EVALUATION OF THE ROAD VEHICLES' FUEL CONSUMPTION BY TYPE OF INFRASTRUCTURE

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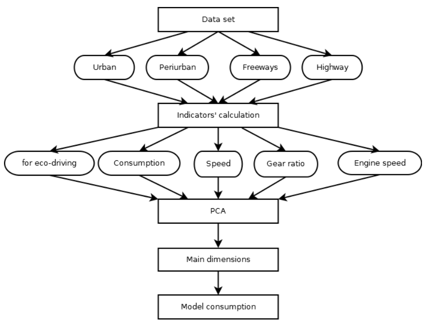
Introduction

Since the last decade and for the coming years, we are faced to environmental and societal challenges: reduction of gas emissions linked to road transport.
In this research, the road vehices' fuel consumption depending on the infrastructure is analysed. We model consumption by type of infrastructure and determine the most influential parameters and actions to reduce fuel consumption.

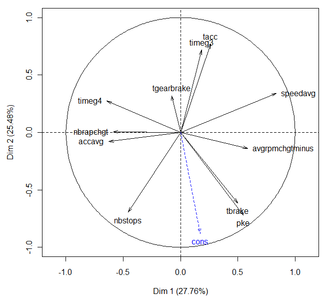
To carry out this research, a large data set collected during Gerico project was processed, including consumption and cinematic paramaters. This data set represents a 70 km route including different types of environment : urban, suburban, highway… This route has been traveled 80 times with different driving modes : normal driving, after training to eco-driving, with the aid of a system which advocates a speed and a gear ratio.

Synoptic of the method

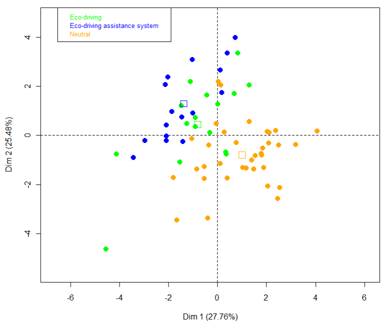


Main factors' identification

- Reduction of dimensions
  - Grouping variables into clusters : Hierarchal clustering
  - Selecting one variable per cluster using silhouette index
- Describing and visualising variables using PCA
- Select the most suitable variables to model consumption



Variables factor map (urban)



Individuals factor map (urban)

Modeling consumption

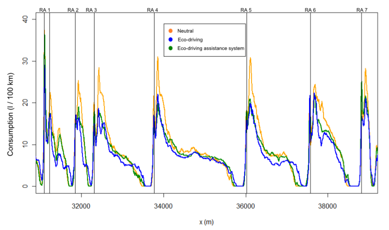
For each environment, we keep the main variables according to PCA results in order to model the consumption. For instance, consumption in urban areas is modeled using the variable pke (positive kinetic energy) and the number of stops per kilometer (F = 214, R^2 =0.87, DF=64) .

$$consumption_{urban} = \beta_0 + \beta_1 PKE + \beta_2 nstops$$

Coefficient	Estimation	Standard error	T	P-value
β0 (Intercept)	5.65	0.21	26.75	<2e-16
β1 (pke)	7.75	0.49	15.76	<2e-16
β2 (nstops)	2.03	0.22	9.13	3.39e-13

Model coefficients

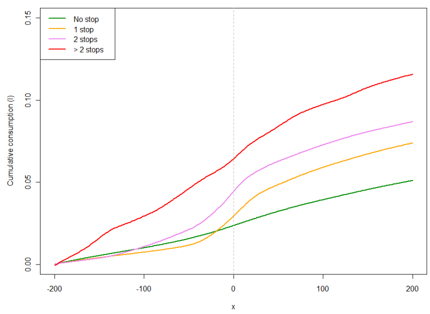
Consumption at roundabouts



Consumption profile (roundabouts)

- For each roundabout, speed and consumption values are smoothed and aggregated by type of driving
- Overconsumption at roundabout crossings is about 20 ml of gas
- Less consumption for users practicing eco-driving
- Lower consumption during deceleration phases
- Less consumption for users anticipating roundabouts

Consumption at traffic lights



Cumulative consumption at traffic lights

- Overconsumption of 17 ml of gas when drivers stop once
- Overconsumption of 29 ml when drivers stop twice
- Overconsumption of 53 ml when drivers stop more than twice

Stops	Passages		Consumption (l/ 100 km)	
	Nombre	%	Median	Average
No stop	867	51%	9.1	9.1
1 stop	811	47%	13.3	13.4
2 stops	27	2%	15.3	16.3
> 2 stops	9	1%	23.3	22.4
Set	1714		11.4	11.3

Consumption by the number of stops

Global results and conclusions

Infrastructure	Consumption (l /100 km)		%
	Neutral	Eco-driving	
Urban	10.3	9.2	11.1%
Periurban	9.3	8.2	11.5%
Freeways	6.9	6.3	9.1%
Highway	8.3	7.1	13.9%
In descent	4.1	3.5	14.2%
In rise	16.3	15.6	4.3%

Consumption by type of infrastructure

- Overconsumption in urban and periurban environment and in rise
- Less consumption on freeways and highway
- Good performance of eco-driving on highway and in descent
- Less performance of eco-driving in rise, in urban environment and freeways

In this research, for each type of infrastructure we analysed vehicle consumption. In future work, we will refine the results and apply the methods to other data sets.

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