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ROZPRAWA DOKTORSKA

Optymalizacja kształtu oraz warunków brzegowych podzespołu
układu oczyszczania spalin

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Summary.

The dissertation deals with issues related to the optimal design of the selected features of heat shields used in exhaust systems of internal combustion engines. The dissertation developed a method for optimizing the shape and boundary conditions using parametric models of heat shields. The finite element method (FEM) for thermo-elastic issues and modal analysis were used to solve numerical simulations. Numerical procedures were developed and commercial FEA software was adopted to solve optimization tasks using both internal and external optimization algorithms, thus significantly increasing the ability to solve such problems in practical applications. Quality criteria related to selected strength characteristics, which are derived from real industrial requirements for this type of systems, were developed and numerically implemented. The effectiveness and flexibility of the proposed method were demonstrated.

In addition, the work proposes and describes a method of creating FEM surrogate models for the heat shield (so-called metamodels), which makes it possible in the proposed optimization method to significantly reduce the time of solved tasks. Metamodeling was carried out using artificial neural networks with appropriate topology. The developed metamodels are characterized by high accuracy in relation to the solutions obtained from FEM simulations.

The research results presented in the paper, in the form of solved practical optimization tasks both with and without metamodeling, confirm the effectiveness and efficiency of the developed method.