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ADJOINT OPTIMIZATION OF A COOLANT PUMP IMPELLER

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The competitive pressure in automotive industry causes a reduction of cost in every branch. Thus to ensure peak performance of all car components the use of computational optimization methods is necessary. Bionic optimization procedures, such as: evolutionary strategies or genetic algorithms, are already an essential part of the process chain in car manufacturing. Nevertheless, these methods are limited to small numbers of design parameters. For the future new design optimization tools are therefore under testing and development.

The adjoint approach is a suitable candidate to replace black box optimization tools. Mainly used for aerospace applications, the interest in adjoint for automotive industry has increased drastically in the last years. While the adjoint approach is already in use for external aerodynamic shape optimization of the car body and internal duct optimization [1, 2, 3, 4], the application range in automotive industry is by far not exhausted. Here the adjoint method is extended to rotating engine components such as coolant pumps with the aim to increase hydraulic efficiency.

While the basic framework for adjoints in turbomachinery is already well known [5, 6], less work about how to interpret the adjoint flow field with regards to the impeller shape has been done so far. This work proposes a shape optimization process for a coolant pump impeller using the open source software OpenFOAM. To reduce computational cost steady state simulations applying the multi reference frame method are conducted. The aim of the work is to identify the optimal impeller geometry while maximizing hydraulic efficiency. Thus the mesh motion tools available in OpenFOAM, as well as morphing with the commerical tool ANSA are investigated. The limits and capabilities of the mesh motion features in OpenFOAM with regards to shape optimization are outlined and compared to the capabilities offered by commercial tools.

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