NEDC Simulation with GT-Drive

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Overview

1. Introduction
2. Simulation Background
3. Investigated Vehicles
4. Split of loss calculation in the NEDC
5. Conclusion
Introduction

NEDC and Split of Loss Calculation:
• Split of loss calculation in combustion engines is commonly used for comparing combustion systems on the test bench
• Gives an idea how to optimize the internal combustion to increase efficiency

➔ How to do a split of loss calculation based on the NEDC?
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Simulation background

City Cycle

EUDC

today

Vehicle speed [km/h]

0 20 40 60 80 100 120

0 200 400 600 800 1000 1200

time [sec]
Simulation background

- GT-DRIVE MODEL
  Vehicle

- GT-POWER MODEL
  SI-Engine

- MEASURED DATA/
  Engine Operating Map
  Diesel-Engine

- COMBUSTION PROCESS ANALYSIS/
  Split of Losses
  NEDC

coupled calculation
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Investigated Vehicles

Vehicle
weight: 1540 kg
gearbox: 6-gears (mechanical gearbox)
cw-value: 0.27

SI-Engine
number of cylinders: 4
gine displacement: 2198 cm³
power: 114 kW (5600 rpm)
compression ratio: 11.3

Diesel-Engine
number of cylinders: 4
gine displacement: 2148 cm³
power: 107 kW (4200 rpm)
compression ratio: 16.5
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Split of loss calculation in the NEDC

- loss by real charge
- loss by not optimal position of the combustion centre
- loss by HC+CO-emissions
- loss by finite combustion duration
- loss by real caloric
- loss by heat release through cylinder walls
- expansion loss
- compression loss
- loss by ideal gas exchange
- loss by real gas exchange
- loss by total gas exchange
- mechanical loss

Intension:
Where does a vehicle with a SI-engine compared to the vehicle with a diesel engine loose efficiency?
Loss by not optimal position of the combustion center [%]
Mechanical loss [%]

Losses will be summed up...
Energy Losses summed up in the EUDC [%] (without engine idle part)

Which losses are higher with SI-Operation?

- Energy Loss [%]
  - + 4% higher because of unsteady effects
  - + 1.5%
  - + 4.2%

⇒ e.g. Stratified Operation allows reduction of the gas exchange losses!
Stratified Operation in EUDC

Loss by total gas exchange [%]

- **Diesel Engine**
- **SI-Engine**

Parameters:
- **V [km/h]**: 0, 20, 40, 60, 80, 100, 120
- **rpm [1/min]**: 500, 1500, 2500, 3500
- **time [sec]**: 775, 825, 875, 925, 975, 1025, 1075, 1125, 1175
- **pme [bar]**: 0, 2, 4, 6, 8
- **gear**: 0, 1, 2, 3, 4, 5
- **L. of total gas. ex. [%]**: 0, 4, 8, 12, 16

**Stratified Operation**
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Conclusion

Split of loss calculation with GT-Drive:
  • Split of loss calculation is very fast and useful for analysing combustion systems
  • Useable on the test bench or based on data coming up with the GT-Power Simulation
  • Split of loss calculation coupled with GT-Drive allows a deep understanding of the different behavior of cars with SI-engines and Diesel engines
  • Powerful Tool to understand where to reduce the fuel consumption in the NEDC