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A comparative Evaluation of Engineering Approaches to the Optimization of the Structure of Energy-Conversion Systems

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Structural Optimization Approaches

Optimization of the structure is meaningful only when it is combined with a simultaneous optimization of the decision variables.

The approaches that can be applied to the optimization of the structure of energy conversion systems include the following:

- ►Mathematical programming methods
- ►Genetic algorithms
- ►Exergoeconomic approaches
- ►Intelligent systems (expert systems, fuzzy logic, etc.)

The first two methods use a superstructure, whereas the third approach is applied iteratively.

The presentation discusses the advantages, disadvantages and applications of each method.

Mathematical Programming Methods (MPM)

- use a superstructure and equations/inequalities to model the system (quality of the results depends on them)
- require cost equations (a complete mathematical model)
- Generally find a “better” solution than the other methods
- applicability is limited by the number of binary variables and the types of equations (example: combined cycle power plant with 28 structural variables and 48 process variables)

Genetic Algorithms

- use a superstructure and generally a simulation software
- require a complete model
- Generally find simpler solutions (a local optimum) than MPM
- require a very long computational time
- can deal with more complex installations than MPM

Exergoeconomic Approaches

- are based on an exergoeconomic evaluation and iterative improvement
- are the most flexible approaches permitting consideration of issues dealing with safety, reliability, maintainability, etc.
- do not need a complete model
- have no restrictions with respect to plant complexity
- provide a wealth of additional information to the engineer and enhance the creativity of the engineer
- cannot find the global optimum or even a local optimum (only a “good” solution)

Intelligent Systems

- developed only for specific rather simple applications
- require an extremely long computational time
- can support other methods
- can find an optimum only in combination with an optimization method