



# THE DEVELOPMENT OF INTAKE SYSTEM IN INTERNAL COMBUSTION ENGINE IN STUDENT-CLASS VEHICLE

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PhD in Engineering

# CADFEM

CADFEM is one of the pioneers of numerical simulation based on the Finite Element Method.

ANSYS software was the main focus and purpose of our internship.



# Internship plan

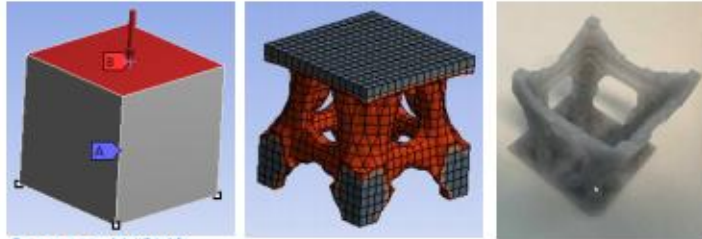
- The study of the company CADFEM methods for solving engineering problems in the software ANSYS
- The study of the company CADFEM techniques and technology solutions of multiphysics problems
- The study of methods of parametric and topological optimization for solving problems in ANSYS
- The development of optimization model of synthesis of the internal combustion engine power system parameters

# Topological optimization

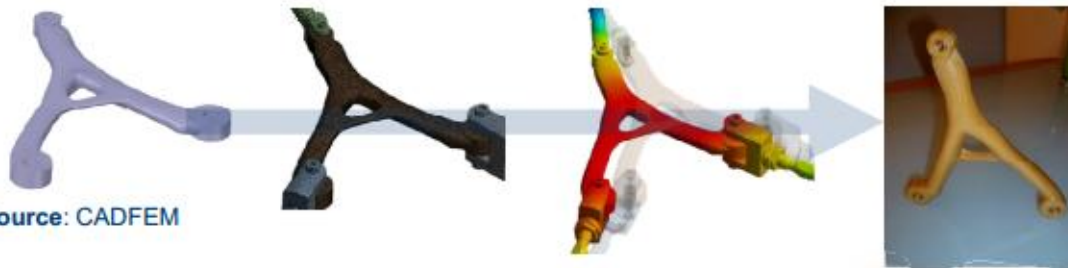
The aim of optimization of the topology:

- To minimize the compliance means to maximize the global stiffness. The most common objective function in topology optimization is the energy of the elastic compliance.
- To get the distribution of material that provides optimum part stiffness.

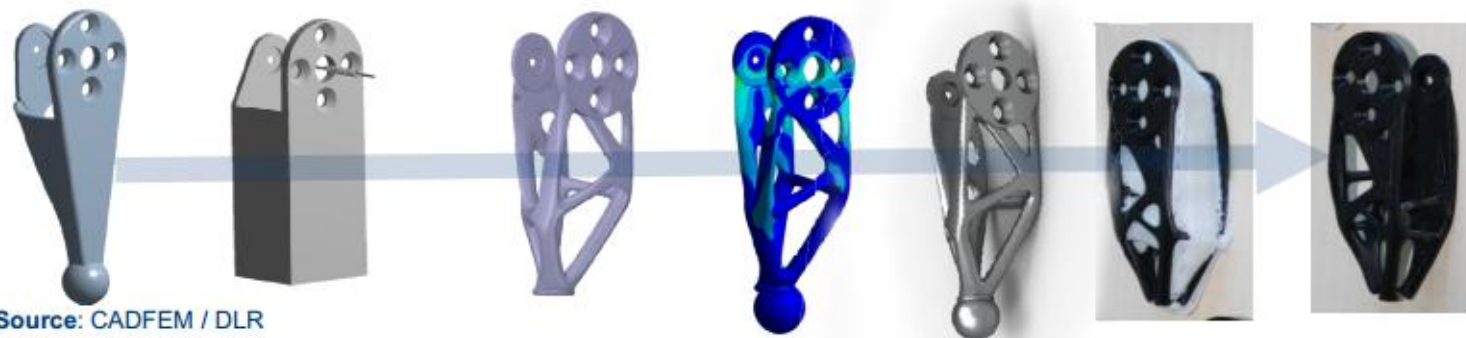
# Some examples of topological optimization



Source: ANSYS



Source: CADFEM



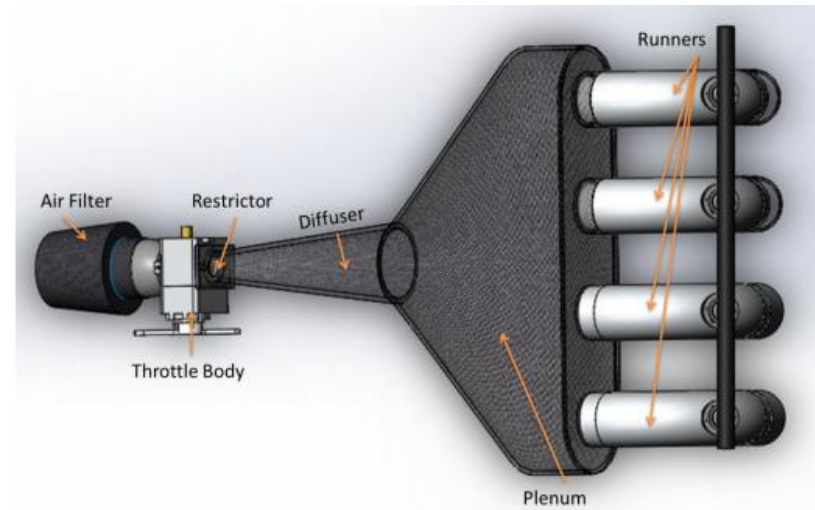
Source: CADFEM / DLR

# Master thesis

## THE DEVELOPMENT OF INTAKE SYSTEM IN INTERNAL COMBUSTION ENGINE IN STUDENT-CLASS VEHICLE

The rules of competition:

- The limit of the engine capacity is up to 610 cm<sup>3</sup>;
- the appropriate fuel type is petrol;
- The noise level mustn't exceed the 110 dB threshold;
- the presence of 20 mm air restrictor is in the intake system.



Sample of the air intake system

# The engineering methodology

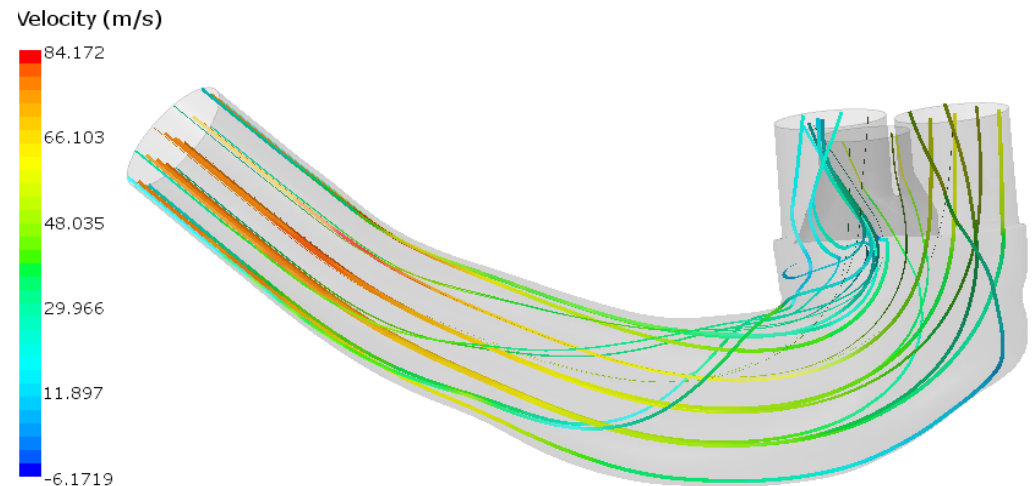
The use of 3D-scanner for determining the connection between dimensions and geometric constraints is associated with the layout of the power supply system



# The engineering methodology

The optimizing criteria:

- The reduction of non-uniformity of the field of flow rates
- the reduction of pressure loss (system resistance)



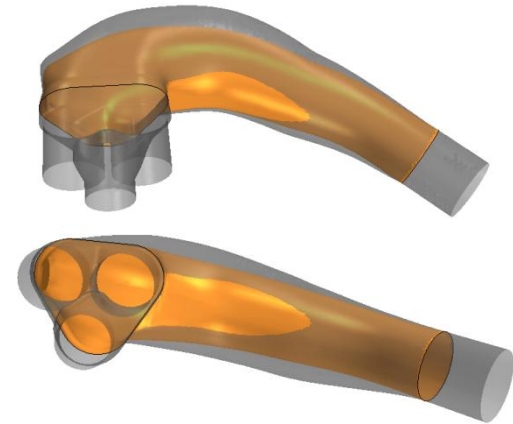
Visualization of the results of numerical modeling for gas flow in the pipe



# CONCLUSIONS

The model obtained by modifying the geometry of construction was able to reduce the resistance to 18.2% in comparison with the original design (to 345 Pa) and non-uniform flow is from 46% to 20.3%.

Therefore the amount of air entering the engine cylinders will increase. The engine power and fuel consumption losses will be minimized.



3d model



# The results of internship

- Methods for solving engineering problems studied in the ANSYS software
- The technique and technology solutions of studied multiphysics problems
- Intake pipe model was created and topologically optimized by ANSYS

