Modeling and simulation the resistance torque for specific wheel alignment in the Electric Power Steering system by using Matlab/Simulink and its application.

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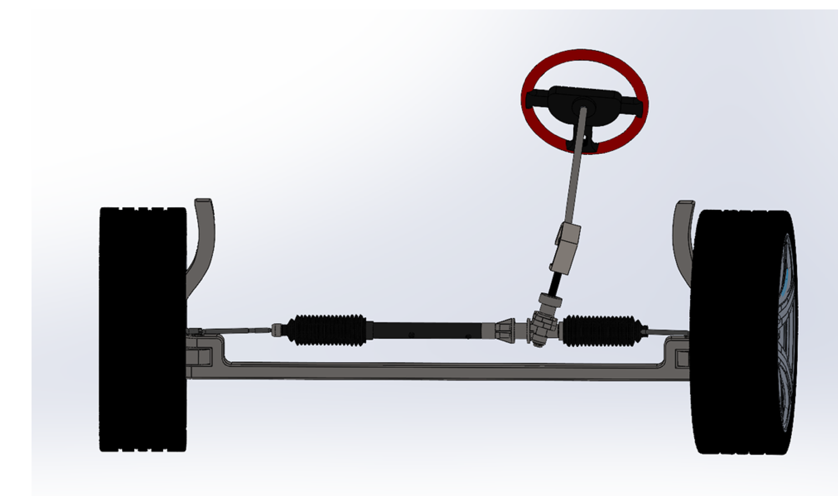


1 Abstract:

Vehicle steering dynamics is an essential topic in development of safety driving systems. These complex and integrated control units require precise information about vehicle steering dynamics, especially, tire/road contact forces. In the term of interaction between tyre force and road surface, we are going to primarily focus on the total resistance moment which is the factor torque that urges the tyres to steer. This resistance moment that causes this will be described in below when considering the mass of vehicle, wheel alignment, lateral force generation, longitudinal force generation and normal force generation. Through this Capstone project, this torque will be fully showed with the theoretically corresponding equation and combine with the result diagrams by using Matlab/Simulink software.

2 Objectives, scope and mission summary:

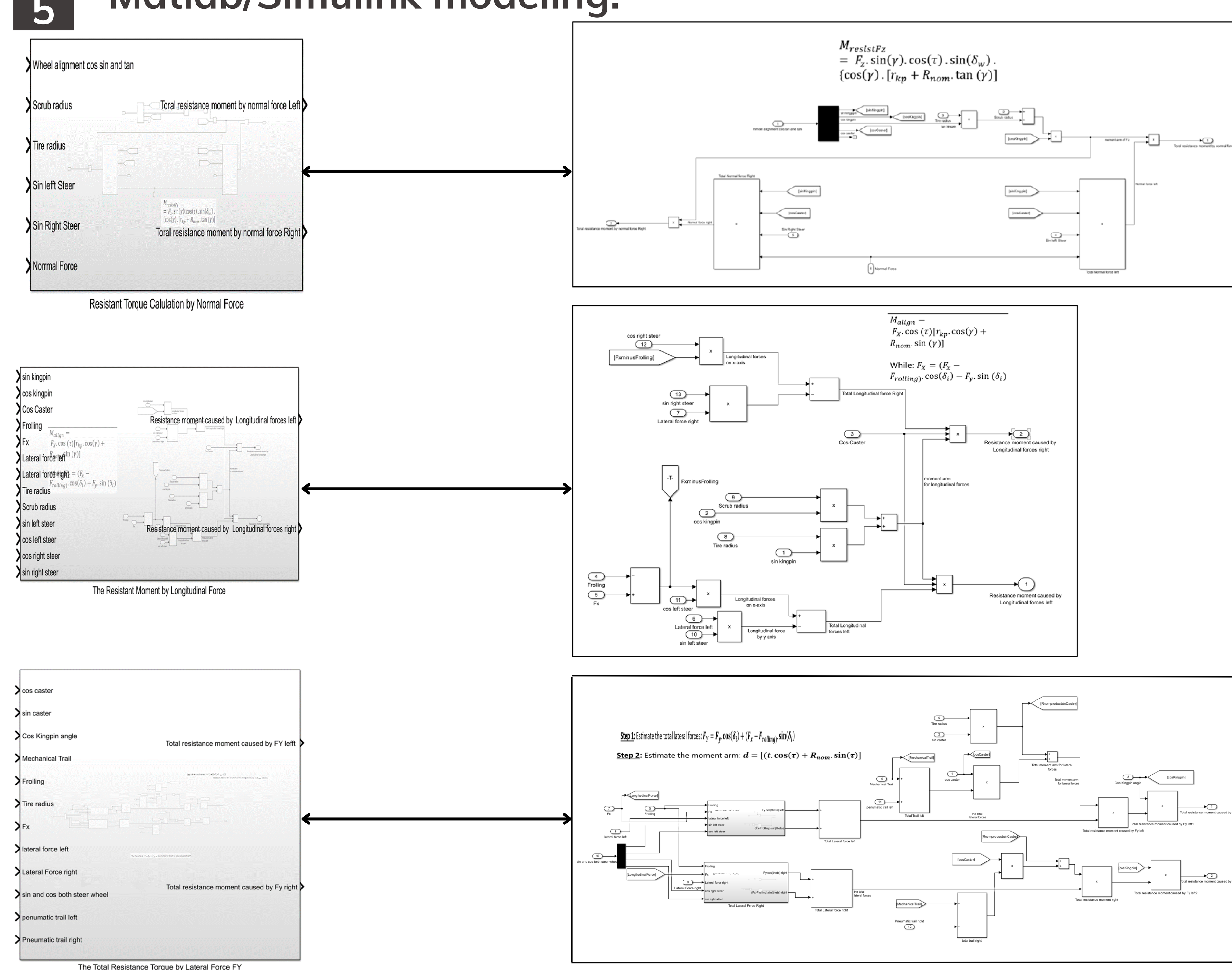
- Objective: focus on building mathematical models and simulations of the magnitude of this resistance torque under different driving conditions.
- Scope: only investigate the effects wheel alignment and specific factor on the total resistance torque.
- Mission summary: base on this scope, I will divide the whole objective into 2 main missions: The first one is get fully understanding knowledge about the resistance torque between the tire force and road surface in steering mechanism especially in the EPS system and the second one is how wheel alignment and other factors can affect to the resistance torque in steering mechanism especially in the EPS system.

3 General mathematical layout diagram:

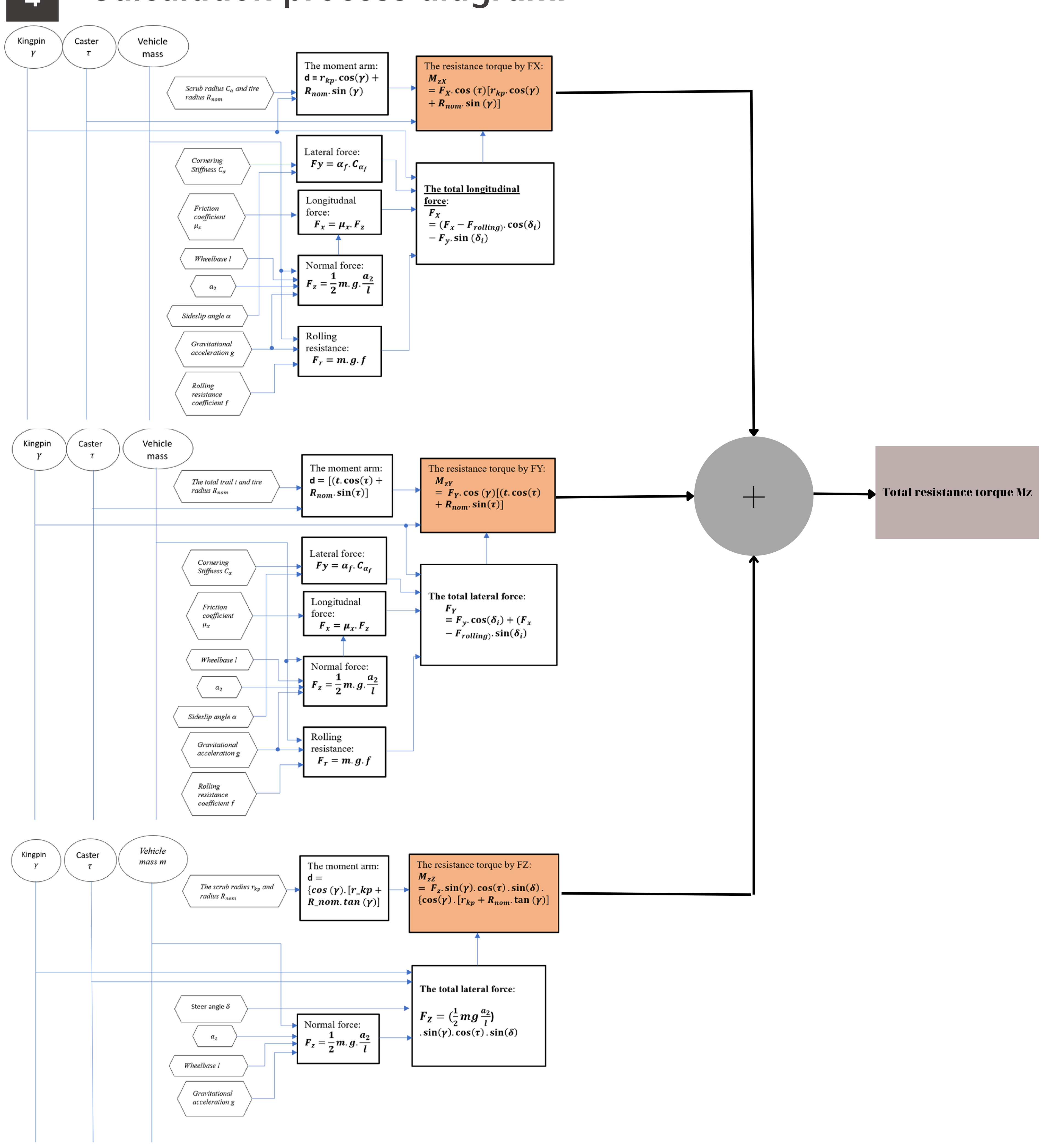
Total resistance torque in steering system especially in EPS

- Total resistance torque caused by longitudinal forces → Longitudinal forces and moment arm equations
- Total resistance torque caused by lateral forces → Lateral forces and moment arm equations
- Total resistance torque caused by normal force → Normal force and moment arm equations

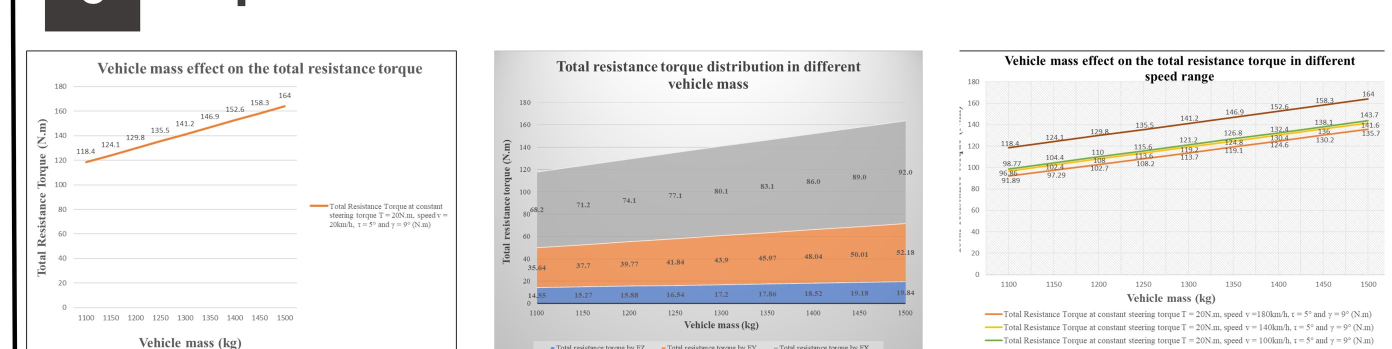
5 Matlab/Simulink modeling:



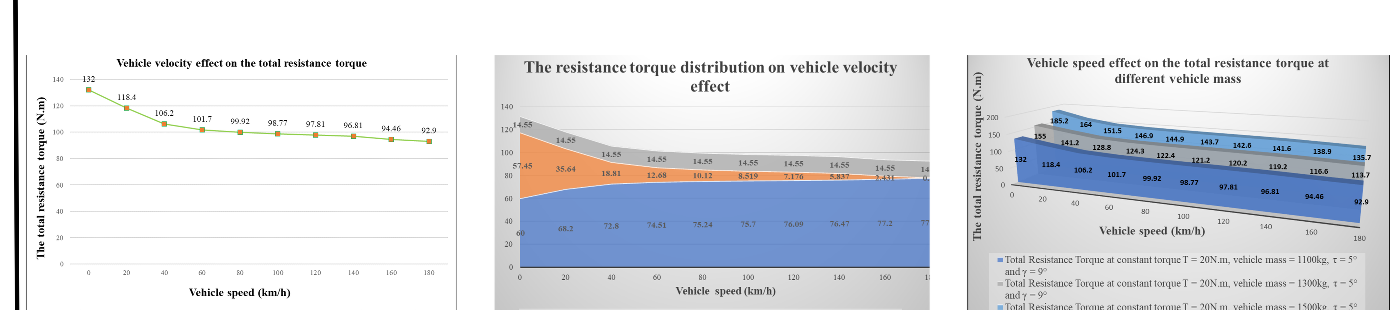
4 Calculation process diagram:



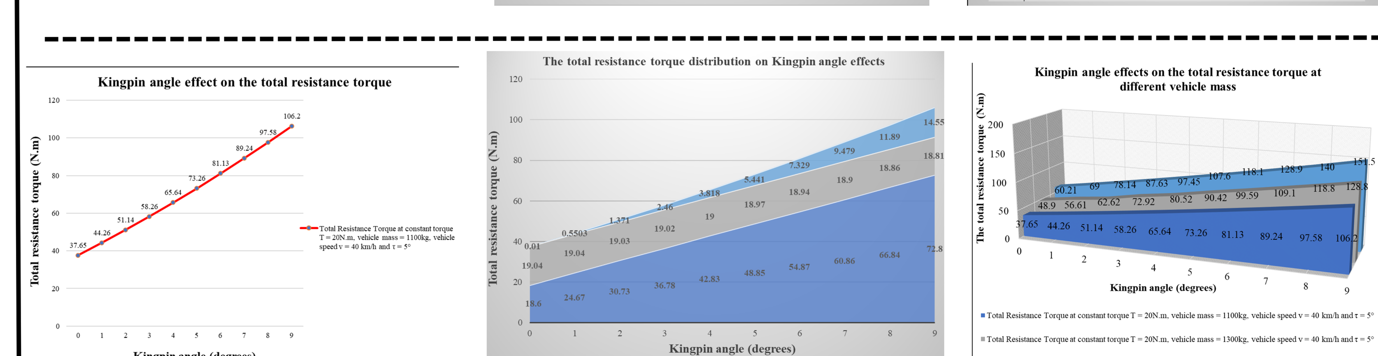
6 Specific results:



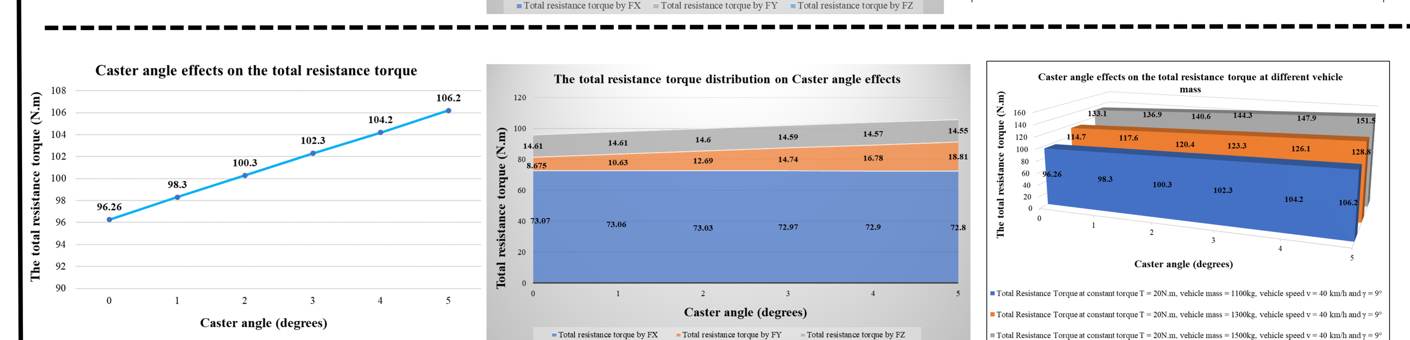
Changing in vehicle mass



Changing in vehicle speed



Changing in Kingpin vehicle wheel alignment



Changing in Caster vehicle wheel alignment

7 Conclusion and future plan:

- The main conclusion obtained in this Capstone project is how the wheel alignment especially Caster angle and Kingpin angle affect to the resistance moment in collaboration with specific factors such as vehicle mass, vehicle velocity,... Through all the figures mentioned above, we can conclude that wheel alignment has the huge impact on the total steering resistance torque in collaboration with vehicle mass and vehicle speed.
- In the future, it is recommended to develop this steering mechanism model and going further to simulate different situations by assist simulator such as Matlab/Simulink base on all relevant theories that mentioned in this Capstone project to provide the exact results in comparision with reality.

8 Acknowledgement:

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