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Functional Aspects of Synthesized In-Line Ten Link Gear Slider Mechanism of Variable Topology using Linkage Software

H. M. Naveen[1], Shrinivas S. Balli[2] and Umesh M. Daivagna[3]

[1]Assistant Professor, Department of Mechanical Engineering, RYM Engineering College, Ballari, Karnataka, India
[2]Professor & Head, Department of Mechanical Engineering, Basaveshwar Engineering College, Bagalkot, Karnataka, India
[3]Professor, Department of Mechanical Engineering, Ballari Institute of Technology, Ballari, Karnataka, India

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Abstract- *The paper presents the hunch to know the functional aspects of In-Line Ten Link Gear Slider Mechanism of Variable Topology with the aid of linkage software. Linkage Software as one of the prominent tool is presented in the paper to study the behavior of the mechanism. The designer can understand the response of the mechanism and its functional aspects using this simulation software. Illustrations are provided with explanation to understand the concept of variable topology mechanism. This is a mechanism with cranks as input and slider as output in phase I and II.*

Key Words: Ten Link Gear Slider, Linkage Software, Variable Topology Mechanism

1. INTRODUCTION

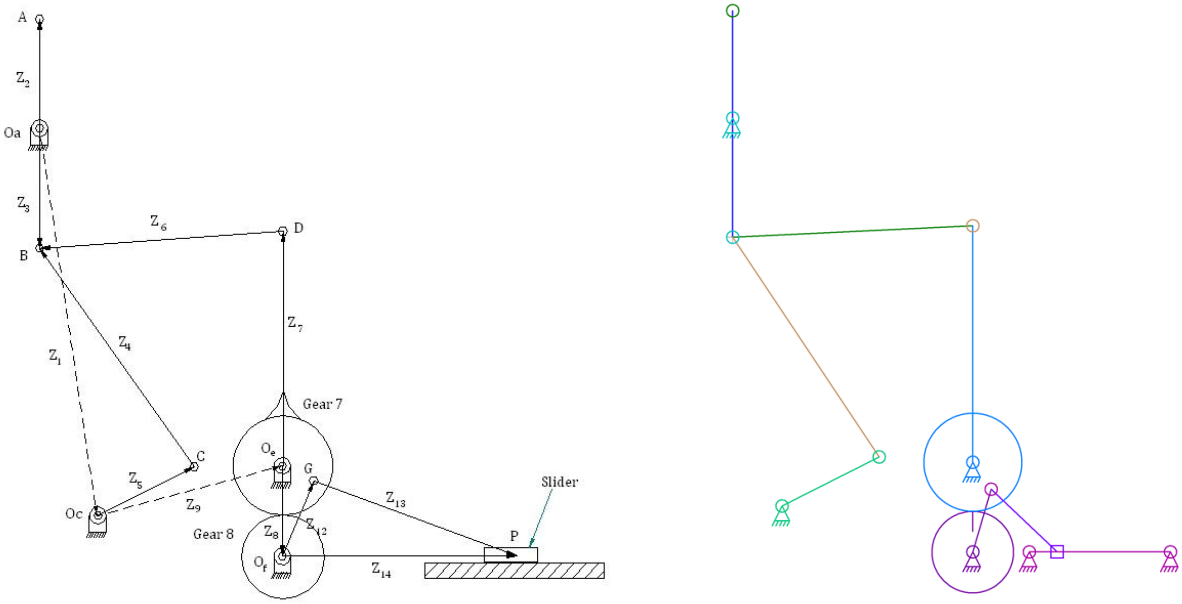
Synthesis and Analysis are the two major aspects of design process of mechanism [1]. In the synthesis process, the mechanism required to perform the desired task is devised and in analysis process the synthesized mechanism is tested for its functional aspects. Once a mechanism is synthesized with some parameters, next processes involve building of virtual model of the mechanism and study its working characteristics. Practically, it is a complex process to build a real model of mechanism to understand the concept under study. In such cases one has to think of simulation software which is playing a vital role in modern industrial sector.

This requires a platform, where in, the synthesized mechanism can be built; inputs can be provided; and thus, the mechanism can be made operational. This process connects to the Computer Aided Design (CAD) program called Linkage. This is a CAD program used for modeling of mechanisms. This is one of the simplest CAD programs which offer quick analysis and modifications while working on the modeling of designs. The accessibility to the program is at DAVE'S BLOG which is developed by David M. Rector [2]. The program is viewed with wide variety of windows versions. Considering this as a base the synthesized mechanisms are studied for their efficiency and efficacy. The link to download the software has been provided in reference section. Further, an example of In-Line Ten Link Gear Slider Mechanism of Variable Topology is considered for discussion.

2. IN-LINE TEN LINK GEAR SLIDER MECHANISM WITH VARIABLE TOPOLOGY AND ITS RESPONSE

The In-Line Ten Link Gear Slider Mechanism is basically two degrees of freedom mechanism which requires two inputs to operate the mechanism. The mechanism synthesized with variable topology method [3-5] has been taken into consideration for the study. Balli and Daivagna [6-7] worked on five and seven link variable topology mechanisms. Prashant and Balli [8] revisited the literature on variable topology. The effectiveness of the mechanism is studied with linkage software. The prefixed parameters are considered and the same mechanism is built in to the linkage. As per the prerequisites of the variable topology, a link is to be fixed temporarily in two degrees of freedom mechanism. Therefore, the links are fixed in the proposed mechanism and is made to work. A comparative study of the mechanism operating in both the Phases I and II, is illustrated below through drawing as well as simulation techniques.

2.1 IN-LINE TEN LINK GEAR SLIDER MECHANISM WITH VARIABLE TOPOLOGY



(a) (b)

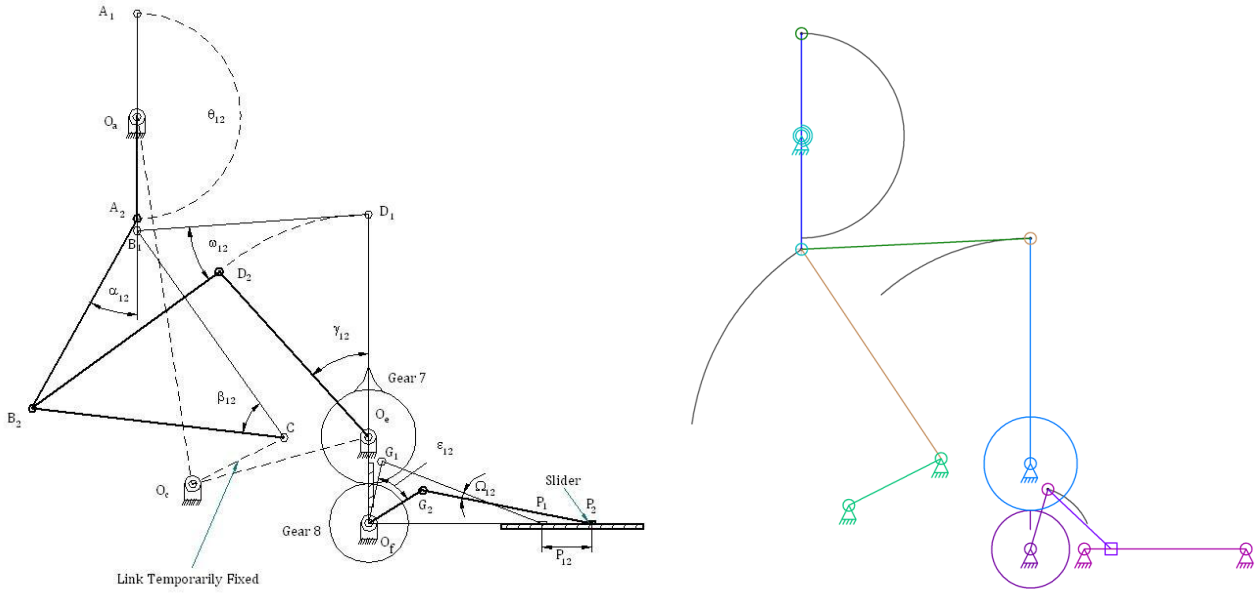
Fig.1 In-Line Ten Link Gear Slider Mechanism with Variable Topology
(a) Drawing (b) Linkage Program

Fig. 1 shows a comparative description of In-Line Ten Link Gear Slider Mechanism with Variable Topology in drawing as well as in linkage program. The mechanism is designed as per the parameters determined in the synthesis process. The obtained parameters of the mechanism using complex number method are as follows:

$|Z_1| = O_aO_c = 137.5$
$|Z_2| = O_aA = 38$
$|Z_3| = AB = 80.1$
$|Z_4| = CB = 92.0$
$|Z_5| = O_cC = 35.4$
$|Z_6| = DB = 85.3$
$|Z_7| = O_eD = 82$
$|Z_8| = O_fO_e = 32$
$|Z_9| = O_cO_f = 69.0$
$|Z_{12}| = O_fG = 22.5$
$|Z_{13}| = GP = 22.5$
$|Z_{14}| = O_fP = 62$
$|P_{12}| = P_1P_2 = 18$

These are the link lengths of the mechanism that are considered for drawing as well as for simulation. The mechanism shown in Fig.1 is in standstill position as no inputs are added. The following paragraph shows the working of the mechanism in different Phases.

2.2 IN-LINE TEN LINK GEAR SLIDER MECHANISM WITH VARIABLE TOPOLOGY IN PHASE I



(b) (b)

Fig.2 In-Line Ten Link Gear Slider Mechanism with Variable Topology in Phase I
(a) Drawing (b) Linkage Program

Fig.2 shows a comparative description of In-Line Ten Link Gear Slider Mechanism with Variable Topology in Phase I in drawing as well as in linkage program. In this Phase, crank O_cC is temporarily fixed, and only input at crank O_aA is made to function. The in-line slider crank mechanism, O_fGP also operates as Gear 8 rotates on its own axis. P is the slider connected to coupler GP. Thus, crank O_aA acts input and slider P acts as output of the mechanism. An input motion of 180^0 in clockwise direction is given to crank, and thus, the working condition of the mechanism is depicted in Fig.2 (b). The tracer point A, designs a semicircle, whereas, both the coupler points B, D and G together trace a curve. This shows the working condition of the mechanism in Phase I.

2.3 IN-LINE TEN LINK GEAR SLIDER MECHANISM WITH VARIABLE TOPOLOGY IN PHASE II

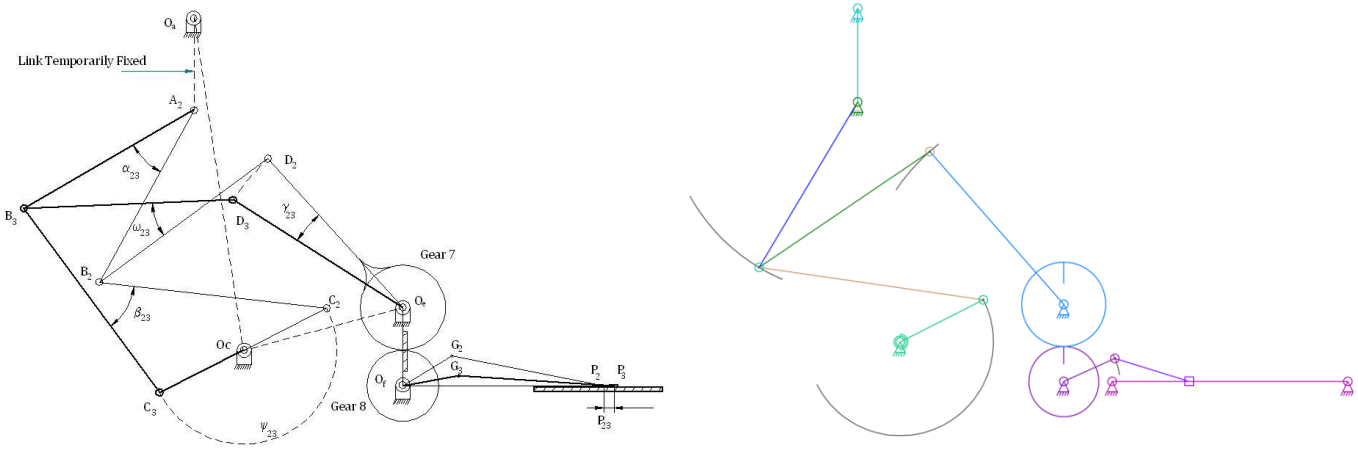


Fig.3 In-Line Ten Link Gear Slider Mechanism with Variable Topology in Phase II
(a) Drawing (b) Linkage Program

Fig.3 shows a comparative description of In-Line Ten Link Gear Slider Mechanism with Variable Topology in Phase II, in drawing and linkage program. In this Phase, the crank O_aA is temporarily fixed at the ending position in Phase I, whereas, crank O_cC which was fixed momentarily in Phase I is released while setting into motion. A motion of 180^0 is given to the crank in clockwise direction in order to depict the working condition of the mechanism in Fig.3 (b). Thus, the working condition of the mechanism is depicted in Phase II.

3. ADVANTAGE OF SYNTHESIZED IN-LINE TEN LINK GEAR SLIDER MECHANISM WITH VARIABLE TOPOLOGY

The synthesized In-Line Ten Link Gear Slider Mechanism with Variable Topology as described earlier is a two degree of freedom mechanism requiring two inputs to run the mechanism. This is made operational by installing two motors operating the mechanism in both the Phases I and II. Added advantage of the synthesized mechanism is that, the same mechanism can be made to work in two phases by using only one input motion provided at Gear 8. This requires a single motor to be connected to the mechanism, without disturbing the temporary link in both the Phases. The following discussion explains the procedure of working of mechanism with only one input in two different Phases.

3.1 WORKING OF IN-LINE TEN LINK GEAR SLIDER MECHANISM WITH VARIABLE TOPOLOGY WITH GEAR AS INPUT (PHASE I)

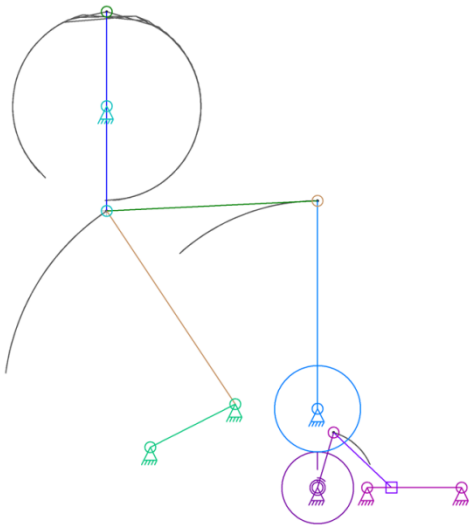


Fig.4 In-Line Ten Link Gear Slider Mechanism with Variable Topology with One Input (Phase I)

Fig.4 shows In-Line Ten Link Gear Slider Mechanism with Variable Topology with one input in Phase I. In this Phase, none of the cranks are given the input motion, however, the gear 8 is made accessible as input to the mechanism. The mechanism in operation in this phase clearly depicts that, the tracer point A draws an incomplete circle with some glitches in between. This is a clear indication of existence of some defects in the operation of the mechanism with gear as an input in Phase I. The gear rotation is limited from 0^0 to 50^0 in this phase. The comparative analysis of the mechanism shows that, the designer on priority has to focus on the defects in the mechanism in order to make the operation smooth and efficient.

3.2 WORKING OF IN-LINE TEN LINK GEAR SLIDER MECHANISM WITH VARIABLE TOPOLOGY WITH GEAR AS INPUT (PHASE II)

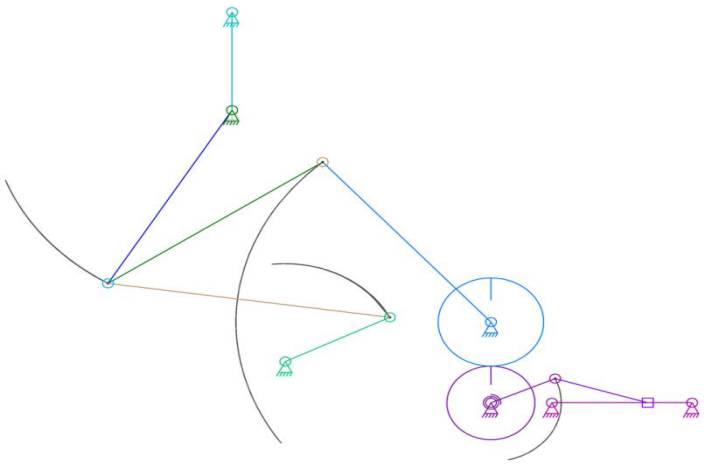


Fig.5 In-Line Ten Link Gear Slider Mechanism with Variable Topology with One Input (Phase II)

Fig.5 is a clear indication of the In-Line Ten Link Gear Slider Mechanism with Variable Topology having one input in Phase II. Even In this Phase also none of the cranks are given an input motion, however, the gear 8 is made as input to the mechanism. The working condition of the mechanism in this Phase depicts that, the tracer point C along with the coupler points B, D and G trace a fine curve. This is a clear indication of flawless working condition of the mechanism in Phase II. Further, it also indicates that, the input gear must be rotated with some specific input angle of motion in order to prevent the mechanism from any threats. The gear rotation is limited from 0^0 to 100^0 in this phase.

4. FUTURE PERSPECTIVE OF VARIABLE TOPOLOGY MECHANISM

The present paper on In-Line Ten Link Gear Slider Mechanism with Variable Topology explains clearly that, a mechanism having two degrees of freedom with gear combination shall be synthesized using variable topology method. The synthesized mechanism operating with gear as 'input' in both the phases shows that Phase I operates with some glitches when compared to error free operation in Phase II. Therefore, the scope of the present work is to identify the defects in the operation of the mechanism and to provide an error free operation.

5. CONCLUSION

A comparative study of functional aspects of In-Line Ten Link Gear Slider Mechanism of Variable Topology with the aid of linkage software predicts that, the synthesis of any mechanism can be under taken for simulation in linkage program in order to predict the working condition of the mechanism. The prediction of characteristics helps any designer to verify the observations and to develop a perfect operating mechanism.

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BIOGRAPHIES

H. M. Naveen, is serving as Assistant Professor, in Department of Mechanical Engineering, RYM Engineering College, Ballari since 2014.

Dr. Shrinivas S. Balli, has his Doctoral Degree from Allahabad University. He has published more than 22 Research Articles in International Journals/Conferences. He has Academic and Research experience of 30 years and currently serving as Professor and Head, Mechanical Engineering, BEC,

Dr. Umesh M. Daivagna, has his Doctoral Degree from VTU. He has published many Research Articles in International Journals/Conferences. He has Academic and Research experience of 25 years and currently serving as Professor, Mechanical Engineering, BITM, Ballari.