Student Challenge – SIA Power Train & Electronics Paris 2019

Which Powertrain for an ultra-light vehicle?

1. Context

In the context of CO2 emissions reduction, different fields are investigated: internal combustion engines efficiency improvements, downsizing, electrification, lightening of vehicles.
In parallel with those developments, the trend towards new small vehicles that can only accommodate one or two people is growing. This leads to a significant decrease of the mass of these vehicles and also of the space available for the implementation of the powertrain.

The main challenge for this type of application is to identify the most relevant Powertrain, satisfying the multiple constraints of tomorrow's urban vehicles. The objective of this project is to study and to identify the best combination of the technological bricks of the market, to meet the specifications of this kind of vehicle, in compliance with standards and regulations.

As part of this project, we want to identify the different combinations of technological bricks and make a comparative study. On the technical side, gasoline engine will be considered, but all kind of choice could be done for transmission systems, level of electrification and hybridization solutions.
We will then consider that we start from existing bricks, adapted to the constraints of the vehicle,

2. Specifications

a) Application – Market and regulations context

The overall objective of the project is to determine the optimal Powertrain in terms of efficiency, meeting the vehicle specifications described below:

1. Mass: 400kg
2. Length: 2.5m
3. Width: 0.9 m
4. Electric Vmax: 70 km / h
5. Vmax: 110 km / h
6. Zero emissions autonomy: 30 km
7. Total autonomy: 300 km
8. Acceleration 0-100: 13s

The main steps of the project will be:

1. Critical analysis of the project specifications
2. Collect information on engines, transmissions, batteries, electrical machines, hybrid architectures.
3. Imagine powertrain architectures in line with the specifications
4. Model the different architectures
5. Cycle simulation (consumptions / performances)
6. Iteration on Architectural Choices
7. Optimum architecture proposal

b) Application constraints

Industrial context: Choice in line with the type of vehicle

- Powertrain volume / mass
- Battery volume / mass
- Limited cost

c) Expected performances

Compliance with the specifications under high cost constraints

d) Priorities for decision

The main objectives of this powertrain are (in order of priority):

1- Low emission level compliant with RDE standards
2- Fuel consumption (CO_2 emissions on the RDE cycle)
3- Cost of use, simplicity & price
4- Performances
5- NVH criteria
6- Lightness and compactness.

e) Provided inputs

Some data needed for this project are provided, such as:

- Gasoline internal combustion engine efficiency and emission maps
- Electrical machine efficiency map
- Real Driving Emission Cycle

f) Deliverables

- Conference type paper as a report (max 15 pages)
- 5 min presentation with a poster support during the Poster Session of the SIA Conference
- 2 min presentation (“pitch” type) during the Plenary Session of the SIA Conference for the winner