BOOK REVIEW

SRIRAM D.: Knowledge-Based Approaches for Structural Design. Computational Mechanics Publications, Southampton — Boston 1987

This volume discussing knowledge-based approaches to structural engineering design is the first representative of a new series supporting people working in this field. The author is a well known expert of knowledge-based expert system applications to engineering design.

The fact that after an algorithmic software tools aided engineering design era, now the need of "real" CAD systems started to develop all over the world gives a remarkable up-to-dateness to this publication. Software products for engineers' use written in imperative programming languages have not ever performed design tasks, but some partial, at the very best, checking calculations. Algorithmic checking calculations represent an important step in the design process, but this fact alone has not too much to do with "design". At this stage of CAD technology the engineer estimates those parameters which are equivalent to the outcome of the design process according to his experience, and he checks their rightness utilizing algorithmic software tools. This level of automation, however, does not mean automated design, i. e., a "real" creative CAD.

Functional programming languages, like above all LISP and PROLOG, provide a means to generate all the feasible solutions exhaustively from a discrete data set within certain constraints. Accordingly, a structure definer logic program module can be built around traditional algorithmic ones, performing preliminary parameter selection based on the experimental and heuristic rules eliminating any subjective interference. At this stage we can really speak about computer aided (automated) design. Researchers dealing with automated structural design live in this world today, which is also ours as well.

As a matter of fact, functional programming languages are meant to make expert system production more comfortable. If the engineer, who is responsible for the logic model, can formulate his definitions in "if ... then ..." type of rules, then expert system shells enable an easy utilization of all the advantages of functional programming (the strategy of exhaustive search, pattern matching, backtracking etc.).

The main merit of this volume is that it gives a comprehensive review of the prospects and the issues up to now in this recognition stage of research. The epoch-making character of the book is not only in that it describes theoretically the future general directions of automated structural design, but also that it rests on real issues. This is the way how it presents conceptual models of integrated structural analysis and design systems, referring to DESTINY, and frame based expert systems performing preliminary structural design, referring to ALL-RISE.

DESTINY consists of several knowledge modules which communicate through a blackboard that is controlled by an inference mechanism. The blackboard consists of several levels which represent a hierarchical decomposition of the designed object.

ALL-RISE synthesizes a number of feasible structural systems from the input by generating each possible combination. It is a goal driven system based on top-down refinement

and constraint handling problem solving techniques. Certain alternatives existing in the context of ALL-RISE can be posted on the blackboard of DESTINY.

The system architectures mentioned above demonstrate the fact that the abstract model of design is generally considered as a sequence of definitions and theorem proving processes.

According to its organization the book starts with a general description of the background involving problems of design from the engineer's point of view and the basic concepts of knowledge based expert systems with respect to computer technology. In accordance with the character of the book and reckoning on engineer readers this latter problem is finely detailed, much deeper than the problems of design. The author analyses minutely the problem solving techniques and knowledge based expert system architectures.

DESTINY and ALL-RISE are described as conceptual models, then other system implementations are also discussed.

DECADE (a system for catalyst selection). ULYSSES (a framework for VLSI design), DOMINIC (an architecture for mechanical engineering design) are selected to demonstrate blackboard architecture. On the other hand HI-RISE (preliminary structural design of buildings), PRIDE (paper handling design system), AIR-CYL (a mechanical design system), VEXED (design of VLSI circuits) are shown as instances utilizing constraint handling and top-down refinement strategies.

This volume can be recommended cordially to people who do not want to stay away from the extremely fast development of design automation. The references given at the end of the book give also remarkable help to researchers of this field. One thing, however, in my opinion, did not get enough stress: information processing techniques open exceptional prospects for engineers, but at the same time we must not believe that knowledge formalization, moreover, consistent and complete rule system construction is easy to realize. These are obviously the problems which are to be solved by the engineer who is supposed to be the expert of the given domain, nevertheless, turning his knowledge into a concious one in a majority of cases stil keeps us waiting.

This book also suggests the engineer reader that he should try to convert his unconscious knowledge of logic level to a formalized conscious one so that the available information processing technology, expert system shells could really support the engineers' society and industry.

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