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AN INTEGRATED SYSTEM FOR DESIGN OF PIPING SYSTEMS BY AN EXPERT SYSTEM

Summary. An integration of artificial intelligence modules with CAD systems on different stages of the design process is considered.

1. Introduction

During the last years we observe big interest for expert systems in the design practice [3,4,5,7,10,12,14,16]. Many experimental expert systems which are fully integrated with CAD systems have appeared.

New experiments are still conducted. The most important seems to be the following items [4,7,10,14]:

- in what stages of the design process it is possible to use expert systems,

- what should be the architecture of such systems and how they should cooperate with other existing software,
- how should the knowledge and data bases supporting the design process be designed.

The following paper shows possibilities of implementation of expert systems in different stages of the design process of a piping systems. It presents an actual version of a system exploiting expert system technology.

2. The CAD- System with an expert system

The chapter shows specialized system [11-12], which consists of 2 systems: one for modeling the geometry of a piping system connected with a second system for analyzing the fluid dynamics problems of fluid in the piping system.

For modeling the geometry of the piping systems the EASYPLOT system [6] is used. The second system which is used in newly created complex system is the system for hydraulic networks dynamics analysis [1]. This system exploits cell formalism. For the modeling of the specific hydraulic system it is necessary to describe a system of nodes, their connections, their parameters and their boundary conditions.

The modeling of the hydraulic system made with several hundreds of nodes costs a lot of designer's effort. And this is why as a first step a module was made which automatically generates a hydraulic model on the basis of a geometrical model. A set of rules was created which allows to build a fluid dynamics model [11-12].

In the following paper some new actually developed modules are presented.

At first a module supporting the simulation parameters control was made. The simulation code has a number of parameters which control the process of simulation: reference fluid flow, maximum change in the fluid flow per time step, minimum and maximum time steps, initial time step, final time of simulation, coefficient indicating steady state achievement. The selection of these parameters decides about

the efficiency of calculations. An expert system on the basis of data given by the designer of the piping system and data taken from the geometrical model suggests the initial values of control parameters.

The simulation experiment is not only connected with selection of initial values of parameters but also with the process of simulation. Then expert system controls the process of simulation too. In the case of failure the expert system suggests some changes in the parameters and the repetition of the simulation. The expert system uses the trace file with the results of the simulation as a source of information.

Another module, developed in the actual version of the code, is the module supporting the organization of visualization of final results. In the class of models considered by the described system it can be difficult to find phenomena which are interesting for the designer. This problem appears especially with large models. Therefore a special expert system was made in which the designer can express his expectations with the presentation of the final results . And as a result you get some diagrams or some animations of all or some selected parts of system. The designer can look for instance for pressure waves, high values of fluid flow etc. An architecture with rule based monitoring of simulation is being developed at the moment. It is similar to an expert system supporting postprocessor. The simulation process will be monitored on line with intelligent searching for phenomena which are interesting for the designer. The new module will have possibility of stopping the calculation before the final steady state. This means in the case of breaking the constraints given by the designer or if you get worse results than in earlier analyzed models the calculation will be stopped.

In all described modules the same expert system is used. Only the knowledge bases, the ways of communication and in some cases the size of system are changed.

3. Conclusions

The actual version of the system is tested on many real examples. New modules are tested separately and are still being improved. The experiments which have been done up to now suggest deep and narrow specialization of every expert module.

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EIN INTEGRIERTES SYSTEM ZUR KONSTRUKTION EINES RÖHRENSYSTEMS MIT HILFE VON EXPERTENSYSTEMEN

Zusammenfassung

Der Artikel stellt die Integration von Elementen künstlicher Intelligenz in CAD Systemen in verschiedenen Abschnitten des Entwicklungsprozesses dar.

ZINTEGROWANY SYSTEM DO PROJEKTOWANIA RUROCIĄGÓW ZA POMOCĄ SYSTEMU EKSPERTOWEGO

Streszczenie

W pracy zajęto się problemem wprowadzenia elementów sztucznej inteligencji do systemów CAD.

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