Heating system designed by genetic algorithm

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Abstract
The contribution deals with the use of the genetic algorithm (evolutionary methods in general) for civil engineering problem solving. The genetic algorithm seeks the optimal size of a heating object in a 3D house, wich emphasis of desired comfort and temperature. The genetic algorithm was created in Matlab, the thermal simulation of the house under consideration of all construction materials is in Comsol Multiphysics and it is based on the finite elements method. The 3D model was created in Catia V5. In this article also the possibilities of utilization of evolutionary methods in complex design process of building subsystems are mentioned.

***Key words**: Genetic algorithm, 3D model, finite element method*

The function of heating subsystem of building is to maintain desired temperature in dependence on person presence, required corded mode and outer conditions. Each room has another temperature mode (e.g. the temperature is different in staircase, office, bathroom etc.) For bigger building gets the task of the design process more complicated and for that reason for experienced engineer is very hard to design optimal heating system (in general each subsystem of the building), therefore it is very important to select a new approach, which is able to solve this problem. In this article is shown how can be solved this and similar problems by genetic algorithm(s). Mentioned tasks have one mutual property, because for theirs solving is needed to create model, which will be used in simulation. The model complexity depends on desired precise and on the amount of significant factors (factors which have influence on tracked quantity). The simulation is starting point for genetic algorithm.
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Solution (at the end of 100th generation)

x	y	z	
0.0095	0.1684	0.0826	// dimensions of heating object

avg	=	294.0168	// average temperature
fit	=	91.6474	// value of fitness
dev	=	79.1218	// balanced difference among 18 points

Conclusion
On the simple example were showed the possibilities which allow mutual interconnection of MatLab and Comsol Multiphysics. By the genetic algorithm were found optimal dimensions of heating object, with fulfillment of prescribed conditions. The amount of parameters needed for simulation of more complex objects (e.g. heating system of whole house) grows considerable and also grows the time needed for one simulation in Comsol (for bigger objects

we have bigger mesh, i.e. more points for FEM solver). If we consider also the building construction (thermal/insulation properties from the point of heating) the string length of GA will be count in tens. With the amount of parameters also grows the population of GA and the number of needed generations. If we assume that one simulation takes about few tens of seconds (on one processor unit) the resultant time for whole computation process can easily reach on few days (months). Therefore is necessary to involve only significant parameters. All in all if we want to reach the acceptable computing time of more complex solutions, is needed to use multiprocessor unit or net of computers.

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