Scilab case study project on

Scilab GUI for Analytical Design and Performance Evaluation of an Automotive Disc Brake

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Abstract

This case study presents the development of a Scilab GUI dashboard for the analytical design and performance evaluation of an automotive disc brake. The work is based on the analytical equations and design guidelines presented in the IEEE paper titled "The Disc Brake Design and Performance Analysis." The dashboard calculates important parameters such as recommended disc-diameter range, disc-thickness check, brake-pad area and radius, hydraulic-cylinder area, clamping force, braking torque, maximum pad pressure, final disc temperature, synchronization coefficient, braking time, and front and rear specific energy dissipation rates. The analytical model is implemented in a separate Scilab file, while the GUI is used to enter inputs, display results, check the design conditions, and generate performance plots. The implementation is limited to analytical calculations and GUI-based evaluation; Pro/E modelling, ANSYS analysis, and experimental validation are not included.

1. Introduction

A disc brake is one of the most widely used braking systems in modern automobiles. It works by pressing brake pads against a rotating disc connected to the wheel. Due to the friction between the brake pads and the disc, the kinetic energy of the moving vehicle is converted into heat energy, and the vehicle speed is reduced. Disc brakes are commonly preferred because of their better heat dissipation, stable braking performance, compact construction, and faster response compared with conventional drum brakes.

The design of an automotive disc brake involves several important parameters such as disc diameter, disc thickness, brake-pad area, hydraulic pressure, friction coefficient, effective braking radius, braking torque, pad pressure, temperature rise, and energy dissipation rate. These parameters are related to each other, and a change in one parameter can affect the overall braking performance. Therefore, analytical calculations are useful during the preliminary stage of brake design to estimate whether the selected dimensions and operating conditions are within acceptable limits.

The reference paper titled “The Disc Brake Design and Performance Analysis” presents an analytical design procedure for an automotive disc brake, along with modelling and analysis using Pro/E and ANSYS. In this case study, the analytical part of the paper is implemented in Scilab through a graphical user interface. The dashboard allows the user to enter vehicle and brake parameters, calculate the required design and performance values, check the implemented design conditions, and generate plots to study the effect of important parameters.

The purpose of this case study is to convert the analytical disc-brake design procedure into an interactive Scilab GUI dashboard. The dashboard is intended for preliminary analytical evaluation and educational understanding of disc-brake design. It does not claim complete real-vehicle brake certification, since detailed CAD modelling, finite element analysis, experimental testing, and standard-based validation are outside the present scope.

2. Problem Statement

The design of an automotive disc brake involves several interrelated parameters such as disc diameter, disc thickness, brake-pad area, hydraulic pressure, friction coefficient, effective braking radius, braking torque, maximum pad pressure, temperature rise, and energy dissipation rate. These parameters directly affect the braking performance and thermal behaviour of the brake system. If these values are not selected properly, the brake may produce insufficient braking torque, excessive pad pressure, high temperature rise, or higher energy dissipation at the friction surfaces.

In the selected reference paper, an analytical design procedure is used to calculate the important disc-brake parameters, followed by modelling and analysis using Pro/E and ANSYS. However, carrying out these analytical calculations manually for different input values can be time-consuming and may lead to calculation errors. Also, a fixed numerical calculation does not clearly show how the brake performance changes when parameters such as hydraulic pressure, friction coefficient, disc thickness, initial speed, or rim diameter are varied.

The problem addressed in this case study is to develop a Scilab GUI dashboard that converts the analytical disc-brake design procedure into an interactive calculation tool. The dashboard should allow the user to enter the required vehicle and brake parameters, calculate the design and performance outputs, check the selected values based on the analytical guidelines implemented from the reference paper, and generate performance plots for parameter study.

The aim is to make the analytical design process easier to understand, execute, and compare for different input cases. The dashboard provides a preliminary analytical evaluation only. It does not include Pro/E modelling, ANSYS structural or thermal analysis, experimental testing, ABS modelling, tyre-road adhesion modelling, or complete vehicle-level brake certification.

3. Basic Concepts Related to the Topic

A disc brake is a friction braking system used to reduce or stop the motion of a vehicle. In this system, a brake disc is connected to the wheel and rotates along with it. When the brake pedal is applied, hydraulic pressure is generated in the braking system. This pressure acts on the piston inside the brake caliper and produces a clamping force. The brake pads are pressed against both sides of the rotating disc, and the friction between the pads and the disc produces braking torque. This braking torque opposes the rotation of the wheel and reduces the vehicle speed.

The main working principle of a disc brake is the conversion of kinetic energy into heat energy. When the vehicle is moving, it possesses kinetic energy due to its mass and velocity. During braking, this kinetic energy is converted into heat at the contact region between the brake pads and the disc. Therefore, the thermal behaviour of the brake disc is an important part of brake design.

The important components and parameters involved in the analytical design of a disc brake are described below.

3.1 Brake Disc

The brake disc is the rotating member of the disc-brake system. It is usually made of cast iron or steel because these materials have good strength, wear resistance, and thermal capacity. The disc diameter and disc thickness are important design parameters. A larger disc diameter increases the effective braking radius and can help in producing higher braking torque. Disc thickness affects the mass of the disc and its ability to absorb heat during braking.

In the implemented dashboard, the recommended disc-diameter range is calculated using the rim diameter based on the guideline adopted in the reference paper.

$$\begin{gathered} \mathbf{Dmin = 0.70\ Dr} \\ \mathbf{Dmax = 0.79\ Dr} \end{gathered} \tag{1}$$

where **Dmin** is the minimum recommended disc diameter, **Dmax** is the maximum recommended disc diameter, and **Dr** is the rim diameter.

3.2 Brake Pads

Brake pads are the friction elements that press against the brake disc. The brake-pad area affects contact pressure, heat generation, and wear behaviour. If the pad area is too small, the pressure on the pad may become high and can increase wear. If the pad area is too large, the brake assembly may become bulky and difficult to package.

In the implemented analytical model, the brake-pad area range is calculated from the vehicle mass using the pad loading guideline followed in the reference paper.

$$\mathrm{Amin} = \mathrm{ma} / 3.5$$
$$\mathrm{Amax} = \mathrm{ma} / 1.6 \tag{2}$$

where **ma** is the vehicle mass, **Amin** is the minimum recommended brake-pad area, and **Amax** is the maximum recommended brake-pad area.

3.3 Hydraulic Pressure and Clamping Force

The braking system uses hydraulic pressure to transfer pedal force to the brake caliper. The hydraulic pressure acts on the piston area and produces clamping force. This clamping force presses the brake pads against the disc.

The hydraulic-cylinder area is calculated as:

$$\boldsymbol{A_c = \frac{\pi d^2}{4}} \tag{3}$$

The clamping force is calculated as:

$$\boldsymbol{F_c = P A_c} \tag{4}$$

where $\boldsymbol{A_c}$ is the hydraulic-cylinder area, $\boldsymbol{d}$ is the cylinder diameter, $\boldsymbol{P}$ is the hydraulic pressure, and $\boldsymbol{F_c}$ is the clamping force.

3.4 Braking Torque

Braking torque is the torque that opposes the rotation of the wheel. It depends on the coefficient of friction, clamping force, and effective braking radius. Higher hydraulic pressure, larger piston diameter, higher friction coefficient, or larger effective radius can increase the braking torque.

The braking torque is calculated as:

$$M = \mu F_c R \tag{5}$$

where $\boldsymbol{M}$ is the braking torque, $\boldsymbol{\mu}$ is the coefficient of friction, $\boldsymbol{F_c}$ is the clamping force, and $\boldsymbol{R}$ is the effective braking radius.

3.5 Pad Pressure

Pad pressure is the pressure acting on the brake-pad surface during braking. It is an important parameter because excessive pad pressure can increase wear and may affect braking performance. In this case study, the maximum pad pressure is calculated using the pad arm coefficient and hydraulic pressure relation followed in the reference paper.

The pad arm coefficient is calculated as:

$$\beta_p = \frac{2\left[R^2 - \left(\frac{r_1}{2}\right)^2\right]}{R^2 + \left[R^2 - \left(\frac{r_1}{2}\right)^2\right]} \tag{6}$$

The maximum pad pressure is calculated as:

$$P_H = \beta_p \frac{R}{R - \frac{r_1}{2}} \frac{d^2}{r_1^2} P \tag{7}$$

where $\boldsymbol{\beta_p}$ is the pad arm coefficient, $\boldsymbol{P_H}$ is the maximum pad pressure, $\boldsymbol{R}$ is the effective braking radius, $\boldsymbol{r_1}$ is the equivalent brake-pad radius, $\boldsymbol{d}$ is the cylinder diameter, and $\boldsymbol{P}$ is the hydraulic pressure.

3.6 Braking Energy and Disc Temperature

When a vehicle is stopped from a given speed, its kinetic energy is converted mainly into heat energy. In the simplified analytical model, this braking energy is assumed to be absorbed by the brake disc for estimating the temperature rise.

The braking energy is calculated as:

$$E = 0.5\, ma\, v^2 \tag{8}$$

The mass of the disc is calculated as:

$$\boldsymbol{m_d} = \frac{\boldsymbol{\rho \pi D^2 B}}{\boldsymbol{4}} \tag{9}$$

The final disc temperature is estimated as:

$$\boldsymbol{T_f} = \boldsymbol{T_i} + \frac{\boldsymbol{E}}{\boldsymbol{m_d c_p}} \tag{10}$$

where $\boldsymbol{E}$ is the braking energy, $\boldsymbol{ma}$ is the vehicle mass, $\boldsymbol{v}$ is the initial velocity, $\boldsymbol{m_d}$ is the disc mass, $\boldsymbol{\rho}$ is the density of the disc material, $\boldsymbol{D}$ is the disc diameter, $\boldsymbol{B}$ is the disc thickness, $\boldsymbol{c_p}$ is the specific heat, $\boldsymbol{T_i}$ is the initial temperature, and $\boldsymbol{T_f}$ is the final disc temperature.

This temperature calculation gives a preliminary estimate of the thermal behaviour of the disc during braking.

3.7 Braking Time

Braking time is the time required to reduce the vehicle speed during braking. In the implemented model, braking time is calculated using the initial speed and the assumed deceleration.

$$\boldsymbol{t} = \frac{\boldsymbol{v}}{\boldsymbol{a}} \tag{11}$$

where $\boldsymbol{t}$ is the braking time, $\boldsymbol{v}$ is the initial vehicle speed, and $\boldsymbol{a}$ is the braking deceleration.

3.8 Braking Force Distribution and Synchronization Coefficient

In a vehicle, braking force is distributed between the front and rear wheels. This distribution is important because the load on the front and rear axles changes during braking. The synchronization coefficient is used to represent the relation between braking-force distribution and vehicle geometry.

The synchronization coefficient is calculated as:

$$\phi_0 = \frac{\beta L - L_2}{h_g} \tag{12}$$

where β is the front braking-force ratio, L is the wheelbase, L_2 is the distance of the centre of gravity from the rear axle, and h_g is the height of the centre of gravity.

3.9 Specific Energy Dissipation Rate

Specific energy dissipation rate represents the energy dissipated per unit friction area per unit time. It is used to evaluate the energy load on the brake pads. Higher energy dissipation can increase pad wear and thermal loading.

The front and rear specific energy dissipation rates are calculated as:

$$e_1 = \frac{\beta E}{tA_1}$$

$$e_2 = \frac{(1-\beta)E}{tA_2} \tag{13}$$

where e_1 and e_2 are the front and rear specific energy dissipation rates, E is the braking energy, t is the braking time, A_1 is the front friction area, and A_2 is the rear friction area.

4. Scope of Implementation

The selected reference paper includes analytical disc-brake design calculations, Pro/E modelling, ANSYS structural analysis, and ANSYS thermal analysis. In this Scilab case study, only the analytical design and performance calculation part is implemented through a GUI dashboard. The scope of implementation is clearly shown in Table 1.

Table 1. Scope of implementation in the present Scilab case study

S. No.	Part of the Reference Paper / Brake Analysis	Implemented in Scilab GUI	Remarks
1	Analytical disc-brake design calculations	Yes	Main equations are implemented in Scilab.
2	Default input case from the reference paper	Yes	Used as the initial validation case.
3	Recommended disc-diameter range calculation	Yes	Calculated using rim diameter.
4	Disc-thickness range checking	Yes	Checked for the selected solid disc.
5	Brake-pad area range calculation	Yes	Calculated using vehicle mass and pad loading guideline.
6	Brake-pad radius calculation	Yes	Calculated from the selected brake-pad area.
7	Hydraulic-cylinder area calculation	Yes	Calculated using cylinder diameter.
8	Clamping-force calculation	Yes	Calculated from hydraulic pressure and cylinder area.
9	Braking-torque calculation	Yes	Calculated using friction coefficient, clamping force, and effective radius.
10	Maximum pad-pressure calculation	Yes	Analytical expression from the reference paper is implemented.
11	Disc-mass calculation	Yes	Calculated using disc diameter, disc thickness, and material density.
12	Braking-energy calculation	Yes	Calculated using vehicle mass and initial speed.
13	Final disc-temperature estimation	Yes	Calculated using braking energy, disc mass, and specific heat.

14	Synchronization coefficient calculation	Yes	Calculated using braking-force distribution and vehicle geometry.
15	Braking-time calculation	Yes	Calculated using initial speed and deceleration.
16	Front and rear specific energy dissipation rates	Yes	Calculated and checked with the implemented limit.
17	Design assessment using analytical checks	Yes	Shows whether the entered values satisfy the implemented criteria.
18	Performance plots for parameter study	Yes	Generated inside the GUI dashboard.
19	Pro/E 3D modelling	No	Not included in the present Scilab implementation.
20	ANSYS structural analysis	No	Not included in the present Scilab implementation.
21	ANSYS thermal analysis	No	Not included in the present Scilab implementation.
22	Experimental testing	No	No physical brake setup is used.
23	Vehicle-level brake certification	No	Outside the scope of this case study.

The design checks implemented in the dashboard are based on the analytical guidelines followed in the reference paper. These checks are summarized in Table 2.

Table 2: Design checks implemented in the dashboard

S. No.	Design Check	Implemented Criterion	Dashboard Output
1	Disc diameter	70% to 79% of rim diameter	WITHIN RANGE / OUTSIDE RANGE
2	Disc thickness	10 mm to 20 mm for selected solid disc	WITHIN RANGE / OUTSIDE RANGE
3	Brake-pad area	Based on pad loading range of 1.6 to 3.5 kg/cm^2	WITHIN RANGE / OUTSIDE RANGE

4	Specific energy dissipation	Front and rear energy rates less than 6 W/mm²	ACCEPTABLE / LIMIT EXCEEDED
5	Overall result	All implemented checks must be satisfied	DESIGN CHECK PASSED / DESIGN REVIEW REQUIRED

The output “DESIGN CHECK PASSED” means that the entered values satisfy the analytical checks implemented in the dashboard. It does not mean complete real-vehicle brake certification. Actual disc-brake design guidelines may vary depending on vehicle type, material selection, company standards, and regulatory requirements. Therefore, the developed dashboard is suitable for preliminary analytical evaluation, educational understanding, and comparison of different input cases.

5. Flowchart

The flowchart represents the working sequence of the developed Scilab GUI dashboard. The GUI program first loads the analytical calculation file, initializes the default values, and displays the dashboard window. The user can either use the default input values taken from the reference paper or modify the input values for another design case. After pressing the Calculate button, the program validates the input values and performs the analytical disc-brake calculations. The calculated results are then displayed in separate sections, and the selected performance graph is generated.

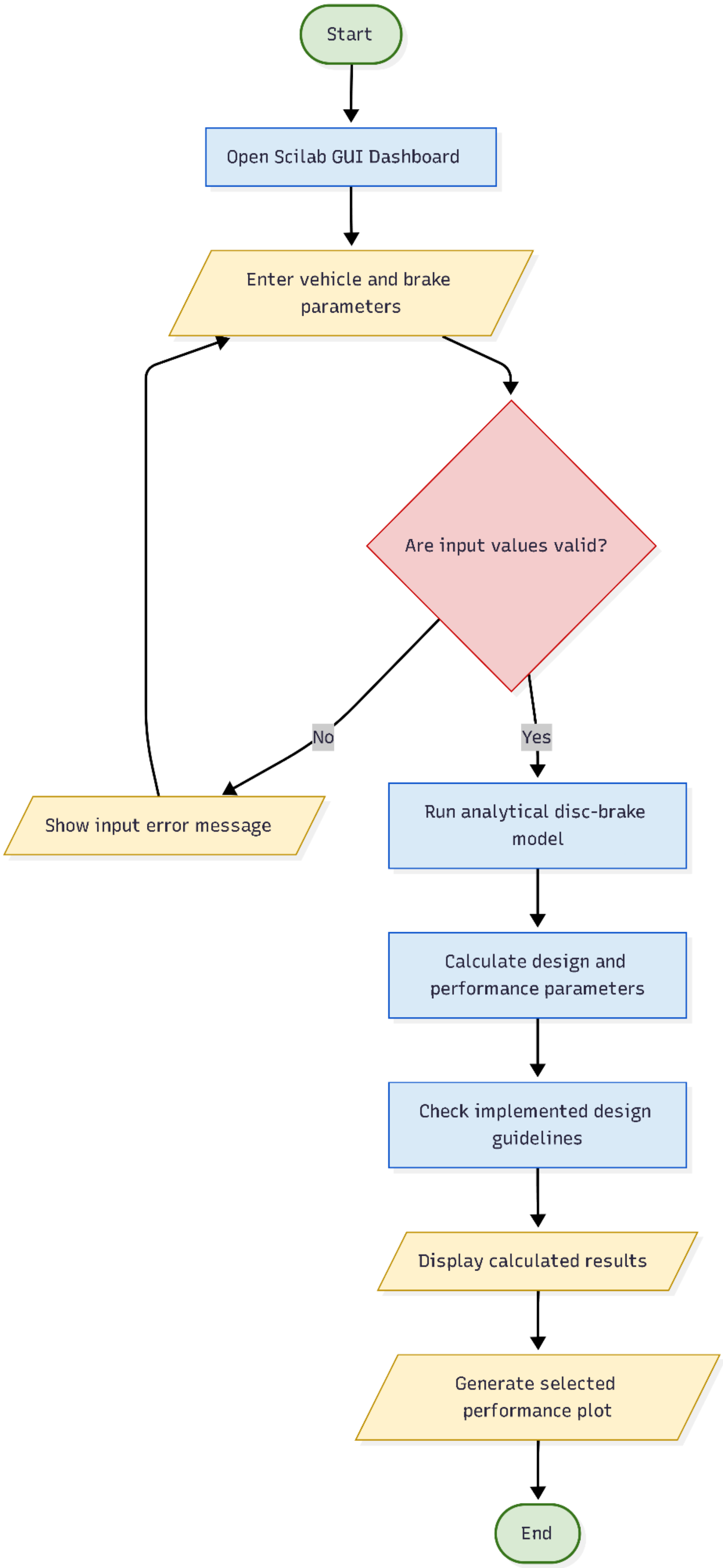

Figure 1: Flowchart of the Scilab GUI dashboard

6. Software/Hardware Used

- Operating System: Windows 11
- Software: Scilab 2026.1.0
- Hardware: Personal laptop/PC with standard processing capability

No physical disc-brake setup, sensors, test rig, or data acquisition system was used in this case study. The disc-brake design and performance evaluation are carried out using analytical equations implemented in Scilab. The GUI dashboard is used for input entry, result calculation, design checking, and performance plotting. Pro/E modelling, ANSYS analysis, and experimental validation are not included in the present implementation.

7. Procedure of Execution

The execution of the case study files can be carried out as follows:

1. Open Scilab 2026.1.0.
2. Open the main project folder named **`Disc_Brake_Analysis_GUI`**.
3. Set the Scilab working directory to the **`Codes`** folder.
4. Open and run the main GUI file: **`Gui.sce`**.
5. The file `Gui.sce` automatically loads the dependency file **`disc_brake_analysis.sci`**.
6. After execution, the Scilab GUI dashboard opens with the default input values.
7. The default values are based on the numerical case used in the reference paper.
8. The user can keep the default values or modify the vehicle and brake parameters in the input section.
9. Click the **Calculate** button to perform the analytical disc-brake calculations.
10. The dashboard displays the calculated outputs under Dimensional Design, Braking and Thermal Results, and Design Assessment.
11. The formula dropdown can be used to view the analytical equations implemented in the dashboard.
12. The graph dropdown can be used to generate performance plots such as torque variation, temperature variation, energy dissipation, and disc-diameter range.
13. The **Reset** button can be used to restore the default input values and clear the previous results.

8. Results

The developed Scilab GUI dashboard was executed using the default input values taken from the reference paper. The dashboard calculates the analytical disc-brake design and performance parameters and displays the results in separate output sections. The output is also compared with the results reported in the reference paper to verify the correctness of the Scilab implementation.

8.1 GUI Dashboard Output

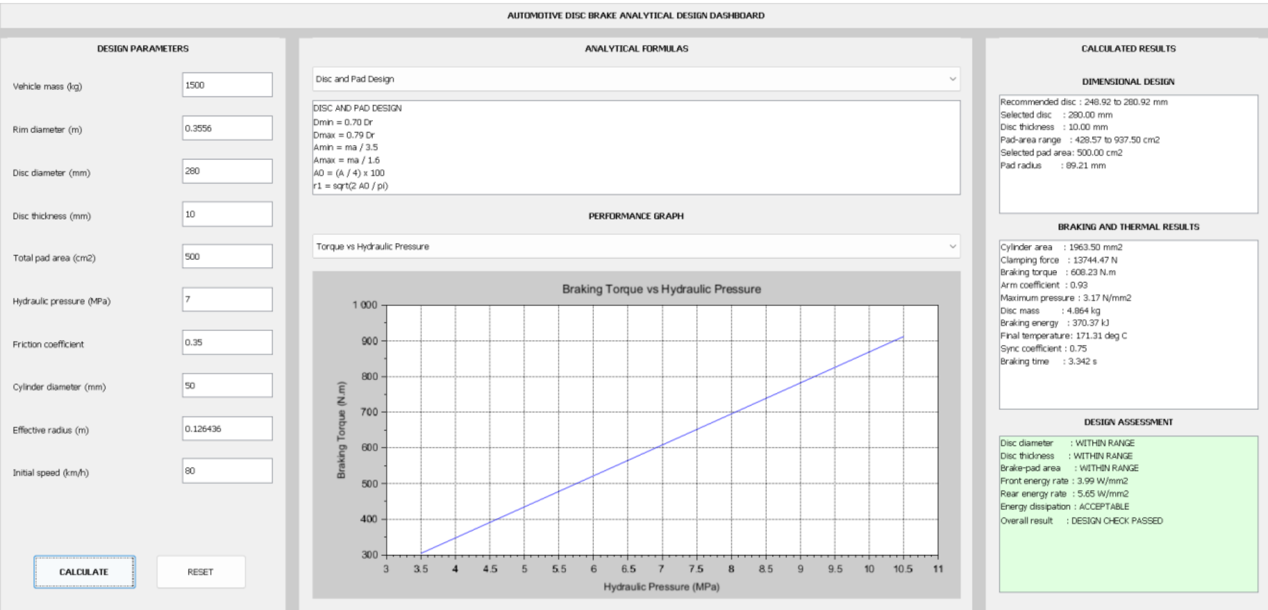

Figure 2: Scilab GUI dashboard after execution with default input values

The GUI dashboard consists of three main sections. The left side contains the input parameters such as vehicle mass, rim diameter, disc diameter, disc thickness, brake-pad area, hydraulic pressure, friction coefficient, cylinder diameter, effective radius, and initial speed. The middle section displays the selected analytical formulas and the performance graph. The right side displays the calculated outputs under Dimensional Design, Braking and Thermal Results, and Design Assessment.

For the default input case, the dashboard displays the recommended disc-diameter range, selected disc diameter, disc thickness, brake-pad area range, pad radius, hydraulic-cylinder area, clamping force, braking torque, maximum pad pressure, disc mass, braking energy, final disc temperature, synchronization coefficient, braking time, and front and rear specific energy dissipation rates. The design assessment shows whether the entered values satisfy the analytical checks implemented from the reference paper guidelines.

8.2 Comparison of Scilab Results with Reference Paper Results

Table 3: Comparison of Scilab GUI results with reference paper results

S. No.	Parameter	Scilab GUI Result	Research Paper Result
1	Recommended disc-diameter range	248.92 to 280.92 mm	248.9 to 280.9 mm
2	Selected disc diameter	280 mm	280 mm
3	Disc thickness	10 mm	10 mm
4	Brake-pad area range	428.57 to 937.50 cm^2	429 to 936 cm^2
5	Selected brake-pad area	500 cm^2	500 cm^2
6	Equivalent brake-pad radius	89.21 mm	89 mm
7	Effective braking radius	0.126436 m	0.1265 m
8	Braking torque	608.23 N·m	608.23 N·m
9	Pad arm coefficient	0.93	0.93
10	Maximum pad pressure	3.17 N/mm^2	3.17 N/mm^2
11	Final disc temperature	171.31 °C	171.3 °C
12	Synchronization coefficient	0.75	0.75
13	Front specific energy dissipation rate	3.99 W/mm^2	3.99 W/mm^2
14	Rear specific energy dissipation rate	5.65 W/mm^2	5.65 W/mm^2

From Table 3, it can be observed that the Scilab GUI results are in close agreement with the analytical results reported in the reference paper. The minor differences in some values are due to rounding of intermediate values and numerical precision used in Scilab. This comparison verifies that the analytical equations have been correctly implemented in the dashboard.

8.3 Performance Graphs

The GUI dashboard also generates performance plots to study the variation of important disc-brake parameters. These plots help in understanding the influence of input parameters on braking torque, temperature rise, energy dissipation, and disc-diameter selection.

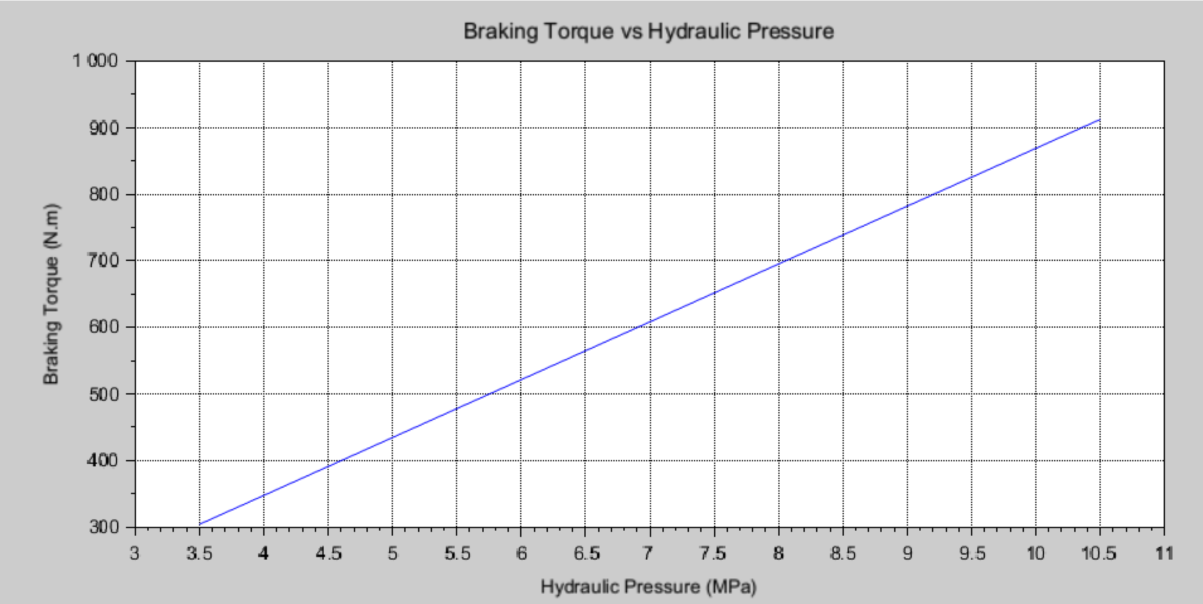

Figure 3: Braking Torque vs Hydraulic Pressure

Figure 3 shows the variation of braking torque with hydraulic pressure. As the hydraulic pressure increases from 3.5 MPa to 10.5 MPa, the braking torque increases almost linearly from about 304 N·m to 912 N·m. This is because the clamping force is directly proportional to the hydraulic pressure, and the braking torque depends on the clamping force.

For the default hydraulic pressure of 7 MPa, the dashboard gives a braking torque of approximately 608.23 N·m, which matches the analytical result obtained from the reference paper. This confirms that the torque calculation has been correctly implemented in the Scilab GUI.

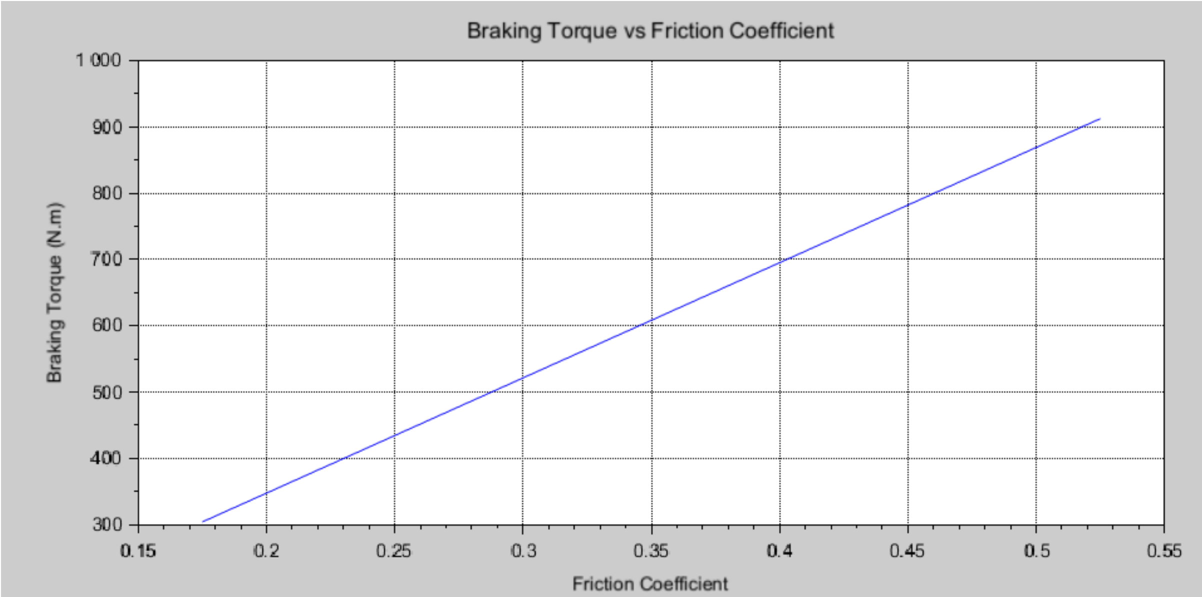

Figure 4: Braking Torque vs Friction Coefficient

Figure 4 shows the variation of braking torque with the coefficient of friction. As the friction coefficient increases from about 0.175 to 0.525, the braking torque increases almost linearly from about 304 N·m to 912 N·m. This linear trend occurs because braking torque is directly proportional to the coefficient of friction.

For the default friction coefficient of 0.35, the dashboard gives a braking torque of approximately 608.23 N·m. This confirms that the implemented analytical model correctly calculates the effect of friction coefficient on braking torque for the selected hydraulic pressure, cylinder diameter, and effective braking radius.

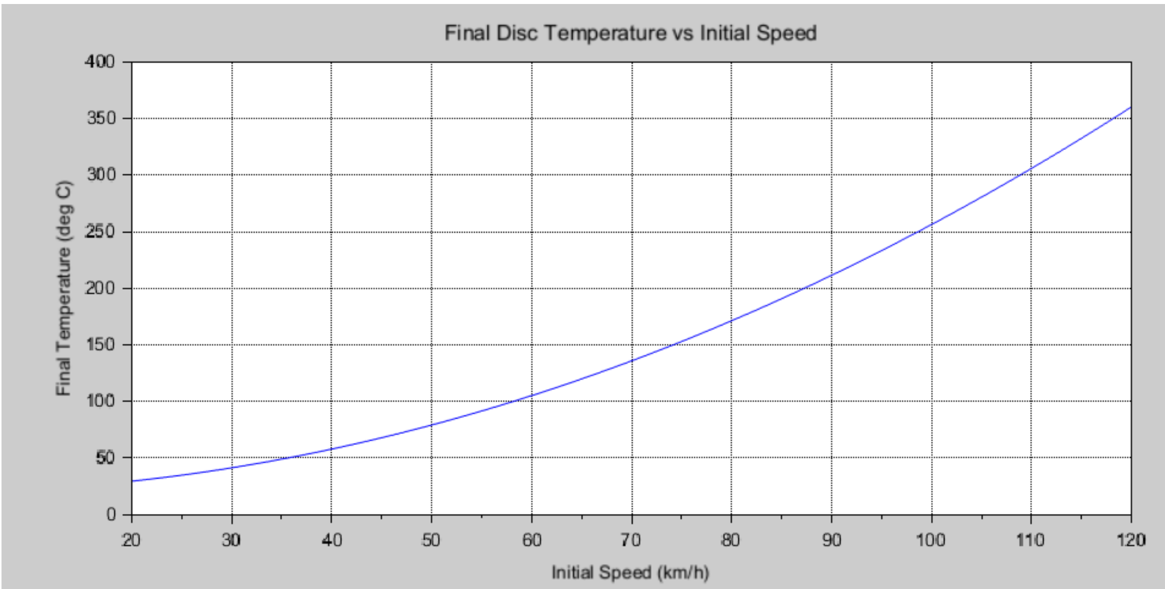

Figure 5: Final Disc Temperature vs Initial Speed

Figure 5 shows the variation of final disc temperature with initial vehicle speed. As the initial speed increases from 20 km/h to 120 km/h, the final disc temperature increases rapidly. The curve is nonlinear because the braking energy depends on the square of the vehicle speed.

For the default speed of 80 km/h, the dashboard gives a final disc temperature of approximately 171.31 °C. This value matches closely with the analytical result reported in the reference paper. The graph shows that vehicle speed has a strong influence on the thermal behaviour of the brake disc, and higher speeds can produce a significant temperature rise during braking.

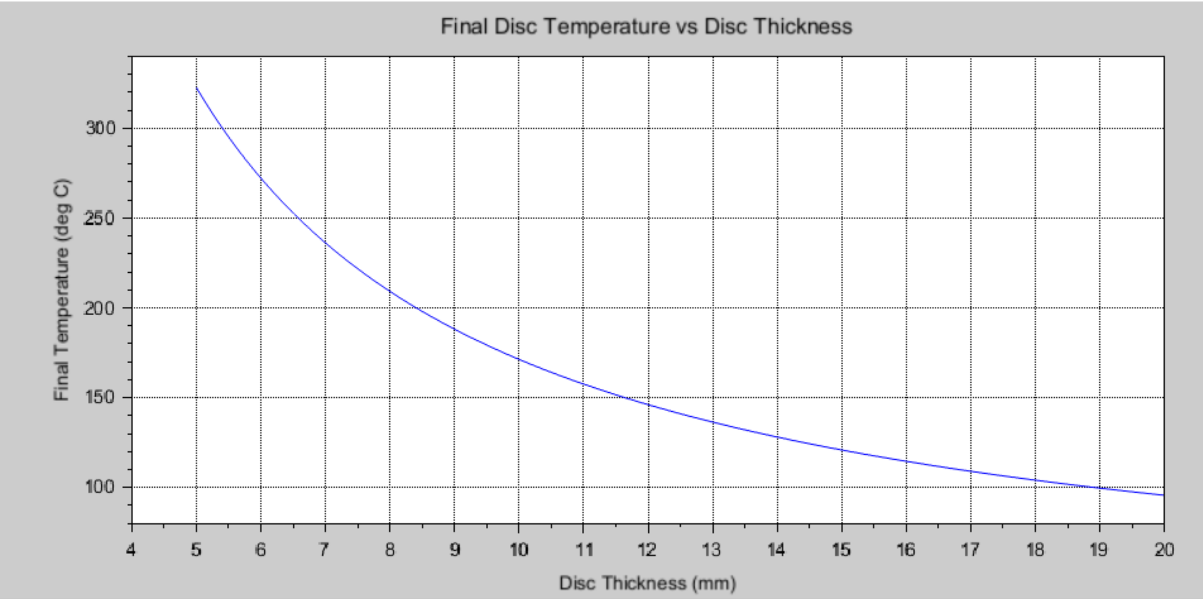

Figure 6: Final Disc Temperature vs Disc Thickness

Figure 6 shows the variation of final disc temperature with disc thickness. As the disc thickness increases from 5 mm to 20 mm, the final disc temperature decreases. This happens because increasing the disc thickness increases the mass of the brake disc, and a higher disc mass can absorb more braking energy with a lower temperature rise.

For the default disc thickness of 10 mm, the dashboard gives a final disc temperature of approximately 171.31 °C, which matches closely with the analytical result reported in the reference paper. This graph shows that disc thickness has an important effect on the thermal behaviour of the brake disc.

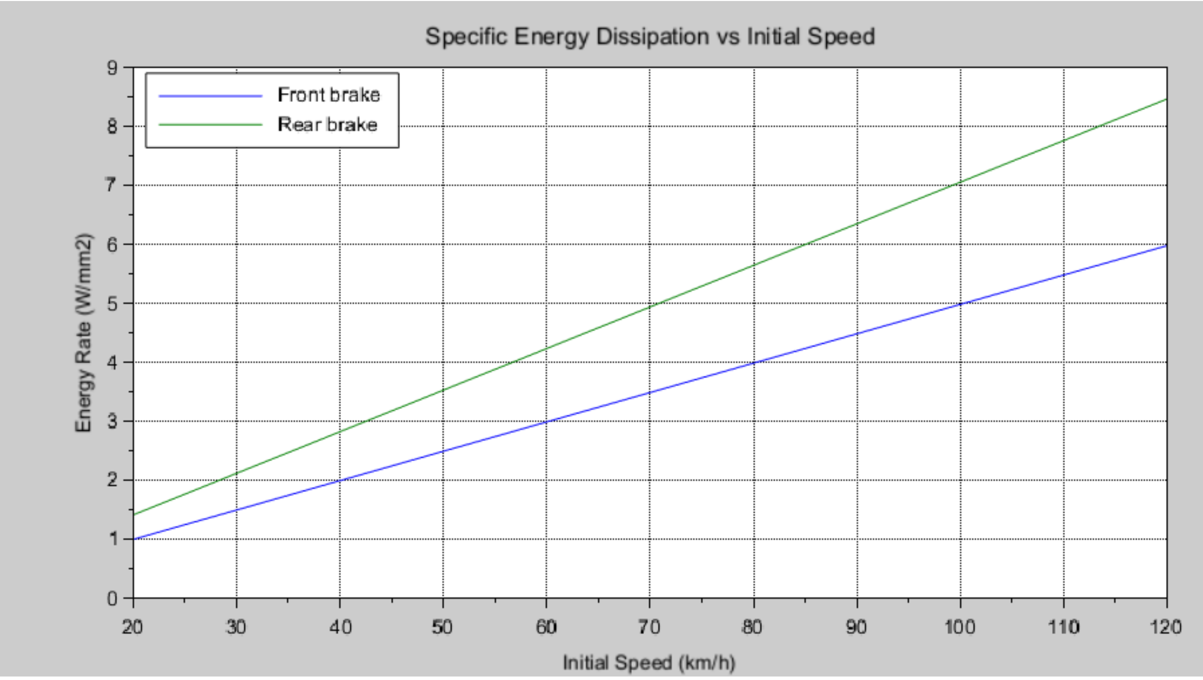

Figure 7: Specific Energy Dissipation vs Initial Speed

Figure 7 shows the variation of front and rear specific energy dissipation rates with initial vehicle speed. As the initial speed increases from 20 km/h to 120 km/h, both front and rear energy dissipation rates increase. This happens because the braking energy increases with vehicle speed, and a higher braking energy increases the energy load on the brake-pad friction surfaces.

For the default speed of 80 km/h, the dashboard gives a front energy dissipation rate of approximately 3.99 W/mm^2 and a rear energy dissipation rate of approximately 5.65 W/mm^2. Both values are below the implemented limit of 6 W/mm^2, so the energy dissipation condition is acceptable for the default case. The graph also shows that the rear brake has a higher specific energy dissipation rate than the front brake because the rear friction area used in the calculation is smaller.

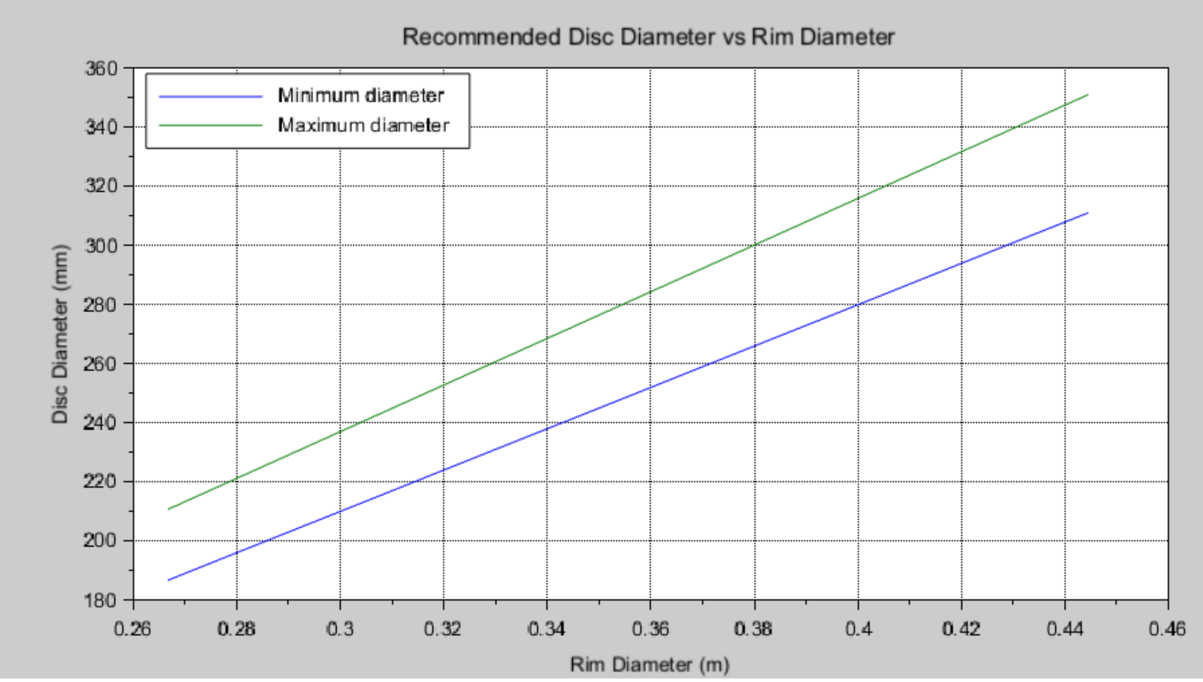

Figure 8: Recommended Disc Diameter vs Rim Diameter

Figure 8 shows the recommended brake-disc diameter range with respect to rim diameter. Both the minimum and maximum recommended disc diameters increase linearly as the rim diameter increases. This is because the implemented analytical guideline selects the disc diameter as a fixed percentage of the rim diameter.

For the default rim diameter of 0.3556 m, the dashboard calculates the recommended disc-diameter range as approximately 248.92 mm to 280.92 mm. The selected disc diameter of 280 mm lies within this range, so the disc-diameter condition is satisfied for the default case. This graph helps the user understand how the allowable disc-diameter range changes when a different rim size is selected.

9. Conclusion

In this case study, a Scilab GUI dashboard was developed for the analytical design and performance evaluation of an automotive disc brake. The analytical equations and design guidelines used in the dashboard are based on the reference paper titled "The Disc Brake Design and Performance Analysis." The GUI allows the user to enter vehicle and brake parameters, perform analytical calculations, display the results in organized sections, check the implemented design conditions, and generate performance plots.

The developed dashboard calculates important parameters such as recommended disc-diameter range, brake-pad area, hydraulic-cylinder area, clamping force, braking torque, maximum pad pressure, final disc temperature, synchronization coefficient, braking time, and front and rear specific energy dissipation rates. The results obtained from the Scilab GUI are in close agreement with the analytical values reported in the reference paper, which verifies the correctness of the implementation.

The generated plots show the effect of hydraulic pressure, friction coefficient, initial speed, disc thickness, and rim diameter on disc-brake performance. These plots make the dashboard useful for preliminary study and comparison of different input cases. The work is limited to analytical calculations and GUI-based implementation in Scilab. Pro/E modelling, ANSYS structural and thermal analysis, experimental validation, and complete vehicle-level brake certification are not included in the present case study.

10. References

[1] "The Disc Brake Design and Performance Analysis," IEEE Xplore, https://ieeexplore.ieee.org/document/5768733

[2] "Scilab Spoken Tutorials," Spoken Tutorials, https://scilab.in/spoken-tutorial