APPLICATION OF KINEMATICS SIMULATION SYSTEMS USING SHARK MODELS

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Abstract—The objective of this paper is to present the methodology to be followed for more accurate simulation of a kinematics system using Shark program. By introducing kinematics parameters we can improve the comportment of the vehicle and the way he respond to the combined stress taken from the road. In the second part, these kinematics conditions will be combined to generate a complex kinematics system. In our case we use kinematics conditions to simulate complex systems of vehicle chassis assemblies.

Keywords—Kinematics, front axle, results, loadings, chassis

I. INTRODUCTION

KINEMATICS – wheel travel, according to DIN (Deutsches Institut für Normung) often also called wheel (or steering/suspension) geometry – describes the movement caused in the wheels during vertical suspension travel and steering, whereas 'elastokinematics' defines the alterations in the position of the wheels caused by forces and moments between the tires and the road [1].

If we take an older definition of the kinematics defined by T.W. Wright it would be: "one body is said to be in motion relative to another body when it changes its position with respect to that other" [2].

Dynamics simulation events (Mechanical Event Simulation - MES) are a class of specialized simulation programs for more realistic analysis of the functioning assemblies to reduce the number of experiments on physical models and laboratory tests.

In spite of numerous past investigation and vast investments of research time and money, vehicle motion stability remains one of the most important unresolved problems of road vehicle transportation. In other words, vehicle stability is the ultimate goal of the study of vehicle resistance to various motion perturbations [3].

Sufficient vertical spring travel, possibly combined with the horizontal movement of the wheel away from an uneven area of the road (kinematic wheel) is required for reasons of ride comfort [1]. The so-called effective axle characteristics are derived from the individual tyre characteristics and the relevant properties of the suspension and steering system [4]. The mechanism is a closed kinematics chain; the kinematic chain is compound or simple and consist of kinematic pairs of elements; these carry the envelopes required for the motion witch the bodies in contact must have, and by these all motions other than those desired in the mechanism are prevented [5].

On many production cars one of the only ways of improving roadholding is the fitting of stiffer springs or anti-roll bars-both of wich have much the same effect.

This applies particulary at the front, where the types of independent suspension most commonly used are subject to considerable camber change on roll [6].

The torque steer effects depend on the size of the change in the longitudinal force, the adherence potential between the tyres and the road, the tyres and the kinematic and elastokinematic chassis design [1].

Our interest was to generate a complex cinematic model, which can be used to simulate various types of front axle and can be easily adapted to the front axle requirements modifications.

In order to generate complex kinematics using Shark software we first need to generate linear front axle.

The viewing angles in the GUI are enabled using the function: Graphics / View Definition Values provided to be placed in one of three orthogonal views.



Fig. 1. McPherson front axle kinematics model

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II. METHODS AND MATERIALS

In order to generate the complex kinematics model we need to introduce the data entry first, that take in to the accounts the coordinates of the characteristic coordinates.

	×(mm)	Y (mm)	Z (mm)	
Point A: Centre liaison pivot evant du bras sur	-6.5500	-372.0900	27.3200	
Point B: Centre liaison pivot arriere du bras sur	293.0000	-356.8800	31,1000	
Point E: Centre rotule interieure du porte-tusee	1731.6801	-736.3600	183.6500	
Point Ta: Point de coulisse amortisseur	1739.8000	-612 2500	368.9000	
Point F. Point de fixation amortisseur sur caisse	46.0000	-592.8500	644.7100	
Point Tb: Point de l'axe d'amortisseur	1735.4399	-617.9650	268.9000	
Point H. Centre de la rotule de direction	1878.4000	-675.4200	325.8500	
Point L: Embout de cremeillere	177.5000	-334.0000	108.5000	
Point Rp: Ancrage resport sur caisse	45.5000	-592.8500	644.7100	
Point R: Ancroge ressort sur porte-fusee	1751.8000	-820.8000	642.8500	
Point J: Centre du joint de transmission cote roue	1737.0000	-705.3300	305.1900	
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Fig. 2. Coordinates of the model

After introducing the coordinate's points we make the kinematics connection between the points of the front axle.



Fig. 3. Construction and modifications of the SHARK model

After the coordinates introduced and the construction of the front axle is ready, we can insert the files obtained after the computing of the weight and the force and moments which has been computed with ADAMS car program.



Fig. 4. Charging the Pseudo-Mac Pherson template

The first step is to charge the template of « Pseudo-Mac Pherson avec barre anti-devers » type.

For this we need to File/ New then activate the case Front Suspension and select Type 2.

It is necessary to calculate the outputs using the transmission, by integrating it using:

- Enter in the menu: Edit / Add to Model / Drive Shaft (s)
- Select the type " length IJ fixed" en click on Fixed Length Drive Shaft

Pick Drive shaft Type :	
Fixed Length Drive Shalt	
🗘 Varying Length Drive Shatt	

Fig. 5. Charging the transmission type

A window will appear to notify that the template is going to be modified and that's why we need to save the model: validate with one click on OK button

1	This Option adds a Drive Shaft to the current ade by modifying the templete.
	To retain this change either the template must be saved or the Template saved with the data file.

Fig. 6. Validate the accepted model and save menu

Two new points are then created:

- Inboard CV Center : Center of transmission gear box (point I)
- Inner CV Axis point : Orientation point for the axis (point Ip)

Return on Edit mode by clicking on the icon: On the graphic interface, click on the two newly created points and update their nomination and coordinates.



Fig. 7. Computing calculation and coordinates

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The definitions of the values are introduced in the SYSART file [7].

The information regarding the joint of transmission with gear box is accessible using:

Data->Compliance Data->Drive Shaft Properties.

Transverse arms and trailing arms ensure the desired kinematic behaviour of the rebounding and jouncing wheels and also transfer the wheel loadings to the body [1].



Fig. 9. Joint of transmission with gear box information

The information's about wheels are displayed as follows:



Fig. 10. Wheel menu information

The point's coordinates, on the vehicle system axis, are readable on the POINTS paragraph in the SYSART file. These points have the same name as the ones used on the SHARK.

In order to make the update of the points click on the

icon:

After clicking the icon a window will appear to fill out the coordinates as follows:

	×(mm)	Y (mm)	2 (mm)	-
Point A: Centre liaison pivot evant du bras sur	-6.5500	-372.0900	27.3200	_
Point B: Centre liaison pivot arriere du bras sur	293.0000	-356.8800	31,1000	
Point E: Centre rolule inferieure du porte-fusee	1731.6801	-736.3600	183.6500	
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Point L: Embout de cremeillere	177.5000	-334.0000	108.5000	
Point Rp: Ancrage resport sur caisse	45.5000	-592.8500	644.7100	
Point R: Ancrage ressort sur porte-lusee	1751.8000	-620.8000	642 8500	
Point J: Centre du joint de transmission cole roue	1737.0000	-705.3300	305.1900	
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For the movement of the train and moving positions of the wheels we take these further steps:

Define the Z pilot move:

Solve-> Motion-> Ground Plane Options-> Move TCP Z (point Q)

Move Wheel Centre Z (point K)

Move Lower Ball Joint Z (point E)

Move Upper Ball Joint Z (point F of double triangle) For specifications on absolute Z position make the selection:

Solve-> Motion-> Ground Plane Options-> Z displacement as position (if not the values entered correspond on the models motion).

For specifications on absolute Y position make the selection:

Solve-> Motion-> Ground Plane Options-> Y displacement as position.

Select the displacements combined mode on turnings:

- Module / SHARK / 3D Bump (only movement):
- 3D Roll (rolling only)
- 3D Steer (Steering only)

3D Combined Motion (movement and steering)

The SYSART document is generated by using the solver ADAMS by computing the loads and displacements of the coordinates of the kinematics points. [8].

The first part of the SYSART generated file takes in to account all the constrains imposed to the virtual model and the definitions of the coordinates and specific axle points.

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The second part of the SYSART generated file takes in to account the links between the coordinates points defined in to the first part os the SYSART file.

POINTS:
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A -6.55 -372.09 27.32
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R 31.274 -599.46 400.025 .
/Centre de la rotule de direction/
X 139.498 -708.98 115.754 .
/Pied de la perpendiculaire abaisses de l'axe d'amortisseur sur l'axe de fures/
C 1.336 -615.832 160.75 ,
/Centre de roue/
K 1.738 -765.036 161.933 ,
/Centre du toint de transmission cote roue/
J 1.563 -700.039 161.418 ,
/Embout de cremaillare/
L 177.5 -334 108.5 ,
ar armany results and the
Fig. 13 The second part of the SVSART file
rig. 15. The second part of the STSART file

After finishing the steps we will get a full controlled virtual motion kinematics that can be edited and modified for the future models/projects.

III. CONCLUSION

The results, depending on the design of the chassis, in kinematic and elastokinematic toe-in and camber changes which can be used to compensate for unwanted changes in lateral forces, particularly in the case of multi-link suspensions.

The resulted model after the computing steps has the capacity of replicating and checking the kinematics model with the real movement of the assembly/ auto vehicle pieces.



Fig. 14. Kinematics model for the left front axle

This model can also be used to be imported in others CAD or CAE programs who can insert also an accurate 3D model of the assembly or subassembly to be simulated.



Fig. 15. Kinematics connection usages

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REFERENCES

- [1] Jörnsen Reimpell, Helmut Stoll and Jürgen W. Betzler "The Automotive Chassis: Engineering Principles", 2nd ed., Butterworth-Heinemann, pp. 13-161
- T. W. Wright "Kinematics, Kinetics and Statics With Applications", [2] 7th ed., pp22
- [3] R. Andrzejewski and J. Awrejcewicz "Nonlinear Dynamics of a Wheeled Vehicle'', pp. 18
 [4] Hans B. Pacejka "Tyre and Vehicle Dynamics", pp. 2
- F. Reuleaux "The Kinematics of Machinery. Outlines of The [5] Theory of Machines", 1876, pp. 51
- Michael Costin and David Phipps "Racing and Sports Car. Chasis [6] Design", pp. 7
- [7] Alexandru Avrigeanu and Razvan Bujoaica "Virtual simulations iterations", Laboratory of University of Pitesti 2012
- [8] Alexandru Avrigeanu and Razvan Bujoaica "Results of Kinematik calculations", Laboratory of University of Pitesti 2012