Modeling between Force and Rotational Angle with Crane Rotational speed etc.
Parameters for One Circle of the Crane Linkage Mechanism in Vehicle

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Abstract

The paper may establish modeling to compute the dynamics of crane linkage in vehicle. The force and rotational angle may be exhibited in this paper. Through the one circle of crane linkage mechanism in vehicle the force will have completed a periodical change. The stability has concentrated on 30°~140° and 220°~310° of rotational angle scope whose value will provide 0.25mN and 0.15mN for the conditions to be crane crane rotational speed 1,000r/m and power 200kW i.e. 265hp & 3,000r/m and 310kW i.e. 411hp in crane linkage mechanism of vehicle’s engine. Through the crane displacement R and linkage one L the bigger force value may have been provided as mentioned in this paper. They have near 10 kN~5kN i.e. one tons value between adjacent R &L.

Keywords: Modeling; Force; Rotational angle &speed; Parameters; Vehicle; Crane linkage; Mechanism
Introduction

The crank linkage is an important mechanism in vehicle which includes crank, crank linkage and sliding block on engine so the research will be proceeded on them is necessary method to calculate with modeling in recent study. So this paper will search the detail database to establish the formula to solve it further. The dynamics can solve the key problem of intrinsic relationship between force and time in engine which can express the detail behavior to the crank linkage force analysis for us to find intrinsic things. As recent the vehicle has been grown rapidly in world so the most significant engine part of crank linkage will play more and more roles in future. The fatigue life will be key to its span life so the force change with time of rotation will be important data for us to search deeply. The force behavior must be established to further clarify the fatigue role and play a key role. Since the time limits the fatigue life wouldn’t be searched here we only play to establish dynamic modelling in terms of Lagrange formula to crank linkage mechanism. We try to find role of force formed on sliding block mass at certain rotation speed and time in order to find its maximum force and its stability. The vehicle design as an important work has significant role. For example the new car be needed to regulate which fits to the demand of purchase from customer. Therein the main parameters are the key of the designing vehicle. Audi’s engine has a maximum power of 333ps,while Mercedes-Benz’s A45 AMG has a 2.0T engine of 360ps. In terms of the demand the whole design may be proceeded with modeling in advance. Furthermore the connecting with the fact will become more and more significant now. Not only this may decrease the design time but also it may cause the reality effect. Through the modeling it could be seen preforming effect, meantime the defect could be observed. It is our destination. [1-14] The defect wants to be found in advance. It could be detected by program for us to mend fitly so it is very important work for us. So the modeling of new design have been established for the cost down and decreasing the leisure time. In special the new function vehicle is the new construction product. It is needed that the match parameters may be proposed so as to the convenient design. Therein the dynamic equilibrium is a new way to design the new car which can connect with virtual reality. Only the dynamic equilibrium could promote and improve our product properties more completely in final. Overall, the new car has been designed through its modeling which is established by our professor and engineer. So the parameter has been thought and best constants are found in regard to design which must be the best conditions. We want to find the mass conditions which causes the bigger force for engine of crank linkage so it is searched on its status in this study. On the other side the shaft rotation is studied too to look for the appropriate effects. As for multibody system dynamics the Lagrange formula is used to analyze it so it is sophisticated and complex to establish the formula. The result has been deviation usually. In this paper the crank linkage system is simulated with Lagrange formula to look for the deviation scope in vehicle engine.

Modeling & Schematic

In Figure 1 it will show that schematic of crane linkage mechanism in vehicle whose crane displacement is R and linkage displacement is L. They are listed as the original point is O; q is crane rotational angle; F1 is the force; s is displacement; q1 is the angle in piston.

![Figure 1 Schematic of crane linkage mechanism in vehicle.](image)

According to the crane linkage mechanism

\[ \text{Since it has } \frac{R}{\sin \theta_1} = \frac{L}{\sin \theta} \quad (1) \]

It has
\[ \sin \theta_1 = \frac{R \cdot \sin \theta}{L} \quad (2) \]

Since it has
\[ dw = F_1 s \cdot \cos \theta_1 d \theta_1 \quad (3) \]

ie.
\[ w = F_1 \int vt \cdot \cos \theta_1 d \theta_1 \quad (4) \]

and
\[ w = -F_1 vt \cdot \sin \theta_1 \quad (5) \]

So it has
\[ w = -F_1 vt \cdot \frac{R \sin \theta}{L} \quad (6) \]

ie.
\[ F = \frac{30 \text{pa} \sqrt{L^2 - (R \sin \theta)^2}}{\pi R^2 \sin \theta} \quad (7) \]

Here
\[ \sin \theta_1 = \frac{R \sin \theta}{L} , \quad F = ma_t . \]

Discussions

Table 1 has shown that the four groups of crane and linkage ratios in vehicle with 4.32~6.33. The displacement may indicate 216mm~450mm with linkage and 50mm~72mm with crane in this paper. Figure 2(a &b) shows that the force may change with the rotational angle in crane linkage mechanism of vehicle for engine power to be 200kW and crane rotational speed to be 1,000r/m. The force may decline from 5mN to 300kN firstly then enhance into 1mN and then decline from 800kN to 250kN and finally enhance from 800kN to 5mN with the angle to be 0º, 25º, 170º, 220º, 340º and 360º correspondingly. Among them the maximum force will indicate 5mN then 1mN and finally 800kN, 300kN &200kN respectively. It has a little change with various crane and linkage displacement R &L in Figure 2(a &b) on the whole. It explains that they are not main factors to affect the force completely. The
stability period may be expressed as below Figure 3 in details.

Table 1: The stroke ratio in Crane Linkage Mechanism of vehicle.

<table>
<thead>
<tr>
<th>Items No.</th>
<th>L mm</th>
<th>R mm</th>
<th>L/R</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>216</td>
<td>50</td>
<td>4.32</td>
</tr>
<tr>
<td>2</td>
<td>294</td>
<td>57</td>
<td>5.15</td>
</tr>
<tr>
<td>3</td>
<td>360</td>
<td>62</td>
<td>5.80</td>
</tr>
<tr>
<td>4</td>
<td>450</td>
<td>72</td>
<td>6.33</td>
</tr>
</tbody>
</table>

Figure 2: The force and rotational angle with crane R and linkage L in crane linkage mechanism of vehicle.

Figure 3: The force and rotational angle with crane R and linkage L in crane linkage mechanism of vehicle amplified from Figure 2.

In Figure 3 the stability force as amplified part from Figure 1 may indicate that about 30kN has been indicated among the general crane and linkage displacement R &L mentioned above. Thereby the adjacent force will provide about 10kN among them in the conditions of power 200kW and crane rotational speed of 1,000r/m. The rotational angle may become 30º~140º and 220º~310º as seen in Figure 2(a) and Figure 2(b) correspondingly. In Figure 3(a) and Figure 3(b) the curve will indicate concave function and convex one respectively whose value may provide 0.33mN~0.17mN and 0.26mN~0.16mN correspondingly. The force size may indicate to L=360mm &R=60mm, L=295mm &R=57mm, L=450mm &R=72mm and L=216mm &R=50mm in turns.
The force and rotational angle with crane R and linkage L & power P=310kW and crane rotational speed n=3,000r/m in crane linkage mechanism of vehicle.

Figure 4(a &b) shows that the force will change with rotational angle for the conditions to be power 310kW and 3,000r/m in crane linkage mechanism. The force may indicate 2.5mN then 0.15mN, 0.6mN, 0.1mN, 0.5mN and 2.5mN with the rotational angle to be 0º then 25º, 170º, 220º, 330º and 360º correspondingly. A little change has been found among those crane and linkage displacement generally. The stability of force may be narrated as below Figure 5.

Figure 5(a &b) shows that the stability of force for Figure 4(a &b) amplified from it will maintain near 0.12mN totally. The detailed stabilized value has indicated 0.17mN~0.09mN and 0.13mN~0.09mN for the rotational angle to be 30º~140º and 220º~310º as seen in Figure 4(a) and Figure 4(b) respectively. The effective turn may be indicated as above mentioned one, they are to become L=360mm &R=60mm, L=295mm &R=57mm, L=450mm &R=72mm and L=216mm &R=50mm in turns. The adjacent force will indicate 5kN between each conditions. Overview, the force and rotational angle may be exhibited in this paper. Through the one circle of crane linkage mechanism in vehicle the force will have completed a periodical change. The stability has concentrated on 30º~140º and 220º~310º of rotational angle scope whose value will provide 0.25mN and 0.15mN for the conditions to be crane rotational speed 1,000r/m and power 200kW i.e. 265hp & 3,000r/m and 310kW i.e. 411hp in crane linkage mechanism of vehicle’s engine. Through the crane displacement R and linkage one L the bigger force value may have been provided as mentioned in this paper. They have near 10 kN~5kN i.e. one tons value between adjacent R &L. At the same time the force may have not followed the stroke ratio in crane linkage mechanism of vehicle according to this paper which has been found.

Conclusions
The force and rotational angle may be exhibited in this paper. Through the one circle of crane linkage mechanism in vehicle the force will have completed a periodical change. The stability has concentrated on 30º~140º and 220º~310º of rotational angle scope whose value will provide 0.25mN and 0.15mN for the conditions to be crane linkage mechanism of vehicle according to this paper which has been found.
mechanism of vehicle’s engine. Through the crane displacement $R$ and linkage one $L$, the bigger force value may have been provided as mentioned in this paper. They have near $10kN$-$5kN$ i.e. one tons value between adjacent $R$ & $L$. Meanwhile, the force may have not followed the stroke ratio in crane linkage mechanism of vehicle according to this paper which has been found.

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