experimental design and analysis. Built-in functions allow the modeler to run ANOVA and regression model analysis on output data. It will also help the modeler set up an experimental design scheme.

3 C++ PROGRAMMING MODULE

The second module is the C++ Object Oriented Programming Module. This module allows the modeler to build highly complex models that are automatically interfaced with the analysis features of the spreadsheet module. The C++ module allows both discrete and continuous modelling in a flexible easy to learn object oriented environment. The output from the simulation runs are fed directly into the spreadsheet module where a set of preset or custom analyses are performed. The analyses results are then formatted into a single output report.

4 AUTOCAD GRAPHICAL MODULE

The AutoCAD Graphical Module allows the modeler to develop simulation models in a 'point-and-click' fashion. The modeler can use predefined icons to represent the resources and entities of the model (ie. workstations, queues, customers, products, etc.). When an icon is chosen from a Sim Engine library, the modeler is then prompted for the appropriate parameters to describe the object. This module allows the modeler to develop libraries of custom industry-specific icons. The icons are easily created through AutoCAD block drawings. The graphical approach to developing a simulation model reduces the model design time and creates the opportunity to perform extensive output data analysis.

The graphical module also provides the modeler with the ability to animate simulation models. The spreadsheet module is linked to the graphical module as well. Using the Dynamic Data Exchange (DDE) format, information in the spreadsheet module is updated as it is changed in the graphical module. The output from the graphical module is analyzed in the same manner as the C++ module and the same report is generated.

5 CONCLUSION

With the growing need for fast, efficient simulation analysis there has arisen a need for a truly integrated approach to simulation study. No longer will it be effective to use multiple packages to analyze input data, design experiments, build models and analyze the output. In order to take full economic advantage of simulation modeling, design integration is essential. Global competitive advantages will be realized with the design integration approach in simulation. Sim Engine gives the simulation modeler this power with a fully integrated analysis and model building package. The added bonus of Windows compatibility gives true portability of data and allows the modeler to use simulation output in any Windows package.

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