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Piotr Berkowski Jacek Boroñ

Building Engineering Institute Technical University of Wroc³aw, Poland

AN ALGORITHM OF COMPROMISE STRUCTURAL OPTIMISATION OF BAR STRUCTURES

1. Introduction

Authors' own research in applied unicriterial [1,2] and multicriterial optimisation of bar structures [3], and also an analysis of accessible bibliography on structural synthesis [4÷9] allows to present herein an attempt to define a general algorithm for proceeding in formulation of a structural optimisation problem.

A practical aspect of such an algorithm consists, in author's opinion, in enabling a designer a correct creation of a mathematical model of synthesis problems, independently of known mathematical methods employed to looking for a conditional extremum of function of several variables.

A proposed algorithm is not a ready-for-use tool for solving all the optimisation problems, but it constitutes an easy-to-expand theoretical basis. This basis should allow a designer to create a proper set of compromises on the way to construct a mathematical model of a specific optimisation problem.

The algorithm, presented in this paper, is constructed as a sequence of the one-after-another problem questions, on which the designer answers: *yes* or *no*, and a set of selections from the knowledge base consisting of the elements of an optimisation problem components. The order of making questions adopted by the authors in the algorithm is subjective, however it is supported by their experience, both in applied optimisation and in designing of structures like trusses or frames.

2. Algorithm of formulation of the mathematical model of optimisation problem

2.1. Assumptions

The authors accepted the following assumptions to define a category of currently considered optimisation problems:

- **a**) as structural optimisation problems are considered that of searching for a conditional extremum of a several variable function,
- **b**) it is assumed that one-branch structural design problems are, from the nature, unicriterial optimisation problems,

c) it is assumed that multi-branch structural design problems are multicriterial optimisation problems, as

it

is natural,

d) there is not excluded an existence of optimisation problems different that defined in b) and c), however

they are not considered in this work,

e) an implemented *knowledge base* consists of *problem bases*, grounded on existing knowledge in the field

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of the applied structural optimisation. Currently it is being developed and bringing up to date by the authors of this paper,

f) compromises considered by designer during the exploitation of the proposed algorithm are divided into

the simple ones (that of answers on problem questions), and the complex ones (that of selections of elements of the optimisation model from the data base).

2.2. Flow chart of the compromise optimisation algorithm









3. Conclusions

The algorithm of creating the mathematical model for a chosen class of structural synthesis problems presented in this paper is a simple tool dedicated for designers and structural engineers. It divides the optimisation problem into unicriterial (one-branch) problem or multicriterial (multi-branch) one. This division is introduced by the authors basing it on the analysis of optimisation bibliography and their own experience in the field of structural synthesis.

Selected compromises necessary to create the mathematical model of optimisation for a specific design problem are the essence of every human activity connected with decision making. A choice of any of them has a fundamental influence on a progress and a result of numerical calculations as the last part of the structural synthesis. A very important part of the presented algorithm is a *knowledge base*, containing ready-to-use detailed elements of the mathematical optimisation model (objective function, design variables, constraints, optimisation methods, etc.). Development and actualisation of such a knowledge data base will be a subject of the further author's investigation.

4. Bibliography

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