TyreOpt - Fuel consumption reduction by tyre drag optimization

Energirelaterad fordonsforskning 2017
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Huvudstödmottagare: Volvo Lastvagnar AB
Andra parter i projektet: Chalmers University of Technology
Inom program: Fordonsstrategisk forskning och innovation
Stödsumma: 5 344 998 SEK

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Outline

1. Background
2. Goals
3. Results
Tyres

- Connecting the vehicle to the road
- Difference between good and bad tyres is significant
Trucks

- Large number of possible vehicle configurations
Environments

- Great variety of operating environments

- Surfaced roads. Well maintained
- Surfaced roads. Less maintained
- Surfaced roads. Badly maintained
- Hard packed sand or gravel surface of bad quality
- Hard packed sand or gravel surface of very bad quality
- Surfaced roads. Very badly maintained
- Washboard
- Off-road
Goals

- Find optimal tyres configuration for each combination of vehicle and environment
  - Minimize energy losses caused by the tyres
  - Select tyres from an existing tyre database
- Formulate the decision problems mathematically
- Develop an efficient methodology to solve the decision problems
- Upgrade the existing tyres selection tool in Volvo
- Improve match of tyres to needs of customers
- Reduce fuel consumption
Joint vehicle, tyres, and operating environment model

- Vehicle model: VTM (in-house vehicle dynamics model in Simulink)
- Tyre model: RRC surrogate model, approximate relations
- Operating environment model: Road generator
Solving one instance of the truck tyres selection: quadDS

- Simulation-based optimization problem with categorical variables
- A computationally efficient algorithm quadDS was developed
- quadDS outperforms the other existing algorithms (GA, NOMAD)
Solving many instances of the truck tyres selection

- SVS vehicles operating in the most common environments: quadDS
- Other vehicles and environments: an efficient algorithm based on weighted response surfaces developed

For each SVS (p values):
- Find the optimal tyres configuration: quadDS
- The optimal tyres configuration (x values)

Set of sample points for each SVS

For each non-SVS (p values):
- Find the approximately optimal tyres configuration
- The approximately optimal tyres configuration (x values)
Results for an FH4x2 vehicle

Find the optimal tyres for the front and the rear axles, 35 available tyres.

The goal of the project was to show that it is possible to save 2–4% by a structured tyre selection.

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<th>Road</th>
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<th>Sold</th>
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More information can be found in the final report of the project and my licentiate thesis:
http://www.energimyndigheten.se/forskning-och-innovation/projektdatabas/sokresultat/?projectid=15805

Thank you for your attention!