ANALYSIS OF 3 DOF QUARTERCAR USING PASSIVE AND ACTIVESUSPENSION SYSTEMS

T Lalit Vidyasagar[1] | S Bhaduri[2]

[1]Automobile Engineering, Godavari Institute of Engineering & Technology, Rajahmundry, Andhra Pradesh, India
[2]Mechanical Engineering, BIT Mesra,Ranchi ,Jharkhand , India

*Corresponding Author Email ID: lalitvidyasagar@giet.ac.in

ABSTRACT

The most significant thing in the vehicle producing process is to give ride solace totravelers. The ride comfort is gotten through the best possible structure and manufactureis done on the suspension frameworks. Due to this factor, it is essentialto improve the suspension frameworks. In this task, we are going to illuminateconduct of uninvolved suspension at various circumstances and furthermore ondynamic suspension frameworks used for controlling the undesirable vibrationsfrom road profile. The work is done on active suspension system through fuzzy logic controllers.
KEYWORDS: *3DOF quarter car, passive suspension system, active suspension system, fuzzy logic*

I. INTRODUCTION

An active suspension is a sort of suspensionarrangement of a vehicle, which utilizesan installed framework to control the vertical movement of the vehicle's hagglesconcerning chassis. Unlike,passive suspension which gives huge springs where themovement is dependant out and about surface. Active suspensions are isolatedinto two classes:

Real dynamic suspensions: These suspensions utilizes an actuator to raiseand lower the case freely at each wheel.

Adaptive dynamic suspensions:
These suspensions changes the safeguard solidnessto coordinate changing road profile.
These advancements permit car producers to accomplish a decent ride quality,vehicle taking care of and permitting better handling and control.
A locally availablelaptop distinguishes body development from sensors all through the vehicleand utilizing that information controls the activity of the dynamic. The frameworkkills roll and contributing many driving circumstancesincluding cornering,quickening, and slowing down.

Fuzzy Logic Controller
The word fuzzy methods something which isn't clear. We watch numerous capacitiesin our everyday life, any capacity's info or yield in genuine framework, can'tbe fresh. We should manage works in obscure way or fuzzy way.Fuzzy Logic looks like the choices made by people. People never give their choicein crisp way. They generally give the choices in the level of truth; the level of truthis rarely either evident or bogus. In genuine the level of truth is rarely Boolean.In actuality, circumstances, the framework is consistently mind-boggling in nature.The fresh data sources furthermore, yields of a capacity over ascent to imprecision.Fuzzy rationale's data sources and outputs are linguistic and those etymologicalfactors extend from 0 to 1. These linguistic factors are further de-fuzzifed so asto get exact yield. De-Fuzzication is done from numerous points of view, forexample, Center of territory strategy, focus of gravity, and so forth.Fuzzy sets can be considered as an expansion and gross misrepresentation of oldstylesets. It tends to be

best perceived with regards to set enrollment. Essentiallyit permits fractional enrollment which implies that it contains components thathave fluctuating degrees of participation in the set. From this, we can comprehendthe contrast between the traditional set and the fuzzy set. Traditional set containscomponents that full ll exact properties of participation while fuzzy set containscomponents that fulfilled loose properties of membership.We definitely realize that fuzzy rationale isn't logic that is fuzzy however logic thatis utilized to depict fuzziness. This fuzziness is best described by its membershipfunction. As such, we can say that the membership function speaks to the level
of truth in fuzzy logic.

II. MATHEMATICAL AND MATLAB/SIMULINK MODELS

The Simulation time has been taken as 10sec. The input of the equation is takenas step size input. This step size input is considered as the road profile input.
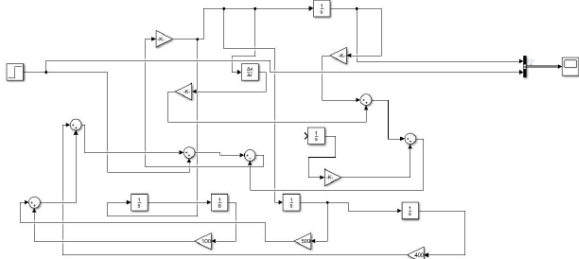
Simulink model of sprung mass

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The input of the model has been taken as step size with simulation time of 100sec. The step input's initial and final step has been taken as 30 to 150.
3.2 Fuzzy Model
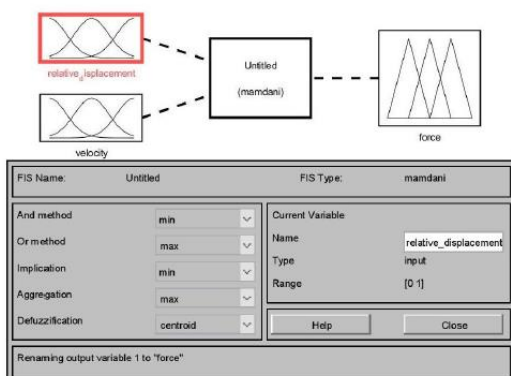
FLC Designer

The fuzzy logic designer is used to feed the set of rules and give the set ofrules some membership functions. The membership function used in this project

is triangular membership function. The input and output variables are linguisticand arranged accordingly with the help of certain decisions. The range of linguisticvariables are in the form of an array.
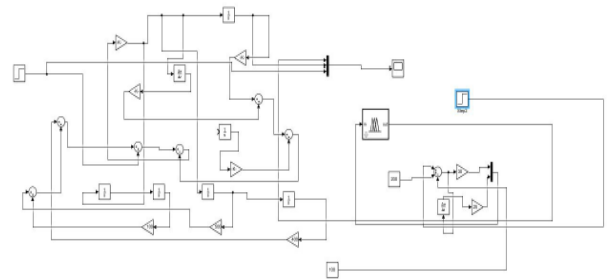The linguistic variables are:
PL- Positive Large
PM- Positive medium
PS- Positive small
Z- Zero
NS- Negative Small
NM- Negative Medium
NL- Negative Large

RELATIVE DISPLACEMENT (Columns) and VELOCITY (Rows)

	PL	PM	PS	Z	NS	NM	NL
PL	PM	PM	PM	PL	PM	PL	Z
PM	PM	PS	PM	PM	PM	Z	NM
PS	PS	PM	PM	PS	Z	NS	NM
Z	PL	PM	PS	Z	NS	NM	NM
NS	PM	PS	Z	NS	NM	NM	NM
NM	PS	Z	NS	NM	NM	NM	NM
NL	Z	NS	NM	NM	NM	NM	NM

Rules table

Fuzzy logic Simulink model
Rules of fuzzy logic
The seven linguistic variables causes 49 sets of rules. The rules which is formedare purely on the basis of human decisions. This set of rules form

Rules of fuzzy logic
Building rules utilizing the graphical Rule Editor interface is genuinely undeniable.In view of the depictions of the info and yield factors characterizedwith Fuzzy Logic Designer, the Rule Editor permits you to build the standardarticulations naturally. You can:
Make manages by choosing a thing in each info and yield variable box,
choosing one Connection thing, and clicking Add Rule. You can pick none

as one of the variable characteristics to reject that variable from a given
principle and pick not under any factor name to refute therelated quality.
Erase a standard by choosing the standard and clicking Delete Rule.
Alter a standard by changing the choice in the variable box and clickingChange Rule.
Determine weight to a standard by composing in an ideal number somewherein the range of 0 and 1 in Weight. In the event that you don't determinethe weight, it is thought to be solidarity

III. RESULTS AND DISCUSSIONS

This rule viewer is used in order to find an optimized force and one calculationsat a time.
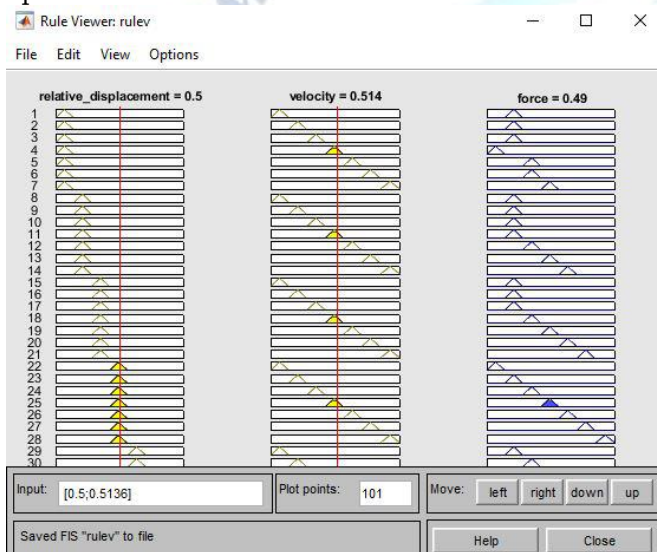

The center red line in figure shows the numerical weightageof the input and corresponding output is been caluculated.The rule viewer helps us in understanding the way of optimization when linguisticvariables are added.The Rule Viewer shows a guide of the entire fuzzy deduction measure. It depends on the fuzzy induction graph depicted in the past segment.You see a solitary figure window with 10 plots settled in it. The three plots overthe head of the figure speak to the precursor and resulting of the main principle. Each standard is a line of plots, and every section is avariable. The standardnumbers are shown on the left of each line. You can tap on a standard number tosee the standard in the status line.
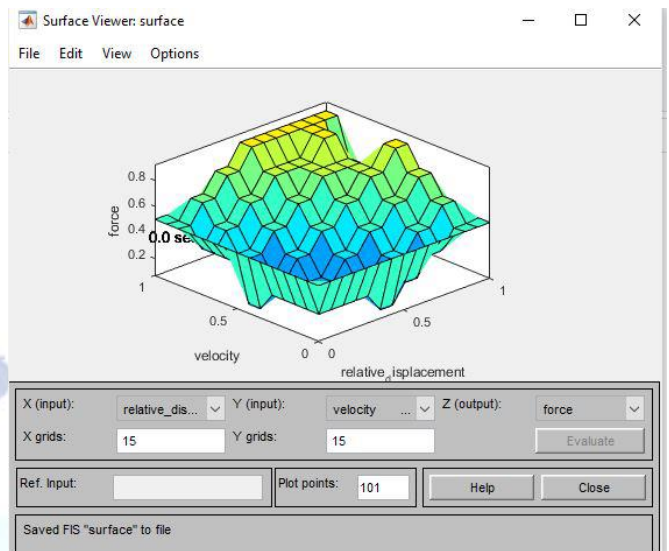
Surface Viewer
The surface view is mainly a plot in 3 dimensional or any dimensional dependingupon the number of variables present in the fuzzy interference. This outputhelp us to understand the type of output is being calculated and the optimizedoutput is being used to give better suspension to the vehicle.
The Surface Viewer is furnished with drop-down menus X (input), Y (information)and Z (yield) that let you select any two datasources and any one yield forplotting. Underneath these menus are two information fields X matrices and Ylattices that let you indicate the number of x-pivot and y-hub matrix lines youneed to incorporate. This ability permits you to keep the estimation time sensiblefor complex issues. Naturally, the surface plot refreshesconsequently when youchange the information or yieldvariable determinations or the quantity of networkfocuses. To impairprogrammed plot refreshes, in the Options menu,clearthe Always assess alternative. At the point when this alternative is handicapped,to refresh the plot, click Evaluate.
In the event that you need to make a smoother plot, utilize the Plot directs fieldtoward determine the quantity of focuses on which the enrollment capacities areassessed in the info or yield range. This field defaults to the base number of plot plots, 101. On the chance that you determine less plot focuses, the field esteem
consequently resets to 101. At the point when you indicate the quantity of plot
focuses, the surface plot naturally refreshes.
Tolerance graph
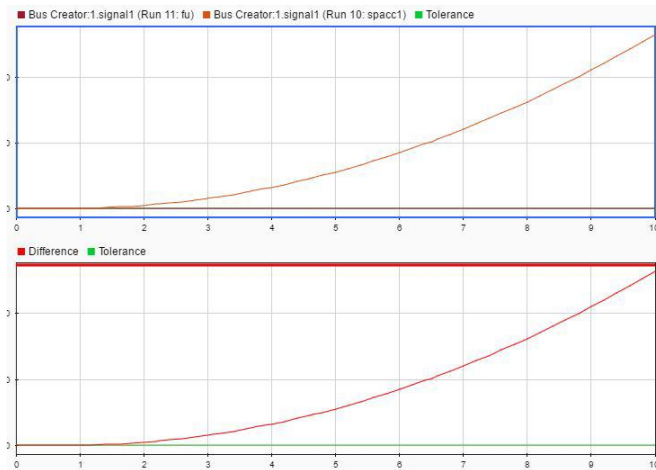
Tolerance and difference graph between fuzzified approach and passivesprung mass displacement

It is found that the sprung mass displacement in passive gives higher amount thansprung mass displacement through fuzzy controller. Nearly 53% more efficientcontrol is provided than passive suspension system.

IV. CONCLUSION

A Matlabcoding is used to take out response of passive suspension system. It is found thatthe passive suspension depends on the speed of vehicle. The active suspensionsystem such as fuzzy logic approach can be utilised, so that the suspension processis independent of the velocity of vehicle.The other analysis is done by giving the conditions such as the one condition is forhandling the vehicle and other condition is for the comfort of vehicle, the passivesystem does not compromise between handling and comfort of the vehicle, whichcan be comprised by using active suspension system.The seat mass and sprung mass blocks are modelled in Simulink and result arefound out. The Fuzzy logic controller block is also used in Simulink and passiveand active suspension system is compared. It is found that the active suspensionsystem controls the vibration by 53% as compared to the passive suspensionsystem. The Fuzzy Logic approach for controllingvibration from road profile isbetter than the passive suspension approach.

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