SUSPENSION RATING IN KINEMATIC CHAIN

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***Abstract*— The present work deals with the problem of detection of suspension rating which is frequently encountered in structural synthesis of kinematic chains. A new method which incorporates all essential feature of matrix method easy to compute & reliable is suggested in this paper. It is capable of detecting rating in all types of planar kinematic chains. Many methods are available to the kinematic chain to detect suspension rating among chains & inversions but each has own shortcoming. Most of the study to detect suspension Rating is based on hamming matrix & multiple equation method. This method is based on joint value & jerk absorbing capacity of kinematic chain. This method is proposed up to six bar kinematic chains & its inversion. C.N.Rao and A.C.Rao have been reported methods to predict the performance and rate the kinematic chains and mechanism among several configurations. In the present work a methodology is used which is based on the influence of type of links, type of joints present in a kinematic chain to predict the performance of kinematic chains without carrying out the dimensional synthesis.**

***Index Terms*— Kinematic Chain, Joint, Degree of Freedom, Kinematic Inversion**

I. INTRODUCTION

The problem of detection of suspension rating between two kinematic chains has been the subject matter of investigation for a long time. This method is proposed that if the link has more jerk absorbing capacity & to produces more kinetic energy then this kinematic chain is more suspension.

Nikunj Yagnik and Anurag Verma[1] proposed a method to rate kinematic chain. A.C. Rao, Raju D. Varada[2] used hamming matrix to detect isomorphism. In this method forming the joint value matrix by the help of two directly connected link.S. Shende & A. C. Rao[8] proposed Mach Theory in this field. After forming this matrix any one link is to be fixed & give a motion or jerk to another link. Calculate the motion of another connected link except that fixed or grounded link. Comparison of characteristic coefficient of the adjacency matrix of the corresponding inversion of kinematic chain is considered to be suitable for this purpose.

Application of the joint value & link assortment method for structural synthesis & analysis of planer kinematic chain has been proven to be an effective & systematic approach in the suspension rating. Many of the method which is to be used for detecting the suspension rating are very lengthy & calculation is more complicated.

. One of the most important and challenging problem in structural synthesis of kinematic chain is to identify the possible structural suspension between given chains. Kinematic synthesis is an essential step at the first stage of designing of a machine, as it represents creation of mechanism to achieve a desired set of motion characteristics. Ali Hasan , Khan R.A[9] used Mach theory in this field. Many researchers have directed their efforts to study various aspects of mechanisms, Machine designer have been synthesizing kinematic chains unconsciously. A lot of literature related to suspension rating detection and detection of distinct mechanism (DM) is available but still there is scope for an efficient simple and reliable method and this paper is an attempt in this direction vary important problem involved structure analysis of chains is the determination of distinct mechanism of a chain and to detect suspension rating among kinematic chains. Attempts have been made in the past to solve this problem, and a number of algorithms proposed by crossly, mainly based on the Graph Theory, are available in the literature. Most of these methods are based on link adjacency matrices or Distance matrices which was first introduced by Freudenstein and Dobrajansky. In this paper we generate a

methodology for six bar and one degree of freedom kinematic chain to get the performance scheme.

II. METHODOLOGY

DEFINATION-Suspension is term given to the system of spring, shock absorbers & linkages that connects a vehicle to its wheel. Suspension system serves a dual propose contributing to the cars road holding for a good active safety & driving pleasure & keeping vehicle occupants comfortable & reasonably will isolated from road noise & vibration.

According to this method –

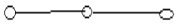
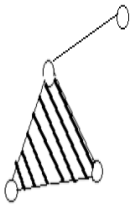
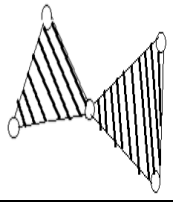
The value of the link can be expressed as the number of node point.

- In the binary link there is only two node point. So, given a value 2.
- In the ternary link there is only three node point. So, given a value 3.
- In the quaternary link there is only four node point. So, given a value 4.

Forming a joint value matrix-

1. If the two binary link are directly connected to each other. So, the joint value will be 2 + 2 = 4
2. If the one binary & one ternary link are directly connected to each other. So, the joint value will be 2 + 3 = 5
3. If the both ternary link are directly connected to each other. So, the joint value will be 3 + 3 = 6

Table 1 (Different type of joint)

S No.	Link Used	Connection
1.	Two Binary Link	
2.	Binary & Ternary Link	
3.	Two Ternary Link	

2.1 Forming a joint value matrix of 6 bar chain-

WATT CHAIN -

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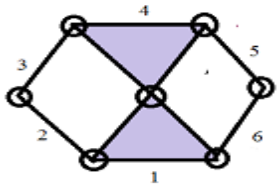

Fig.1-watt chain

LINK	1	2	3	4	5	6
1	0	5	0	6	0	5
2	5	0	4	0	0	0
3	0	4	0	5	0	0
4	6	0	5	0	5	0
5	0	0	0	5	0	4
6	5	0	0	0	4	0

STEPHANSON CHAIN-

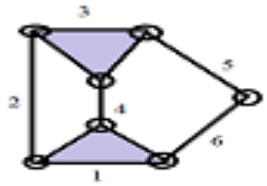

Fig.2-stephenson chain

LINK	1	2	3	4	5	6
1	0	5	0	5	0	5
2	5	0	5	0	0	0
3	0	5	0	5	5	0
4	5	0	5	0	0	0
5	0	0	5	0	0	4
6	5	0	0	0	4	0

By the definition is to be proven that if the link have good jerk absorbing capacity in the form of deflection (motion) than the link is good suspension.

When one link of kinematic chain is to be fixed & applied a jerk (force). Due to which every link are in motion or deflected rather than fixed link.

So, we assume that every link to be deflected more or less. The more deflected link is directly proportional to the suspension of kinematic chain.

Because of that for finding the more suspension of kinematic chain the most higher or maximum value of row or column can be added to there each element of row or column respectively.

2.2 Forming a Link assortment matrix of 6 bar chain-

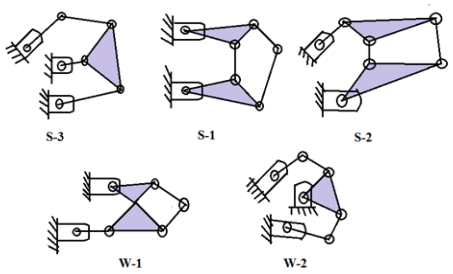

Fig 3- possible structures of kinematic chain

Link assortment matrix for Watt chain-

LINK	1	2	3	4	5	6	SUM
1	0	11	6	12	6	11	46
2	10	0	9	5	5	5	34
3	5	9	0	10	5	5	34
4	12	6	11	0	11	6	46
5	5	5	5	10	0	9	34
6	10	5	5	5	9	0	34

Total = 228

Link assortment matrix for Stephenson chain-

LINK	1	2	3	4	5	6	SUM
1	0	10	5	10	5	10	40
2	10	0	10	5	5	5	35
3	5	10	0	10	10	5	40
4	10	5	10	0	5	5	35
5	5	5	10	5	0	9	34
6	10	5	5	5	9	0	34

Total = 218

In the six bar kinematic chain there are 7 number of node are present.

- So, when binary link is fixed than number of joint are to be free for give motion or deflection (7-2) = 5
- also when ternary link is fixed than number of joint are to be free for give motion or deflection (7-3) = 4

III. RESULT

Adding the value of link assortment & free joint value for best.

Chain No.	Link Assortment	Joint Value	Total	Rating
W-1	228	5	233	1st
W-2	228	4	232	2nd
S-2	218	5	223	3rd
S-1	218	5	223	4th
S-3	218	4	222	5th

IV. CONCLUSION

kinematic chain is a standard Used technique for the rating of simple jointed planner test where dimensional Synthesis need not be carried out. The methodology is generic and can be implemented on n-link, single- degree of freedom Chain with slight modification. Our analysis using the said methodology results that six-bar Watt-I linkage suspension, is better than other configuration of watt chain & Stephenson chain.

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