KINEMATICS APPLIANCE BY USING CATIA FOR AUTOMOTIVE FRONT AXLE

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REZUMAT. Obiectivul acestei lucrări este prezentarea metodologiei care trebuie urmată în scopul de a genera simularea unui sistem cinematic folosind programul CATIA. În cea de a doua parte, aceste condiţii cinematice vor fi combinate pentru a genera un sistem complex cinematic. În acest caz, se folosesc condiţiile cinematice pentru a simula sisteme complexe ale ansamblurilor şasiului vehiculului.

Cuvinte cheie: cinematică, punte faţă, rezultate.

ABSTRACT. The objective of this paper is to present the methodology to be followed in order to generate the simulation of a kinematics system using CATIA program. 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: kinematic, front axle, results.

1. 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 'elasto-kinematics' defines the alterations in the position of the wheels caused by forces and moments between the tires and the road [1].

The differnts types of front axle on wich we cand improve the comportments of the vehicle are McPherson front axle and Pseudo McPherson front axle.

Fig. 1. McPherson front axle.

Piloting the wheels is provided by a transverse arm (usually triangular) below the wheel, arm strength so that the coupling bar (tie).The advantages of such designs are on the unmortised lower mass, an important support base for reliable work and floor space fiabil.Today is the representative bridge is used on mid-range [1].

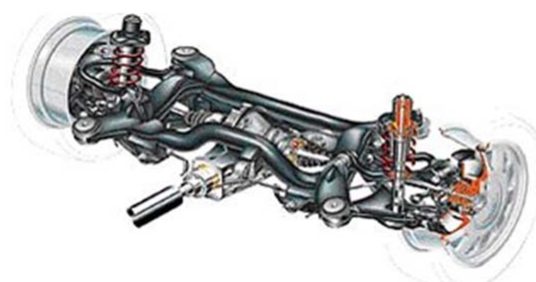


Fig. 2. Pseudo McPherson front axle.

The double triangle cross a bridge, pivot wheel is piloted by two triangular arms on either side to the wheel axis (triangular lower and upper triangle), and a coupling bar. Vertical position is provided by the helical spring rod found on the lower triangle [1].

Advantage of the bridge: large height and width reliable loading and behavior results complete.

This bridge is called Pseudo McPherson, resume components as System in McPherson, but make it independently the anti-roll bar lower arm, which thus becomes a triangular [2].

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 [3].

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 [4].

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. The concept was introduced MES ALGOR package that provides complete solutions, integrated from modeling to finite element analysis for a wide range of industrial applications in the most diverse fields.

In order to generate complex kinematics using CATIA we need first to generate the coordinates by introducing them in to the dedicated computing software.

SHARK generates complex kinematics using Shark by using the computing on the linear front axle. In order to do that 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.

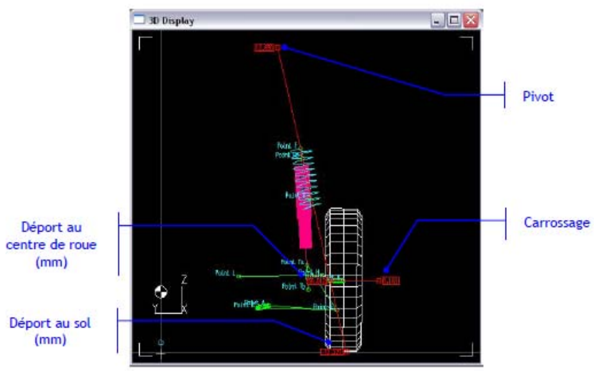


Fig. 3. McPherson front axle kinematics model.

Angles visible in the GUI are updated depending on the position of the train. To view a particular location, select the menu: View / Set Display Mode Tool then click Single Step and choose the position of the train in the dropdown menu.

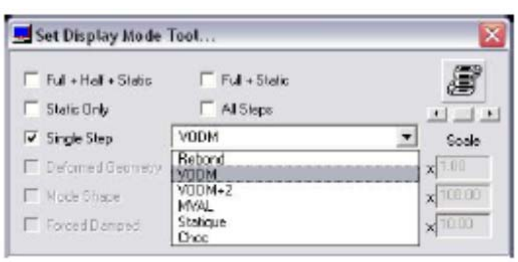


Fig. 4. Visualization of the train angle menu.

2. METHODS AND MATERIALS

More functional, it may be necessary to make an adjustment of parallelism by modifying the length of the tie rod LH.

It must first be placed in the following conditions:

• Select the position of the train (see Fig. 1): View / Set Display Mode Tool / Single Step;

• Move to above by clicking J;

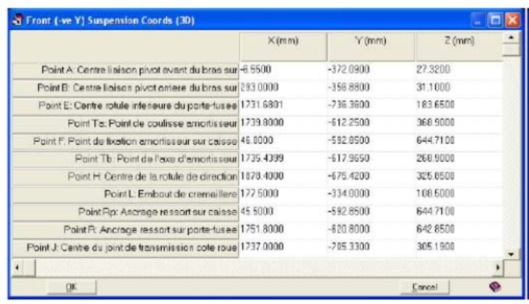
• Activate display angle values: Graphics / View Definition Values;

• Move to the setting mode lengths: Edit / Change Mode / Set Lengths Parts Lengths editable appear in green parts.

To change the angle to take into account in the model unit, click View / Change Units and then select the unit in the Angle drop-down menu.

The angles that can be improved and modified on yhe SHARK kinematic model are Pincer angle, Camber angle, Pivot angle and the Chasse angle.

The coordinates of the kinematic model are inserted in the coordinates menu on the SHARK entry data.



Front (-ve Y) Suspension Coords (3D)

	X (mm)	Y (mm)	Z (mm)
Point A: Centre liaison pivot avant 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 inferieure du porte-fusee	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 cremaillere	177.5000	-334.0000	108.5000
Point Rp: Ancrage ressort sur caisse	45.5000	-592.8500	644.7100
Point R: Ancrage ressort sur porte-fusee	1751.8000	-620.8000	642.8500
Point J: Centre du joint de transmission cote roue	1737.0000	-705.3300	305.1900

OK Cancel

Fig. 5. Coordinates of the model.

After introducing the coordinates and computing the various angle of the front axle an file of results is generated wich we are going to name “SYSART file”.

The SYSART file is the resulted file on which we can find the first position of the coordinates as well as the angles modifications during the movements of the front axle by take into the account the forces and the torsion of each separate elements as well as the dynamic characteristic of each sub-assembly.

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!===== CALCUL DU YINT,YI,YEXT =====!
  !COS. DIR. DES 2 ARBRES! CD I1I  = U(1) , CD I J = U(2) ,
  !SIN ET COS DE L'ANGLE DES 2 ARBRES!
   !SIN I! PV U(1) U(2) = U(3) , OS U(3)V(4) = T(1) ,
   !COS I! PS U(1) U(2) = T(2) ,
  !YI!  PS I  V(2) = T(3) ,
 !CALCUL DU DEPORT et de sa VALEUR ABSOLUE!
 OS 24.5*T(1)/T(2) = T(4) , VA T(4) = T(4) ,
  !YINT! OS T(3)-T(4) = T(6) , !YEXT! OS T(3)+T(4) = T(5) ,
  PR (T7,'YINT=',F8.2,'  YI=',F8.2,'  YEXT=',F8.2)  T(6)-T(3)-T(5) ,
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Fig. 6. Fragment of the SYSART file resulted.

After introducing the resulted files computed by SHARK program we can visualise the kinematic chains of the mechanism on the screen with all the kinematic constrains and all the early introduced coordinates and angle.

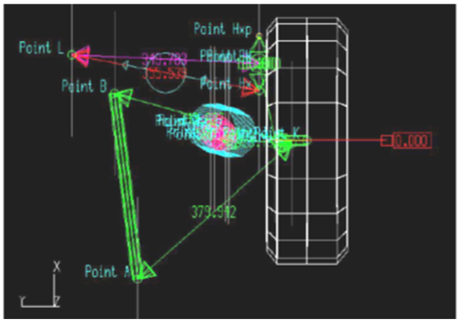

Fig. 7. SHARK kinematics imported from the SYSART file.

I. 3. RESULTS AND DISCUSSIONS

After the results are charged in to a post processing program (Ex CATIA, I-Deas), we extract the coordinates and introduce them in to the Sketch window and build the lines that delimitates the moving coordinates.

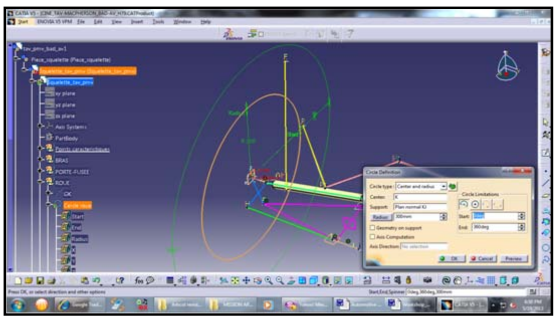

Fig. 8. The kinematic sketch drawn.

The resulted drawn is configured and synchronized with the coordinates obtained from the SHARK computing therefore we need to synchronize with the 3D virtual mechanism axle.

All the data's output are converted to the files needed and after imported in the simulation software.

The resulted sketch drawn respects entirely the movement and the trajectory of the computed front axle and the dynamic and constrains of the assembly and subassembly from witch it takes part.

In order to ensure the vehicle comportment's and to synchronize the virtual model with the real comportment of the physical axle we need to verify these modifications on the physical test bench, and after the synchronization is completed to correct in real time the error that might occur.

By taking into accounts all the modifications made using symulation methods we save time. After all the modifications made to the model and all the errors correcterd we can implement the model to the other structural analysis.

The resulted 3D model support any modifications based in the after by computing made in ADAMS, and can ensure the virtual comportment of the computed simulation.

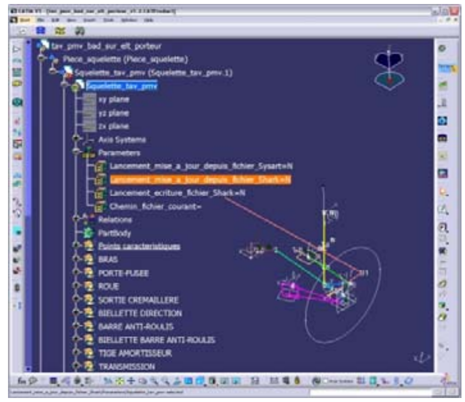

Fig. 9. Kinematics imported files from Shark.

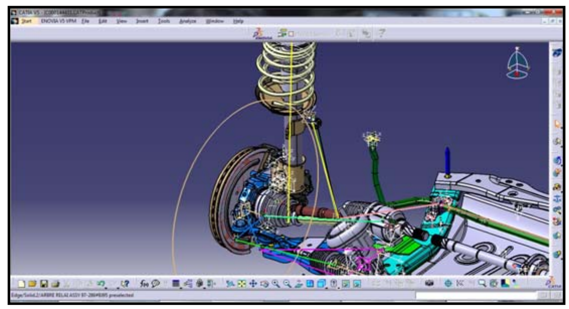

Fig. 10. Synchronize 3D kinematic model movement with the 3D axle.

After we obtain the virtual CATIA kinematic model we need to synchronize and verify it with the psychical model.

Using a computer and a specific program (RPR) in the frequency transfer function H (f) PCB-assembly-hydraulic-mechanical analog is obtained from signal generation Xb (f) and the response or Yb (f) the trap testing.

Fig. 11. Convergence simulation virtual and real measurements.

This result corresponds to an approximation of pilotage researched and is called „test 100%".

These tests are intended to assess the fatigue behavior of bodies called "security" or primordial proper functioning of a mechanism. They participate in validating the reliability of the different organs. For each type of body can be a kind of bench. Requests are multidirectional and efforts exerted amplitudes are calculated by formulas that involve duplicating the same severity as the reference mission profile.

After these simulations the value to approach to the real measurements are ready to be corrected and implemented to the computed sequence program.

5. CONCLUSIONS

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.

By using this new modified kinematics we can improve the comportment's of the car by adding or modifying the values of the coordinates, or just modifying the new angles of the front axle with the ADAMS computed results.

Acknowledgment

This work was partially supported by the strategic grant POSDRU/88/1.5/S/50783 (2009) of the Ministry of Labor, Family and Social Protection, Romania, co-financed by the European Social Fund – Investing in people.

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