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The Automatic Development of Expert Systems for Stress Analysis

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ABSTRACT

The development of the SACON expert system [1] resulted in a program that advised users on mechanics and the use of the MARC program. This work was extended in SACON2 to include execution of scripts so that the advisory function was extended to carrying out an analysis by the MPACT program.[2] Expert systems have demonstrated their power by focusing on restricted domains where the complete knowledge can be brought to bear on the problem. The development of the rules to implement such knowledge requires the knowledge of both the domain and the operation of the Expert System. Since these rules are designed to mimic an expert's knowledge, the process requires incremental improvement and so can be demanding on human resources. Recent work by the authors have resulted in the **S**emantic **CAN**vasser (**SCAN**) program for **N**atural **L**anguage **P**rogramming. In this work, we use the SCAN program to read documents written in English to generate the required rules to be used with the SACON2 program.

Two documents were used. The first defined the modeling problem for the MPACT FE program. The second defined the scripting required to operate the GUI program MPAVE in order to generate the required data for MPACT. The SACON2 program was modified to accept rules for the generation of scripts. Previously, the generation of scripts was hard-wired into the program. This resulted in the SACON3 program.

The decision to adopt the use of an expert system for modeling and analysis is a trade-off between learning a GUI system such as MPAVE and the by-passing of the process. The experienced MPAVE user wishes to exploit the ability of an expert system to carry out and monitor multiple analysis. At the same time, the user wants to take advantage of the GUI for performing certain tasks. In order to maintain this flexibility, SACON3 can also read in and use partially completed scripts generated by MPAVE. Thus, the user generates a mesh and its equivalent CAD data. The user applies all the constraints and loads graphically. The user then completes the modelling process with the expert system. The result of the analysis is converted to a report. Data is extracted from this report by the SCAN program for further use by SACON3.

The SACON3 program was used to carry out a number of linear and nonlinear analysis. The value of a linear probe was shown in [2]. The linear probe allows the expert system

to gauge the rate and amount of loading that can be applied. The expert system can also be used to verify the model by Design of Experiments.

The successful automatic generation of expert systems demonstrated here has widespread ramifications. The gathering of data from multiple documents and their natural language processing requires a lot of computing. Such a process may be summarized by the automatic generation of expert systems, which can in turn be queried interactively in the usual way. This combined system in fact suggests the future hierarchical relation between NLP and expert systems in AI.

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