HO CHI MINH CITY UNIVERSITY OF TECHNOLOGY
FACULTY OF TRANSPORTATION ENGINEERING
Department Automotive and Engine

STUDY ON AUTOMOTIVE PUSH-ROD SUSPENSION SYSTEM

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I. Introduction of the thesis

Objectives: Evaluate the technical characteristic of the Push-rod suspension system

- Relationship between the wheel displacement and the suspension travel
- The spring stiffness and damping coefficient
- The change in camber angle and sliding range of the tire

Project's Idea:

Compare with the conventional suspension system with the same conditions:

- Natural frequency
- Damping ratio

II. Method and solution

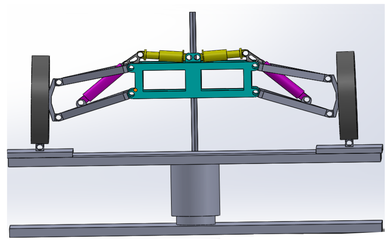

Fig 1. 3D model on SolidWorks

Build a 3D model on SolidWorks with the appropriate linkage components and properties (mass)

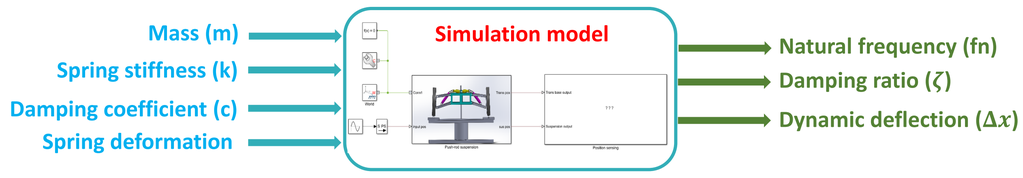

Fig 2. Simulation model in Matlab/Multibody environment

Importing to Matlab/ Multibody environment to create and simulate the models

III. Implementation process

1. Build 3D model

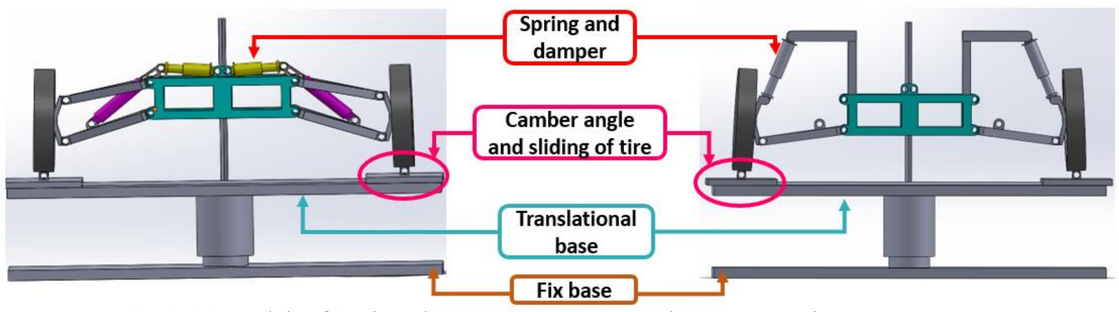

Fig 3. 3D models of Push-rod suspension system and Conventional suspension system

Parameters	Unit	Meaning	Value
m_{s_1}	Kg	Sprung weight (1/3 load)	574
m_{s_2}	Kg	Sprung weight (2/3 load)	706
m_{s_3}	Kg	Sprung weight (full load)	840
m_u	Kg	Unsprung weight	80
k_s	N/m	Spring stiffness	28566
c_s	Ns/m	Damping coefficient	2090

Table 1: light truck suspension parameters (Source: Vibration analysis of a light truck by 3d dynamic vehicle vibration model by Mr. Truong Hoang Tuan, Dr. Tran Huu Nhan and Mr. Tran Quang Lam.)

2. Simulate on Matlab/Multibody

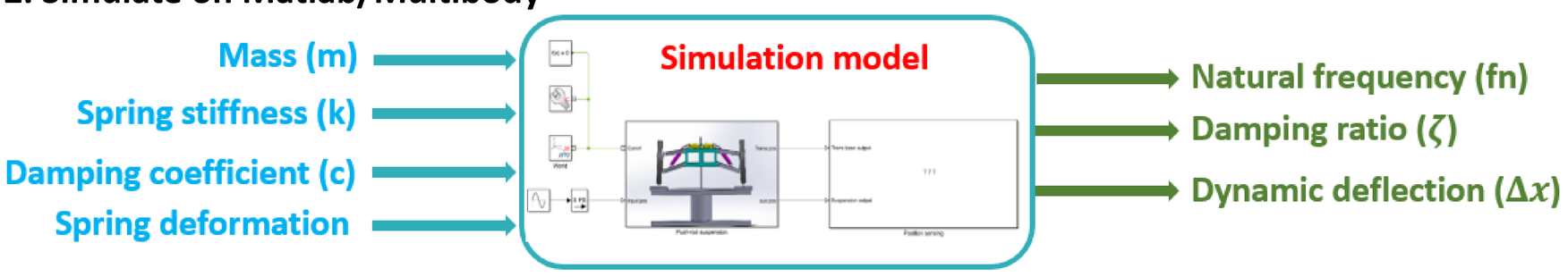

Fig 4. Simulation model in Matlab/ Multibody environment

3. Road profile simulation

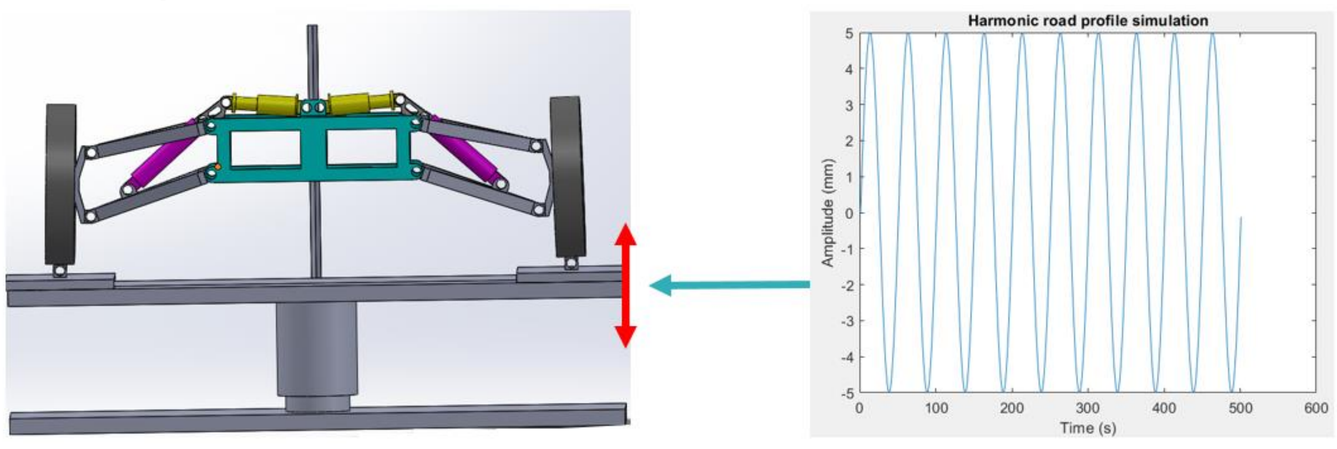

Fig 5. Harmonic road profile simulation on Matlab/ Multibody

4. Calculation flow

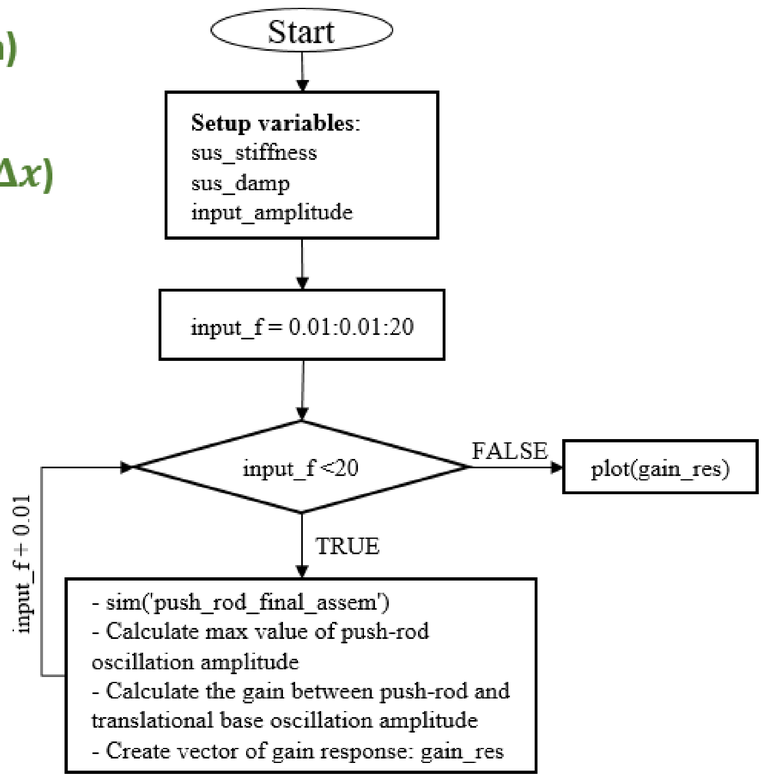

Fig 6. Calculation flowchart of the simulation model

IV. Result and disscussion

Wheel displacement and suspension travel

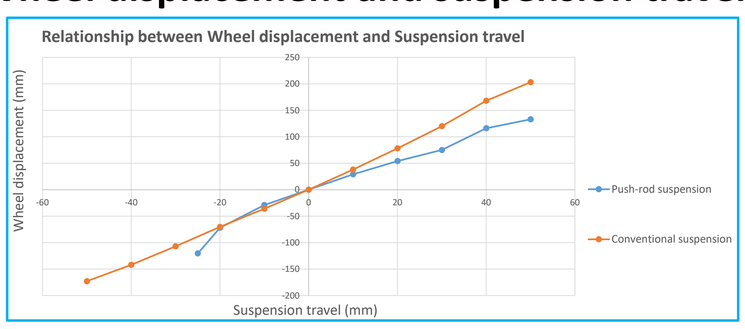

Fig 7. Relationship between wheel displacement and suspension travel curve

Change in camber angle and sliding range

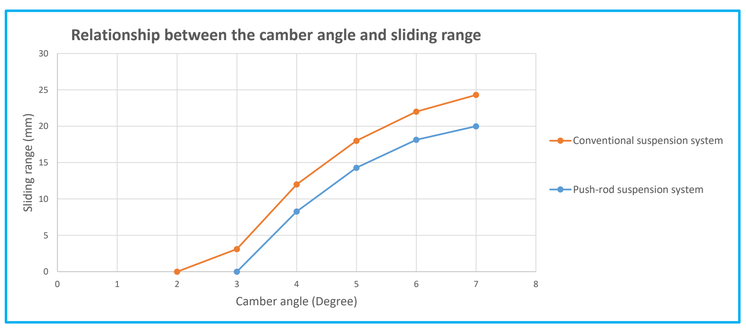

Fig 8. Relationship between change in camber angle and tire's sliding range curve

Gain response spectrum

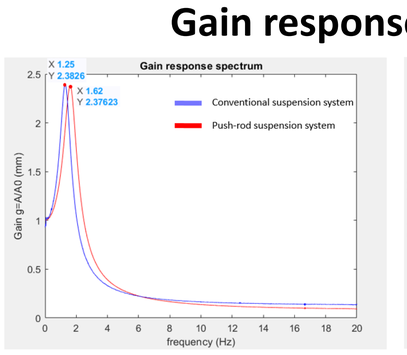

Fig 9. Gain response spectrum of 1/3 load condition

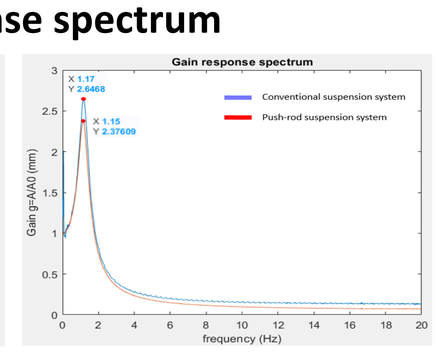

Fig 10. Gain response spectrum of 2/3 load condition

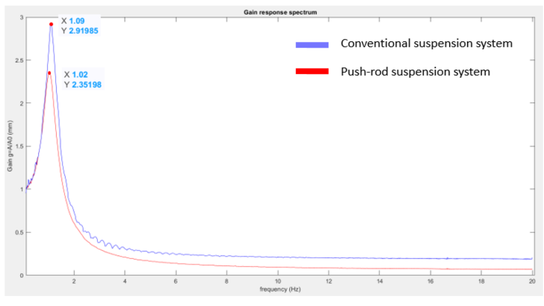

Fig 11. Gain response spectrum of full load condition

Simulation results

	1/3 Load		2/3 load		Full load	
Suspension	Push-rod	Conventional	Push-rod	Conventional	Push-rod	Conventional
Natural frequency	1.62	1.25	1.15	1.17	1.02	1.09
Damping ratio	0.259	0.259	0.249	0.249	0.274	0.274

Table 2: Natural frequency and damping ratio of Push-rod and Conventional suspension system with different load condition

	Push-rod	Conventional	Difference
Spring stiffness (N/m)	36500	28566	1.27 times
Damping coefficient (Ns/m)	3034	2090	1.45 times

Table 3: Spring stiffness and damping coefficient of Push-rod and Conventional suspension system

Discussion

- More linkage components
- Shorter suspension travel and body movement
- Greater spring stiffness and damping coefficient