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MH01AH2743

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

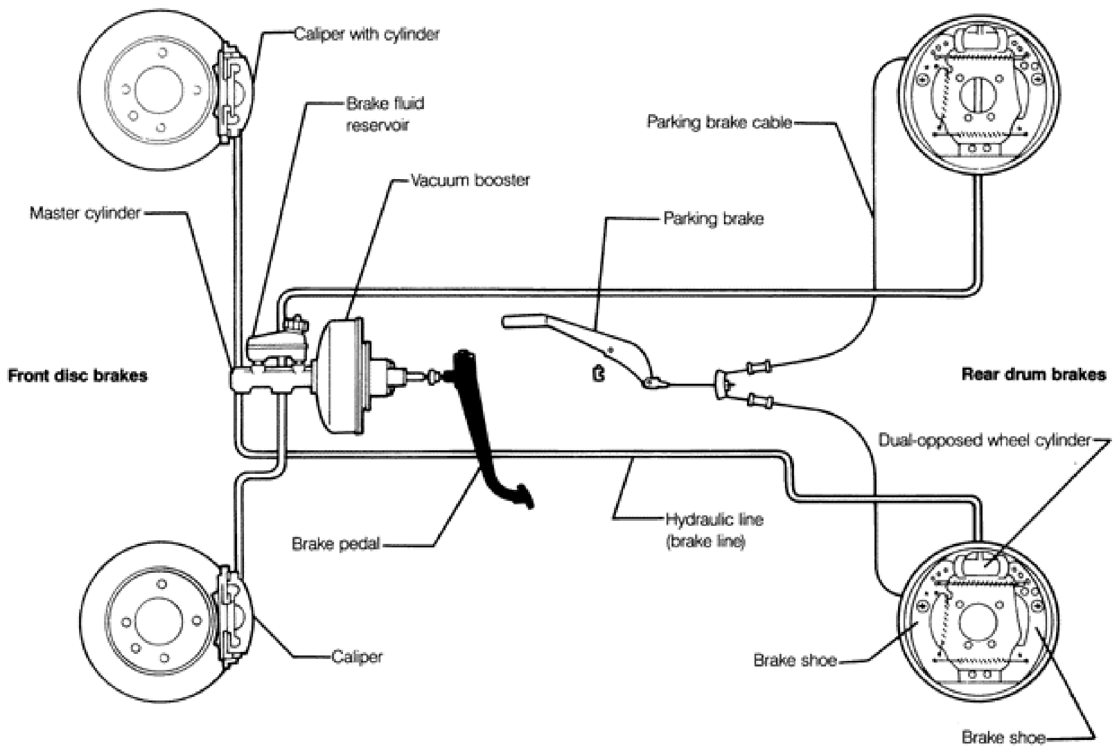
Objective

- 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?

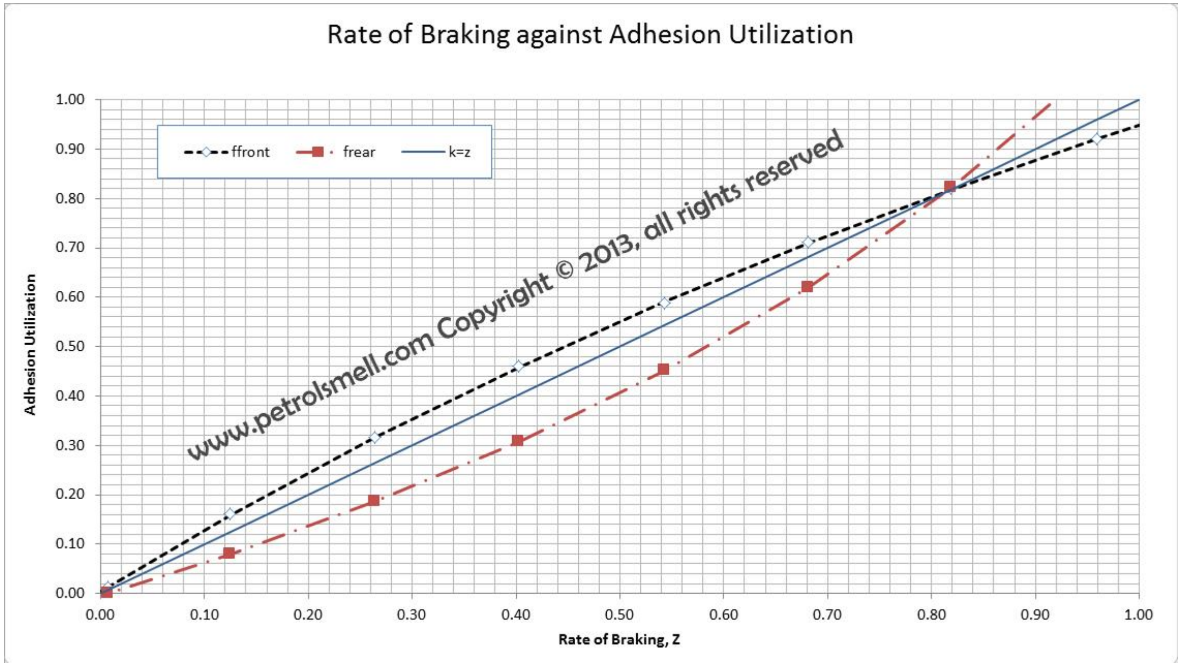


- Energy source - muscular effort vacuum booster
- Modulation system - to control brake force
- Transmission system - brake tubes, brake hoses(flexible tubes)
- Foundation brakes – calipers, drums

Image source : http://vnc.thewpp.ca/stuff/bentley/ep0niks.ctech.ca/vw/eva2/SU02/ch1.1.html

Performance curves

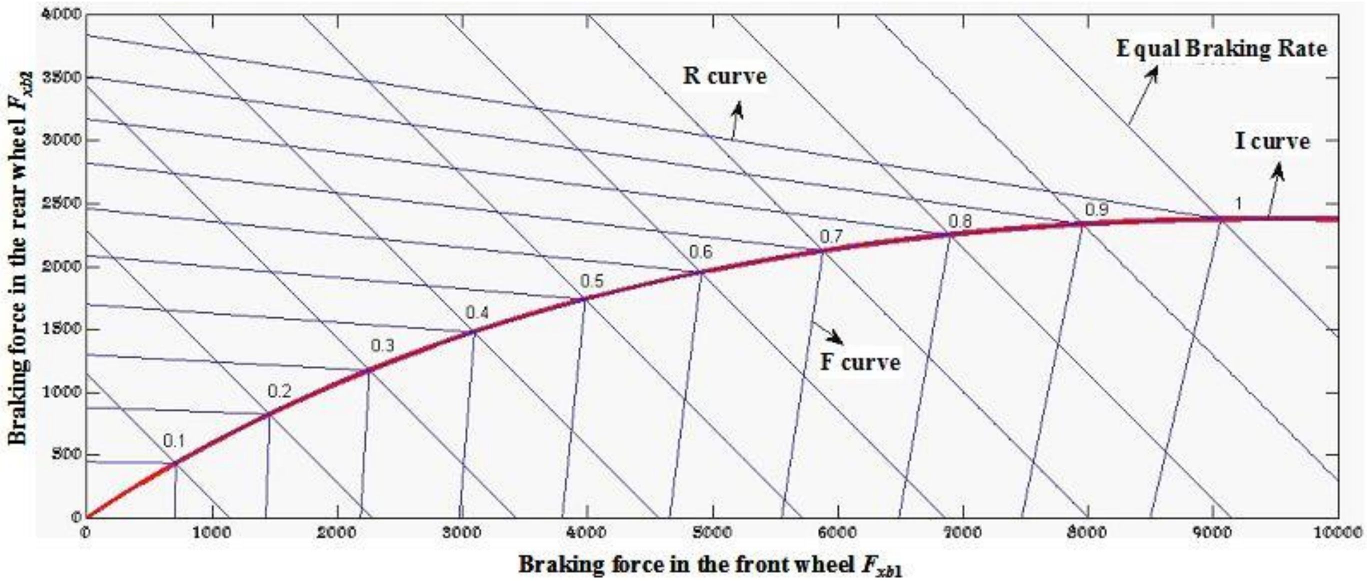
1. Adhesion utilization vs deceleration



- 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.

Image source: http://petrolsmell.com/2013/03/09/relationship-between-the-adhesion-utilisation-and-the-rate-of-braking/

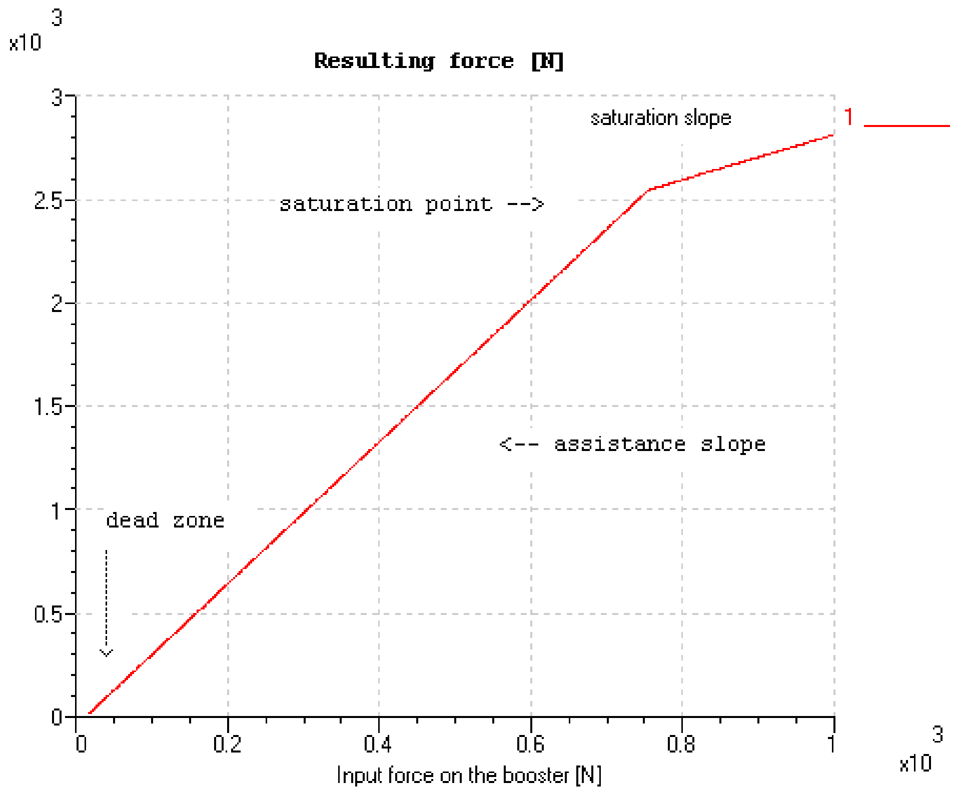
2. Braking forces diagram



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

Image source: https://www.intechopen.com/source/html/41424/media/image7_w.jpg

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

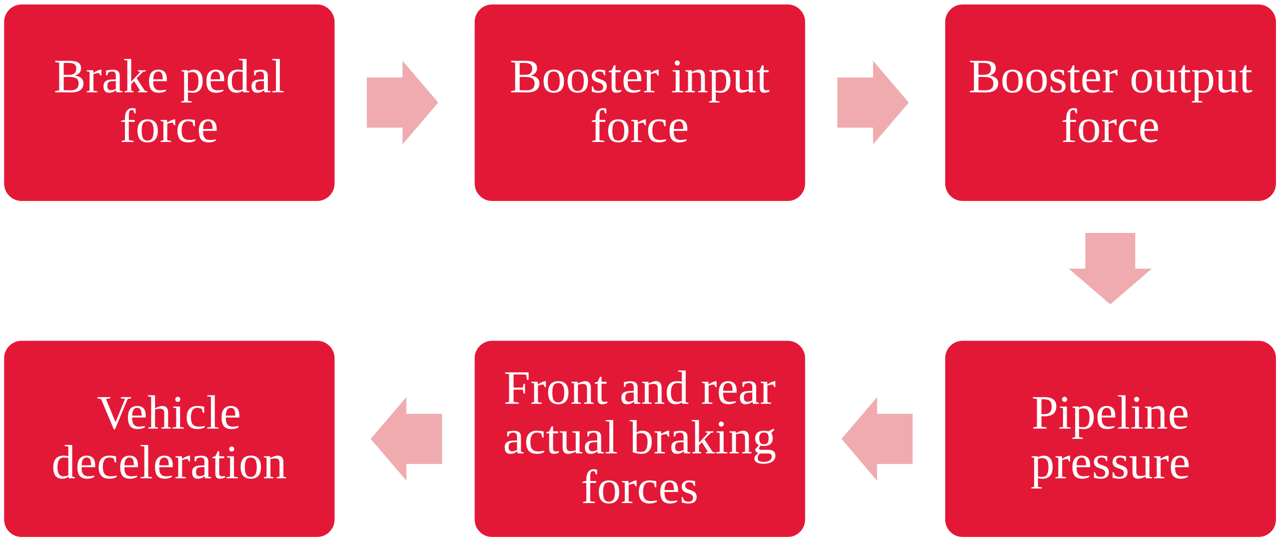
Image source: http://nupet.daelt.ct.utfpr.edu.br/_ontomos/paginas/AMESim4.2.0/demo/Applications/Braking/Braking.htm

MATLAB application

Process workflow

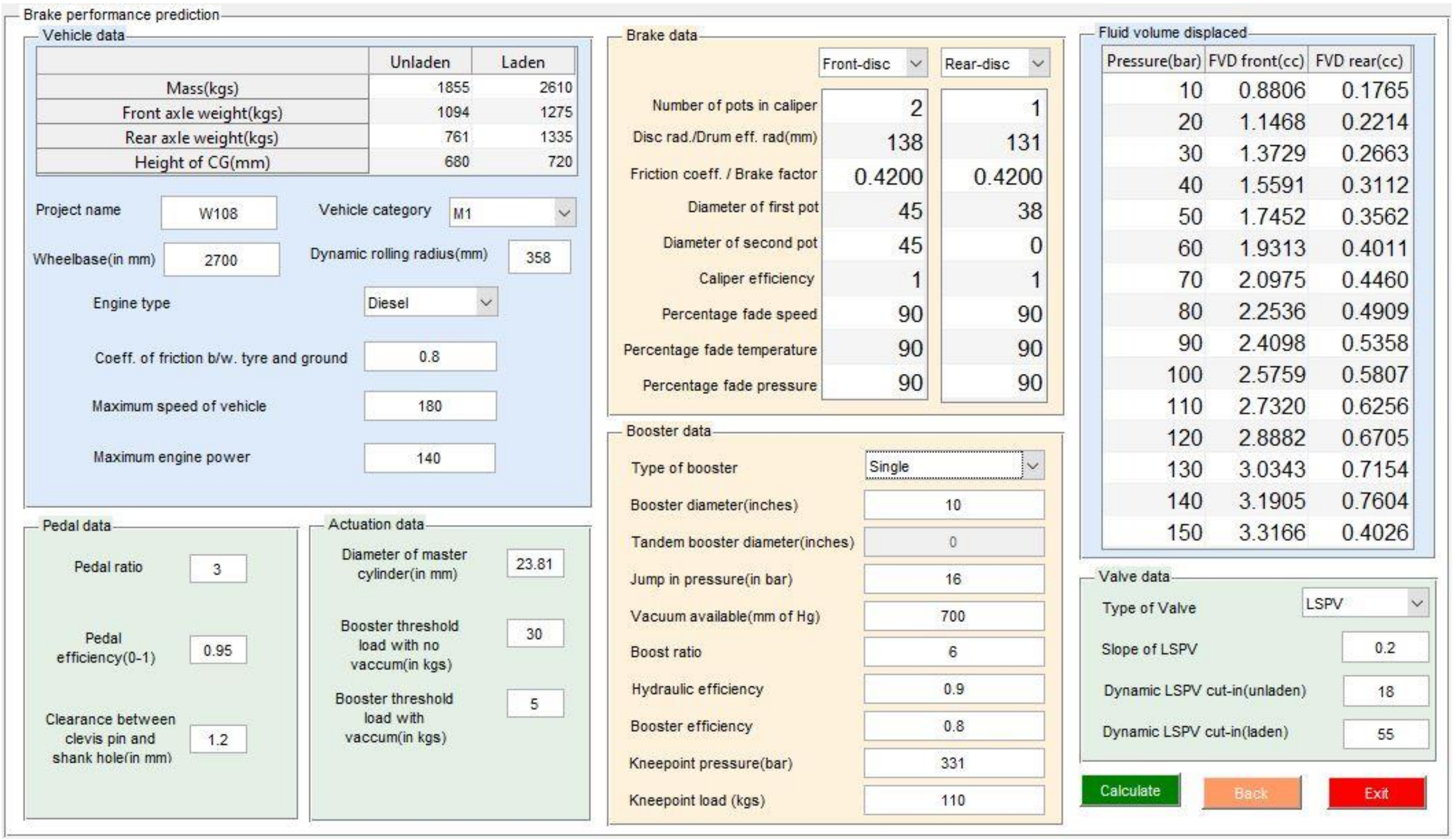
- **Screen 1**
  - Choice between X split and H split vehicles
- **Screen 2**
  - Menu for performance selection(ex. Parking brake, Booster characteristics, Brake performance prediction)
- **Screen 3**
  - Data collection from the user
- **Screen 4**
  - Graph window with plot options
- **Screen 5**
  - Output values table
- **Screen 6**
  - Regulations comparison table
- **Final**
  - Report

Calculation methodology



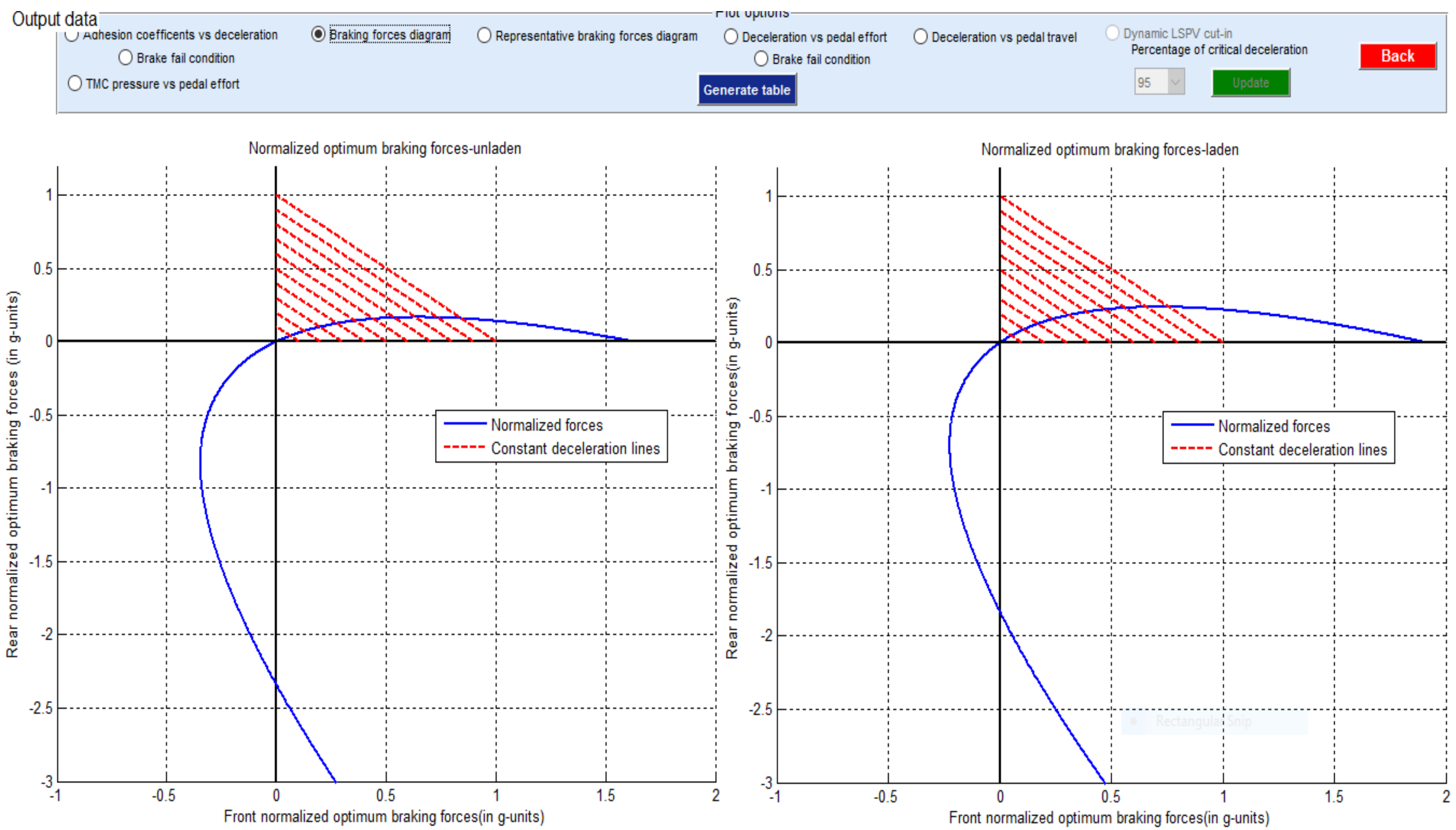
- Tools used: MATLAB, GUI, Report Generator toolbox
- For LSPV vehicles, cut-in point taken as input from user
- For ABS vehicles, actual forces follow optimal curve after critical deceleration

Data screen of the application



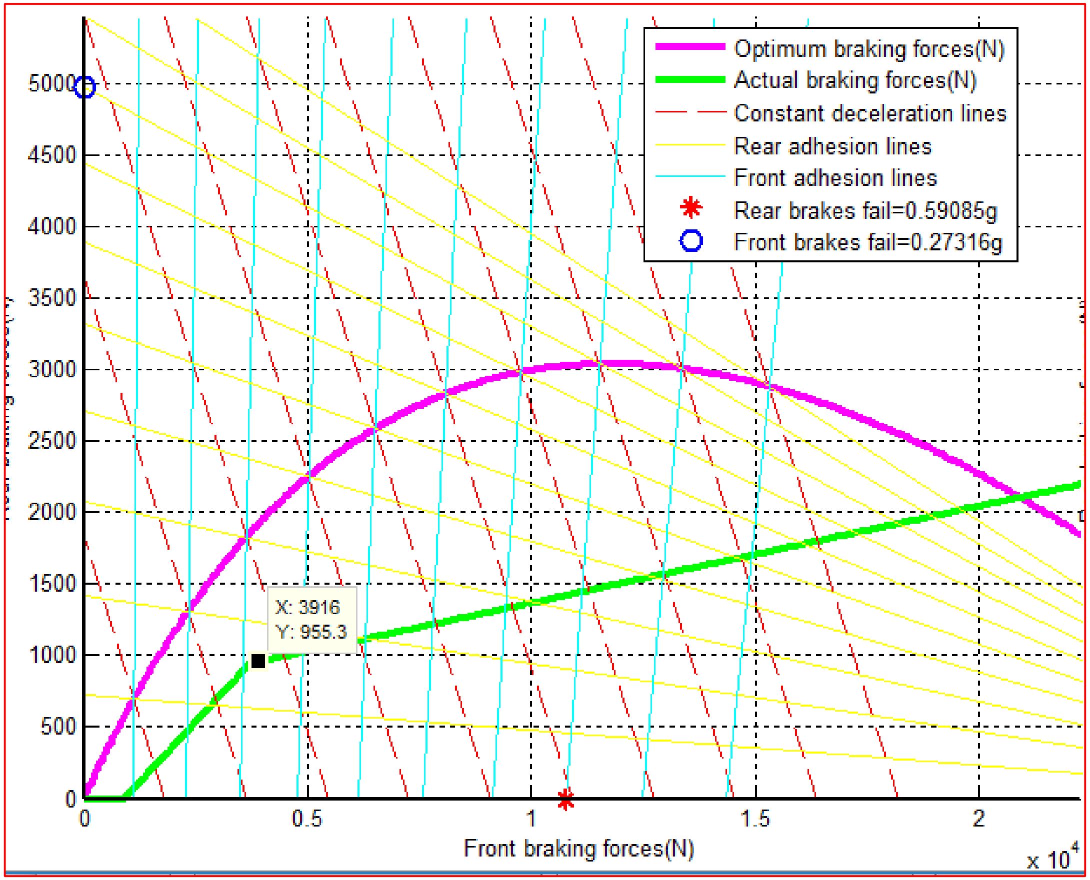
- Default values in the window
- Drop-down menu for LSPV and ABS modules
- Dynamic GUI based on option selection from drop-down menu

Graph screen



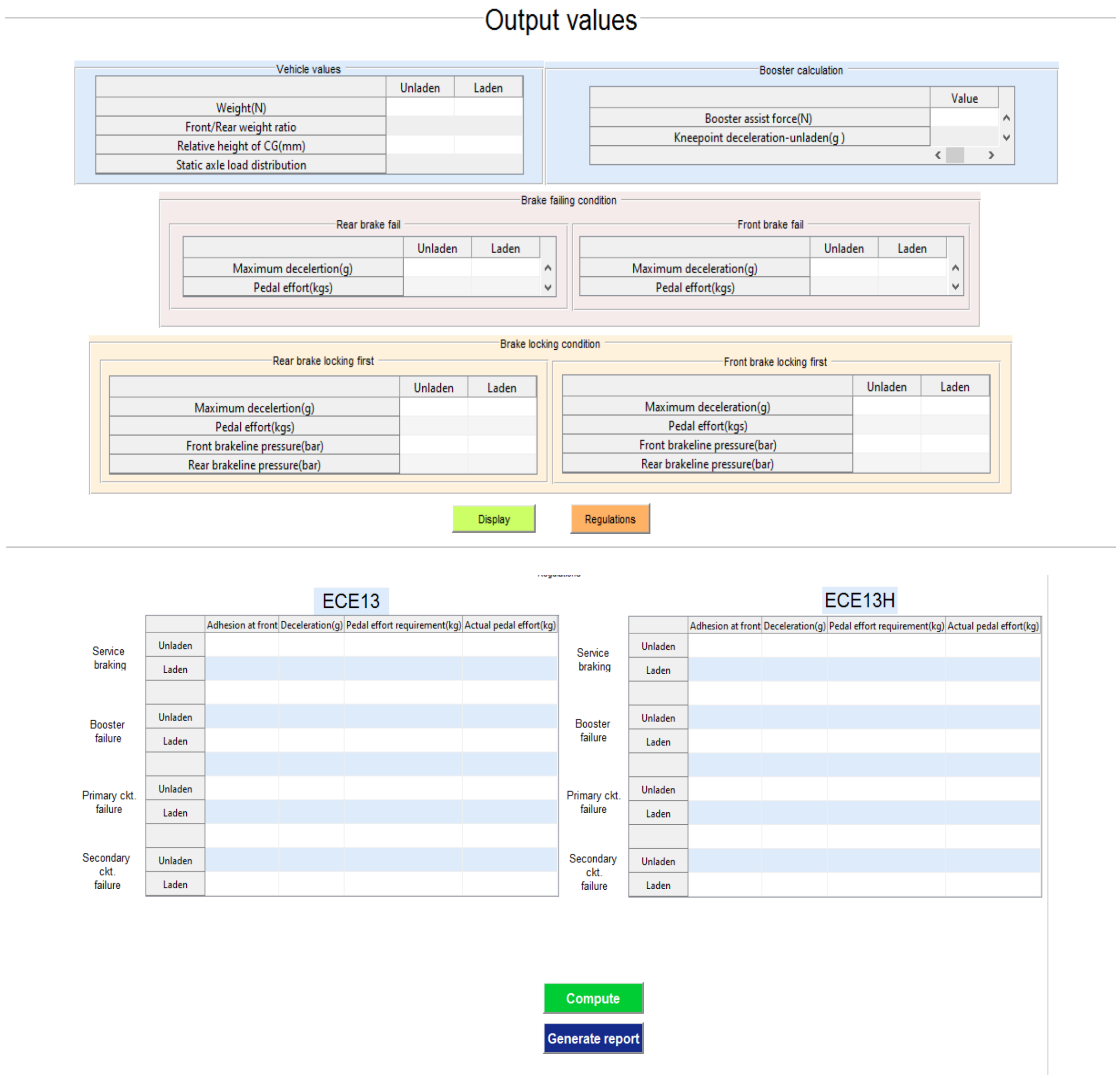
- Display of graph is instant – earlier application took 174 seconds to display all the graphs
- Comparison of data for unladen and laden conditions

Representative diagram of braking forces



- Values at particular points can be easily obtained
- Graphs can be printed from this menu

Output values screen



- 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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