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Operations in Synthesized Eight Link Gear Variable Topology Mechanism using Python Programming

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ABSTRACT

This paper illustrates the implementation of python programming in the field of kinematics and helps the planners to visualize the working nature of the synthesized mechanism. In the present context, the authors have considered eight link gear variable topology mechanism in this paper which is synthesized using a complex number approach. This synthesized mechanism is studied using MATLAB programming and the various positions obtained are taken into the consideration for python programming. These advanced tools create an insight among the design engineers on the working nature of the mechanism. The operating condition of the synthesized eight link gear variable topology mechanism in two different phases is analyzed using python programming. This shows the mechanism operating condition in two different phases and validates the output obtained with the help of visualization results in mechanism orientation.

Keywords : Variable Topology Mechanism, Python Programming, Synthesized Eight Link Gear Mechanism

I. INTRODUCTION

As mechanism is defined as a mechanical device that serves the role of transferring the motion or force from an input link to an output link during the operation. This operation helps the mechanism to carry out different tasks that may be useful in one or the other way. The mechanism consists of links or bars connected by joints to form a closed loop. Further, mechanism may also contain lower pairs, higher pairs or combination of both pairs. Many mechanisms are in operation with five or more links having two degrees of freedom. The various methods which are in operation used to synthesize these mechanisms are abstract and complex.

In order to cope up with these difficulties faced by the kinematicians in such mechanisms can be made to operate in two or more phases as suggested in variable topology method. Thus this type of synthesis can be carried out smoothly and with least effort. This

proposed synthesized eight link gear mechanism with variable topology is working in two phases with one degree of freedom. The synthesis is carried out in each phase. Further, in each phase a link next to permanently fixed link is temporarily fixed. The resulting mechanism in eight link gear becomes like a seven link gear mechanism with one degree of freedom. In this context an effort has been made by the authors to illustrate the synthesized eight link gear mechanism in python programming.

II. REVIEW : AN OVERVIEW

Several studies have been conducted by the experts who have worked in the area of variable topology mechanism. The outcomes of these studies have been reviewed in present context. The study conducted by Shrinivas S. Balli and Chand [1] illustrated that, an analytical method can be used to synthesize five bar mechanism with variable topology. The work was carried out for movement between extreme positions of the mechanism for function generation. In continuation of the research work Shrinivas S. Balli and Chand [2] proposed the complex number method and utilized it to synthesize the mechanism having five links for motion and path generation tasks with variable topology for movement between extreme positions. Added to this Shrinivas S. Balli and Chand [3] suggested an analytical method to synthesize planar seven link mechanism with variable topology for motion between two dead centers. In continuation Gadad, Umesh M. Daivagna and Shrinivas S. Balli [4] focused on synthesis of planar seven link mechanism using triad and dyad with variable topology for the task function generation. Daivagna and Balli [5] dealt with synthesis process of an off-set five link slider mechanism with variable topology. Ren-Chung Soong, Kuei-Shu Hsu and Feng-Tsai Weng [6] applied a geared seven-bar mechanism for mechanical forming presses. Daivagna and Balli [7] synthesized a variable topology seven-bar slider mechanism to have motion between two dead-center positions. Volken, Eres Soylemez and Engin Tanik [8] presented an analysis and synthesis method for a geared four-bar mechanism. Daivagna and Balli [9] worked on the synthesis of variable topology mechanism with five-bar slider for finitely separated positions. Prashant and Balli [10] reviewed the works on variable topology method. H. M. Naveen, Shrinivas S. Balli and Umesh M. Daivagna [11] dealt with synthesis of eight link gear mechanism for motion generation. H. M. Naveen, Shrinivas S. Balli and Umesh M. Daivagna [12] dealt with synthesis of In-Line Ten Link Gear Slider Mechanism of Variable Topology. Prashant and Balli [13] synthesized a seven bar slider for limiting positions using variable topology. H. M. Naveen, Shrinivas S. Balli and Umesh M. Daivagna [14] presented the behavior of mechanism using linkage software. H. M. Naveen, Shrinivas S. Balli and Umesh M. Daivagna [15] dealt with the functional aspects of ten link gear slider mechanism. H. M. Naveen, Shrinivas S. Balli and Umesh M. Daivagna [16] worked on Phase III operating conditions in variable topology mechanism. H. M. Naveen, Shrinivas S. Balli and Umesh M. Daivagna [17] worked on alternative approaches in variable topology mechanisms. H. M. Naveen, Shrinivas S. Balli and Umesh M. Daivagna [18] dealt with transmission angles in eight link gear variable topology mechanism. H. M. Naveen, Shrinivas S. Balli and Umesh M. Daivagna [19] presented the solid edge 3D model of synthesized eight link gear variable topology mechanism. H. M. Naveen, Shrinivas S. Balli and Umesh M. Daivagna [20] presented the 3D model of ten link gear slider mechanism. Prashant and Balli [21] synthesized seven bar slider for dead center positions using variable topology method. H. M. Naveen, Shrinivas S. Balli and Umesh M. Daivagna [22] dealt with synthesis of geared slider crank mechanism. H. M. Naveen, Shrinivas S. Balli and Umesh M. Daivagna [23, 24] authors have dealt with variable topology mechanisms.

III. VARIABLE TOPOLOGY MECHANISM

The variable topology method is used to simplify the process of synthesis by reducing degrees of freedom. The eight link gear mechanism is reduced to a single degree of freedom seven link gear mechanism in two phases. The mechanism is designed to carry out different task in different phases. The complex number method, one of the analytical synthesis techniques is presented as an ideal tool for modeling linkages with groups of standard form of equations for motion, path and function generation. Hence the method of variable topology using complex number draws the attention of design engineers. The synthesized eight link gear mechanism in phase wise operation will be studied using Python Programming Language in the present context.

3.1 WORKING PRINCIPLE OF EIGHT LINK GEAR VARIABLE TOPOLOGY MECHANISM

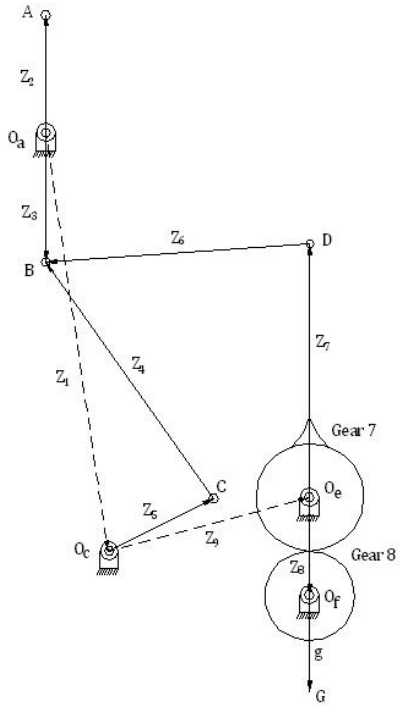

Figure 1 Eight Link Gear Variable Topology Mechanism

The eight link gear variable topology mechanism is presented in figure 1. This mechanism consists of links O_aA and O_cC working as input links. The permanently fixed ground link is O_aO_c. These input links are attached to links AB and CB, which in turn are attached to link DB, which acts as couplers of the considered mechanism. The coupler DB is attached to gear 7 at point D. This is an extension of gear 7, paired to gear 8. The extension O_eD is fixed on to gear 7 which oscillates along with it. The gear pair is mounted by a rigid link O_eO_f. Both the gears rotate on end pivot points of the rigid link. O_eO_f are said to be the axes of rotation for the pair of gears. When motion is given to any of the input link with the predefined condition of fixing the link temporarily in Phases, the obtained motion is transferred to the through links AB CB and DB to the link O_eD which will oscillates according to the desired input motion provided. The vector g (O_fG) represents the rotation of gear 8. With variable topology method this mechanism can be made to work in different Phases to carry out different tasks. This can be achieved by making one of the input links to be "active" and another input link to be stationary or temporarily fixed.

3.2 OPERATION OF EIGHT LINK GEAR VARIABLE TOPOLOGY MECHANISM IN PHASE I

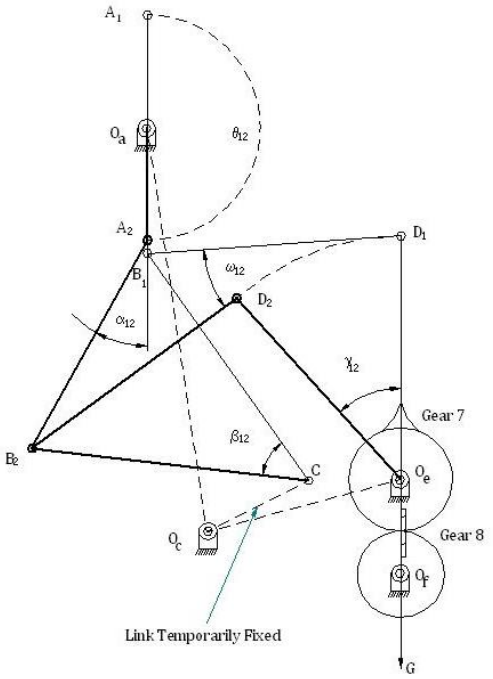

Figure 2 Operation of Eight Link Gear Variable Topology Mechanism in Phase I

The operation of mechanism in Phase I involve fixing of link O_cC temporarily and rest of the mechanism operates for a given input motion. In this Phase, the crank O_aA is made to move from 0^0 to 180^0 as shown in the Figure 2. These two reference angles are treated as starting and ending position of the mechanism which are operating in this Phase I.

3.3 OPERATION OF EIGHT LINK GEAR VARIABLE TOPOLOGY MECHANISM IN PHASE II

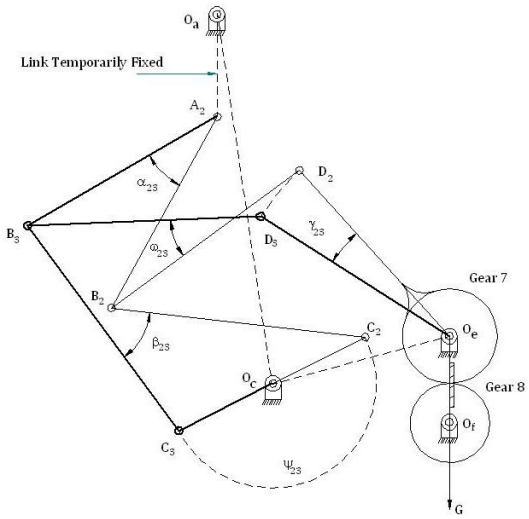

Figure 3 Operation of Eight Link Gear Variable Topology Mechanism in Phase II

The operation of mechanism in Phase II involves fixing of link O_aA temporarily and rest of the mechanism operates for a given input motion. In this Phase the crank O_cC is made to move from 0^0 to 180^0 as shown in the Figure 3. These two reference angles are treated as starting and ending positions of the mechanism which are operating in Phase II.

IV. IMPLEMENTATION OF PYTHON PROGRAMMING IN VARIABLE TOPOLOGY MECHANISM

The python programming language offers more flexible environment to study the positions of the mechanism. Here implementation of Python Programming in synthesized eight link gear variable topology has been discussed. In this context, the synthesized eight link gear variable topology mechanism is used in the present context using python programming. This mechanism is made to operate in two different phases, Phase I and Phase II. These positions of the mechanism operating for every

10^0 movement of crank angle in different phases are studied. The color used to indicate is the links of the mechanism shown in black color, fixed ground link in represented in blue color, temporary fixed link is represented in sky blue color and the movement of crank which acts as input to mechanism is represented with black tracing dotted line.

3.4 EIGHT LINK GEAR VARIABLE TOPOLOGY MECHANISM USING PYTHON PROGRAMMING IN PHASE I

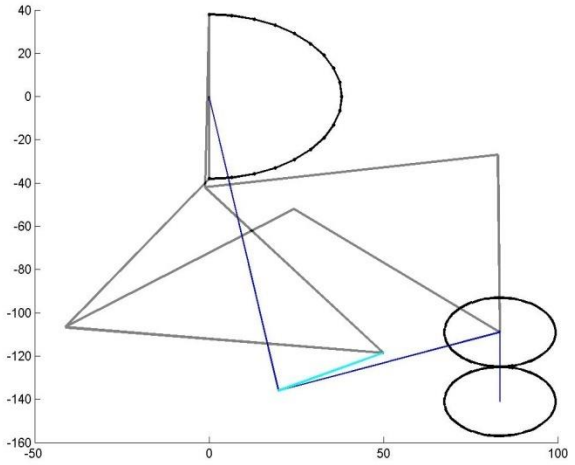

Figure 4 Eight Link Gear Variable Topology Mechanism using Python Programming in Phase I

The Figure 4 shows synthesized eight link gear variable topology mechanism operating in Phase I. In this Phase the mechanism operates in between two positions namely, Position 1 and Position 2. The Position 1 is the initial position in which the mechanism occupies the 0^0 crank angle orientations. Hence this position is treated as starting position of Phase I. As the crank move and reaches position 180^0 the mechanism is said to occupy Position 2 which is treated as ending position of Phase I. The same operation is represented using python programming.

4.2 POSITIONS OF EIGHT LINK GEAR VARIABLE TOPOLOGY MECHANISM USING PYTHON PROGRAMMING IN PHASE I

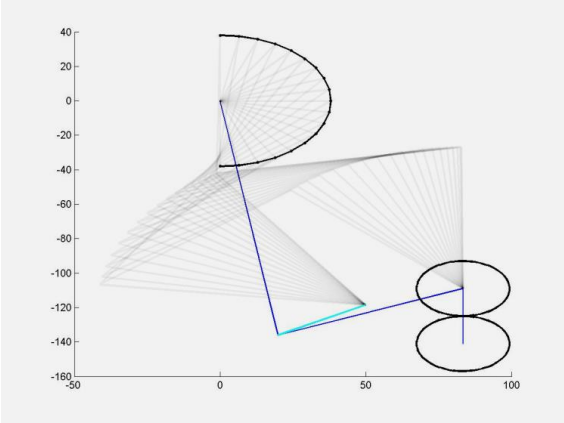

Figure 5 Positions of Eight Link Gear Variable Topology Mechanism using Python Programming in Phase I

As mentioned in the Section 4.1 the mechanism operates between two positions. The crank moves from 0^0 to 180^0. Because of this action the associated links change the orientations and that can be visualized with the help of python program. The movement of mechanism and change in orientation of links for every 10^0 movement of crank angle is taken into consideration and is represented in Figure 5.

4.3 EIGHT LINK GEAR VARIABLE TOPOLOGY MECHANISM USING PYTHON PROGRAMMING IN PHASE II

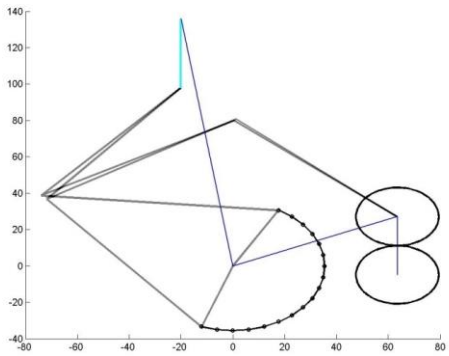

Figure 6 Eight Link Gear Variable Topology Mechanism using Python Programming in Phase II

The Figure 6 shows synthesized eight link gear variable topology mechanism operating in Phase II. In this Phase the mechanism operates in between two positions namely Position 2 and Position 3. Position 2 is the initial position in which the mechanism

occupies the 0^0 crank angle orientations. Hence this position is treated as starting position of Phase II. As the crank move and reaches position 180^0 the mechanism is said to occupy Position 3 which is treated as ending position of Phase II. The same operation is represented using python programming.

4.4 POSITIONS OF EIGHT LINK GEAR VARIABLE TOPOLOGY MECHANISM USING PYTHON PROGRAMMING IN PHASE II

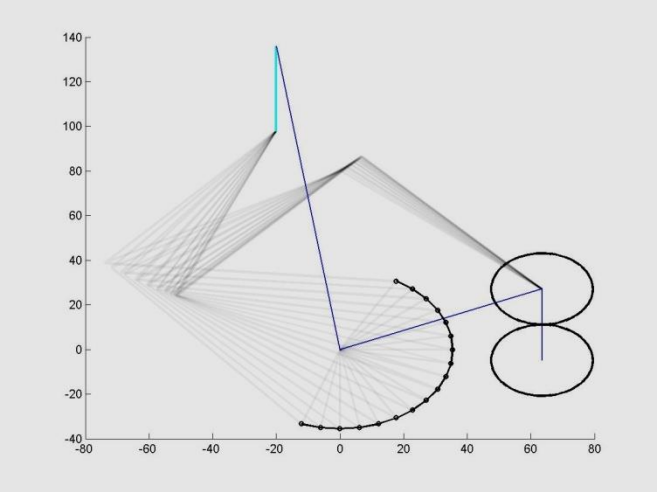

Figure 7 Positions of Eight Link Gear Variable Topology Mechanism using Python Programming in Phase II

As mentioned in the Section 4.3 the mechanism operates between two positions. The crank moves from 0^0 to 180^0. Because of this action the associated links change the orientations and that can be visualized with the help of python program. The movement of mechanism and change in orientation of links for every 10^0 movement of crank angle is taken into consideration and is represented in Figure 7.

V. CONCLUSION

The study of synthesized mechanism operation using python programming opens up a new field of study in kinematics research. With the help of MATLAB programming and Python programming languages the design engineers shall validate the obtained results by a comparative study. The present study carried out shows the mechanism operating condition in two different phases. This validates the output with the help of obtained visualization results in mechanism orientation.

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