The optimization of structures in macro scale is widely used nowadays. The goal of the paper is to apply optimization techniques to obtain better performance on the micro level in multiscale modelling. The structures build with an optimal microstructure can obtain the best performance. The microstructure can be optimized taking into account loads of the macro structure. Optimization of the microstructure is not easy currently, but in future, in applications where performance of the structure is very important, the presented approach may be used with success. A bio-inspired method based on an artificial immune system (AIS) is used to solve the optimization problem. Immune computing provides a great probability of finding the global optimum. It is developed on the basis of a mechanism discovered in biological immune systems.

An immune system is a complex system which contains distributed groups of specialized cells and organs. The main purpose of the immune system is to recognize and destroy pathogens - funguses, viruses, bacteria and improper functioning cells. The artificial immune system takes only a few elements from the biological immune systems. The mutation of the B cells, proliferation, memory cells, and recognition by using the B and T cells are used the most frequently. The unknown global optimum is represented by the searched pathogen. The memory cells contain design variables and proliferate during the optimization process. The B cells created from memory cells undergo mutation. The B cells evaluate and better ones exchange memory cells.

The optimal topology is generated by the level set approach. The crowding mechanism is used - the diverse between memory cells is forced. A new memory cell is randomly created and substitutes the old one, if two memory cells have similar design variables. The crowding mechanism allows finding not only the global optimum but also other local ones. Additional the Gaussian mutation is used in this approach. The paper presents methodology, algorithm of optimization and numerical examples.

Acknowledgement

The research is financed from the Polish science budget resources as the project R07 0006 10.