"Performance Analysis for Providing Effective Tolerance on a Link in Planer Mechanism Considering Pin-Joint Tolerances by using Software Technology"

Dr. C.C.Handa[1], R.K.Bhoyar[2], S.D.Thakare[3], S.M.Pimpalgaonkar[4]
[1](Asst Professor & Head, Department of Mechanical Engg, K.D.K.E, Nagpur, India)
[234](Asst Professor, Department of Mechanical Engg, P.B.C.O.E, Nagpur, India)

Abstract

Mechanisms are designed for desired output or required performance for specified input. Error in link length and joint clearance results in variation in the performance of mechanism. Machines are consisting of mechanism for their successful operations. The link length inaccuracies are due to no. of factors like machining errors deflection of link, clearances in joint etc. Due to manufacturing defects & clearances, the link length varies. This variation in link length causes variations in designed performance of mechanism. In this paper a simple class I four bar mechanism is analyzed, assuming that links are rigid. Design engineer wants tight tolerances for accurate performance; while on other hand manufacturing engineer prefer loose tolerances. This paper proposes an approach to identify the effect of change in link length on the performance of the mechanism, using C# language for programming to develop software.

Keywords: *Mechanism, Joint Clearance, Tolerance, Performance Ratio, C# language.*

I. INTRODUCTION

Graphical velocity analysis is the important phase for the analysis of four bar mechanism. It is the graphical method which requires great drafting skill and it is the only practical way to solve velocity analysis problem. One can rapidly solved for the velocity of particular point or link in a mechanism for any one input position by drawing the vector diagram. it is very tedious approach if velocities of links of the mechanism for many positions are to be found, because each new position require completely new set of vector diagrams be drawn.

To solve this problem and for accurate result of velocity of any point or link for any position of the mechanism, a software is developed which used quick result of performance of given mechanism. Also, it is trial and error method considering different set of tolerance to minimize performance variation due to change in link lengths.

II. DIFFERENT STAGES USED

The language used for programming is 'C-language'. The computer program can be divided into different stages like

Stage 1: a program to check a class of mechanism

Stage 2: program to sketch the basic mechanism

Stage 3: program to find co-ordinates of velocity diagram

Stage 4: program to find maximum and minimum performance at an angle Θ

Stage 5: program to find set of dimensions for which variation in performance is more than defined acceptable performance in percentage.

III. FLOW CHART OF THE PROGRAMMING

Flow chart of the programming of the software is as shown follow.

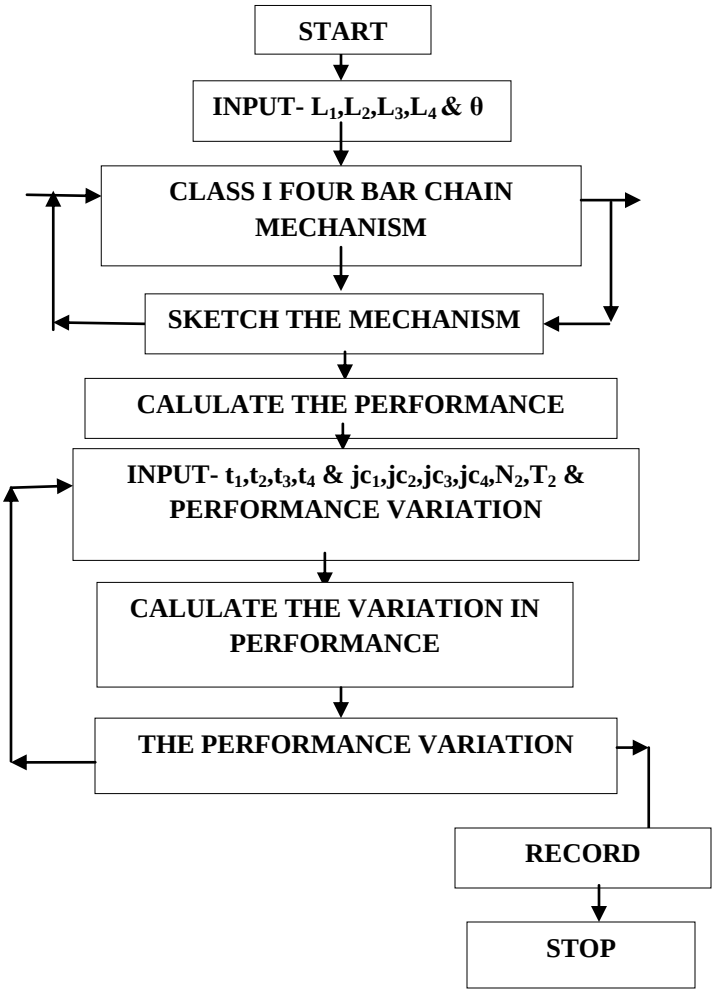

Fig 2.1 Flow Chart of the Programming

IV. PROCEDURE TO RUN THE SOFTWARE

Various steps involved to run the software are as fallows.

Performance Ratio Calculator: Image 3.1 shows the Performance Ratio Calculator for the Four Bar chain Mechanism prepared for the program. This Performance Ratio Calculator contains Input Length Box, Input Length Tolerance Box, Check Button, Calculate Button, Input Torque and Input Crank Speed Button, Reset Button, and Progress Bar. It also shows the maximum and minimum performance. Image 3.1 shows Main Home Screen in which Input Length Box and Check Button are active.

Input Link Lengths: Initially, only link lengths of a mechanism are required. Thus link Length Box and Check Button are active. Check Button is used to check whether mechanism is Class I or not. If the link data is shown, it is clear that the mechanism is Class I mechanism. Link data contains the shortest and longest link.

Calculate: The Calculate Button will compute performance of the mechanism in terms of output torque for every 1° rotation of the crank. Data required for the calculating the performance of the mechanism is crank angular velocity or cranking speed and input torque. Select the respective button, click on it and enter the respective data. One click on 'View Ideal Reading 'button shows the performance sheet for all 360° rotation of the crank. The performance sheet can be saved in .doc or excel format. Maximum and minimum performance is shown on the screen.

Standard Performance Reading:

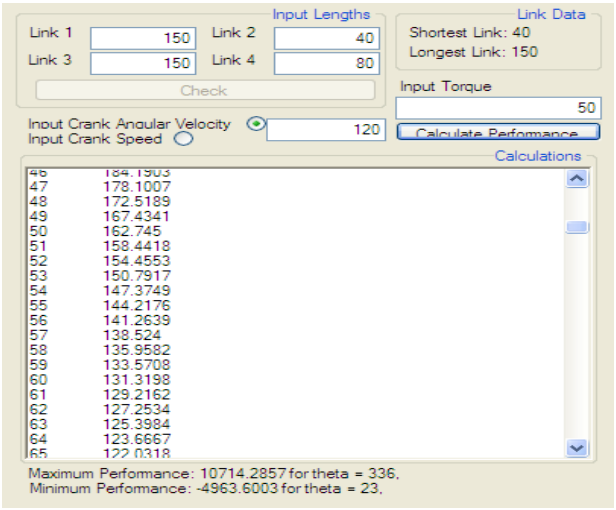

Fig 3.1 Standard Performance Reading

Angle	Torque	Angle	Torque
1	-143.168	336	10714.29
2	-149.402	337	-4958.68
3	-156.347	338	-2005.88
4	-164.029	339	-1250
5	-172.656	340	-906.687
6	-182.288	341	-709.119
7	-193.221	342	-582.1
8	-205.577	343	-492.659
9	-219.78	344	-427.046
10	-236.058	345	-376.44
11	-255.129	346	-336.606
12	-277.441	347	-304.183
13	-304.201	348	-277.553
14	-336.464	349	-255.102
15	-376.471	350	-236.046
16	-427.122	351	-219.771
17	-492.712	352	-205.568

18	-582.174	353	-193.213
19	-709.321	354	-182.281
20	-906.865	355	-172.644
21	-1250.31	356	-164.024
22	-2007.49	357	-156.337
23	-4963.6	358	-149.393
24	10691.38	359	-143.164
25	2608.696	360	-137.496

Standard Maximum Performance: 10,714.29

Standard Minimum Performance: -4,963.60

Input length Tolerance & Joint Clearance: Enter values of tolerance on each link length and joint clearance and acceptable performance variation in percentage.

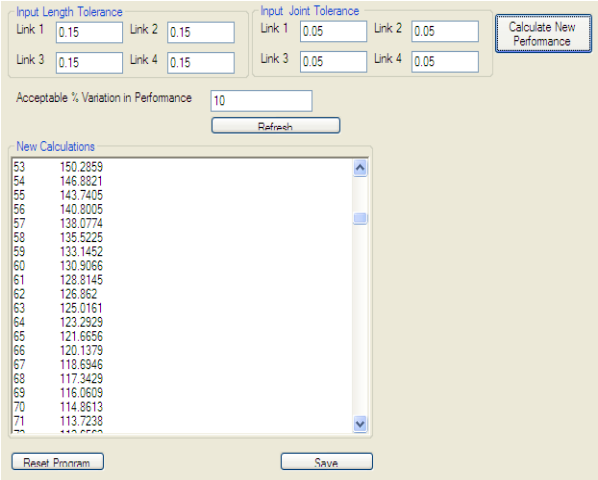

Fig 3.2 New Performance Reading

Calculate New Performance: After entering the values of tolerance and joint clearance, dimension of respective length will be change. It will change performance of mechanism. One click on 'Calculate New Performance' Button start process of calculation and new performance reading is obtained.

Reset Program: Reset button is used to clear the home screen and all calculations done by the software.

V. RESULT

By considering input angle θ=60°, The standard performance reading is 131.3198.After entering the values of each link and joint clearance the new performance reading at θ=60° is 130.9066 which is shown in fig.3.2. The variation of new performance reading with respect to standard performance reading is less than 10%, so it acceptable.

VI. CONCLUSION

The proposed Software technical method is useful in determining performance variation of any planar four bar mechanism cause due to dimensional inaccuracies. Computer software can help in easy workout of possible variation in link dimension.

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