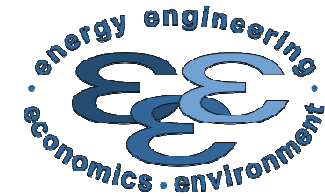




**Technische Universität Berlin**

**Institute for Energy Engineering**



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

**George Tsatsaronis**

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***tsatsaronis@iet.tu-berlin.de***  
***www.iet.tu-berlin.de***

# Structural Optimization Approaches

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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)

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- ▶ 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

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- ▶ 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

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- ▶ 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

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- ▶ 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