MOOC@TU9 – Week 7

Mobility - Metropolitan Car - Metropolitan Aircraft

Please prepare your answer electronically and send it as PDF or Word document!

First task – Metropolitan Car

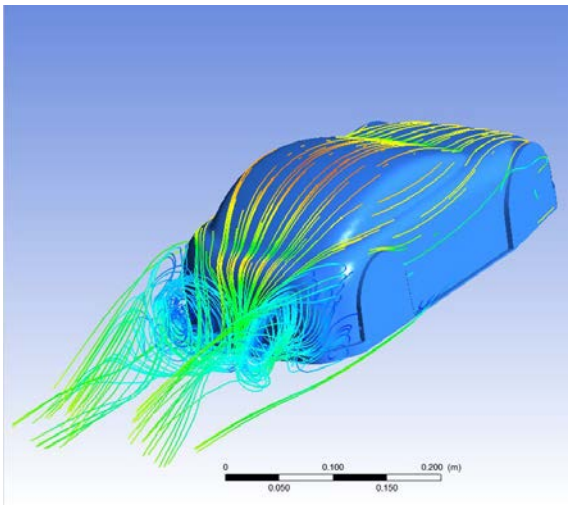
We have already described the driving resistance of a vehicle and you have identified different measures to influence the driving resistance.

1. Which kind of car is probably more inefficient for a city or short distance?
    a. A small car with an electric engine
    b. A big car with a diesel engine
2. Do you think that the weight of the car is an important aspect for fuel consumption?
    a. Yes
    b. No
3. Which kind of road surface can be seen as the worst one for fuel consumption?
    a. Dry concrete surface
    b. Sand
    c. Wet Asphalt
4. Do you think that different weather conditions influence fuel consumption?
    a. Yes
    b. No
5. The driving resistance is bigger by:
    a. Driving in a straight line
    b. Driving in a curve

    .. and why?

Research work:

1. In the picture below you can see the air turbulence behind the car. Please describe, how you would proceed to reduce the turbulence?



2. The air drag resistance is a very important aspect. Please calculate, how much smaller must C_W be to reach a 10% higher vehicle speed with the same air drag resistance. The other factors don´t change. To explain this, use the formula for air drag resistance.

• Air drag coefficient	C_W	=	0,4	
• Vehicle speed	v	=	100	km/h
• Projection surface of the car	A	=	2	m^2
• Air density	ρ	=	1,29	kg/m^3

Second task – Aircraft

During the MOOC some simple relationships and analysis was shown to explain the principles in fundamental behavior of bypass engines with regards to their efficiency and the generated thrust.

a) Give a short explanation, why an increase in bypass ratio in general beneficial for the efficiency of a jet engine. Assume a constant thrust requirement as well as a constant subsonic flight speed (e.g. Ma = 0,75) for your examination.

b) Calculate the exit velocity u_e of an engine in order to achieve a propulsion efficiency η_p of at least 80% for above flight speed at a flight altitude of 11000m, where the ambient temperature should be -50°C.

c) Analyze the history of the bypass-ratio (BPR) of commercial jet engines in the last 50 years, what is the general trend ?

d) Discuss possible constraints for a growing bypass-ratio from your perspective. Keep the thrust requirement constant but allow for different (low and higher) flight speeds and review also possible effects on engine mass and engine integration.