Brake-Performance prediction

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Agenda

▪ Objective of the application
▪ How does the brake system in your cars work?
▪ Performance curves
▪ MATLAB application
▪ Problems resolved
Objective

- To create a standalone application for predicting the brake performance curves.

- This application will:
  - Take input vehicle parameters from the user
  - Process the data and generate performance graphs
  - Tabulate the data against regulations
  - Generate a final report of the system

- Decide the brakes system design parameters
How does the brake system in your cars work?

- Energy source - muscular effort vacuum booster
- Modulation system - to control brake force
- Transmission system - brake tubes, brake hoses (flexible tubes)
- Foundation brakes – calipers, drums

Image source: [http://vnc.thewpp.ca/stuff/bentley/ep0nicks.ctech.ca/vw/eva2/SU02/ch1.1.html](http://vnc.thewpp.ca/stuff/bentley/ep0nicks.ctech.ca/vw/eva2/SU02/ch1.1.html)
Performance curves

1. Adhesion utilization vs deceleration

- Adhesion utilization is equivalent to coefficient of friction
- Relates the maximum wheels-unlocked deceleration to the lowest tire-road friction coefficient with which the deceleration can be achieved without locking of any brakes.

2. Braking forces diagram

- Relates the braking forces on the front and rear wheels
- Ideal braking curve
- Actual braking curve
- Constant deceleration lines
3. Booster characteristics curve

- Relates output force from booster with the input force
- Key points in booster:
  - Jump-in pressure
  - Boost ratio
  - Knee-point pressure

Image source: http://nupet.daelt.ct.utfpr.edu.br/_ontomos/paginas/AMESim4.2.0/demo/Applications/Braking/Braking.htm
MATLAB application

Process workflow

Screen 1 • Choice between X split and H split vehicles

Screen 2 • Menu for performance selection (ex. Parking brake, Booster characteristics, Brake performance prediction)

Screen 3 • Data collection from the user

Screen 4 • Graph window with plot options

Screen 5 • Output values table

Screen 6 • Regulations comparison table

Final • Report
Tools used: MATLAB, GUI, Report Generator toolbox
- For LSPV vehicles, cut-in point taken as input from user
- For ABS vehicles, actual forces follow optimal curve after critical deceleration
Data screen of the application

- Default values in the window
- Drop-down menu for LSPV and ABS modules
- Dynamic GUI based on option selection from drop-down menu
Display of graph is instant – earlier application took 174 seconds to display all the graphs
Comparison of data for unladen and laden conditions
Representative diagram of braking forces

- Values at particular points can be easily obtained
- Graphs can be printed from this menu
Critical values in a tabular column
Comparison with regulations ECE13 and ECE13H
Problems resolved

- Inclusion of ABS logic
- Fast execution time (close to 1.5 s for graph generation)
- Distribution of standalone executable files with user access
- Successful report generation
- Modules for each and every section – code modifications
- Data values at every point of the graph
- Dynamic GUI
- Easy-to-interact interface
Thank you

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