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Dimensional synthesis of planar kinematic linkages has always been a vital area to augment the requirements of automation industry. A vast number of mechanisms have been dimensionally synthesized, but still there is need to invent useful mechanisms. The basic aim of dimensional synthesis is to determine principal dimensions and home position of all links along with their orientations of an envisageable mechanism for a specified kinematic task. The principal dimensions include link lengths i.e. pivot-to-pivot distances and angles of all types of links of the mechanism. The home position of each link is specified by angular positions with respect to frame of reference.

Dimensional synthesis of various kinematic linkages has been dealt by many researchers in the past and it is found that still, there is a need to explore new synthesis methodologies to overcome the limitations of existing methodologies. The specified kinematic task, which includes generation of prescribed path, motion or function, is an important consideration in dimensional synthesis of mechanisms. The existing methods are mainly based on carrying out dimensional synthesis of mechanisms between extreme positions for single tracing point, mechanism with limited number of intermediate precision points and optimal synthesis of mechanism. Therefore, there is a need to extend the research and perform dimensional synthesis of mechanisms between extreme positions for simultaneous tracing of two precision points which is required to perform sophisticated manufacturing operations in automation industry. This requires development of new methodologies to synthesize mechanisms with finite number of intermediate precision points and carry out their optimal synthesis.

In the proposed methodology of dimensional synthesis of mechanisms that transmit motion between extreme positions, the simultaneous tracing of two coupler points is taken into consideration. Most of the previous methods lacks in this respect. In the present research work, the proposed methodology is applied to conduct dimensional synthesis of a 5-bar 2 DOF planar kinematic linkage. The motion is transmitted by double tracing points of the mechanism between two extreme positions. The synthesis is carried out in two different stages for three kinematic tasks viz. path generation, motion generation and function generation. In each stage, the link adjacent to permanently fixed link is alternately fixed temporarily thereby reducing the DOF to 1. During the synthesis process, various dyad and triad equations in the form of complex numbers are generated

and subsequently solved. The proposed method is simple, non-iterative, offer reduced solution space and overcome the drawback of graphical techniques of limited accuracy.

Another proposed methodology is applied in the synthesis of those mechanisms having higher number of links that transmit motion for finite number of precision points. For this purpose, two planar kinematic linkages namely 6-bar Stephenson-III 1 DOF and 6-bar Stephenson-II 1 DOF are taken into consideration. The number of precision points for these two mechanisms is 12 and 15 respectively. The synthesis is carried out for each of these mechanisms on the basis of path generation only. During synthesis process, various dyadic and triadic loop closure equations are generated and subsequently solved. The parameters in these equations are identified as design parameters, prescribed parameters and assumed parameters. The equations are solved with the help of MATLAB code. This proposed method is also advantageous as the previous proposed method.

Finally, an optimal synthesis of a 6-bar Stephenson-I 1 DOF planar kinematic linkage is taken into consideration to reduce the position error between the actual path followed by the coupler tracing point and the desired path prescribed by the designer. The number of precision points considered is 12. The position error is calculated as the square root summation of square of Euclidean distances between each actual point followed and corresponding desired point. The objective function is generated to minimize the position error between the synthesized path and desired path of the linkage. The constraints are set that truly define the configuration and dimensions of the given linkage.

The optimization is carried out by applying Genetic Algorithm (GA) technique using MATLAB optimization toolbox. The optimal dimensions and orientations of various links of the given linkage so determined represent the optimal configuration of the linkage that has minimum error between synthesized path and desired path of the mechanism. The purpose of using GA optimization technique is to obtain reduced solution space with minimum position error between the actual path followed by the coupler point and the desired path prescribed by the designer for the linkage. The MATLAB programs are written for fast computation of various link dimensions and their orientations of the various mechanisms discussed above. These programs require input in terms of prescribed precision points and assumed parameters only.

The present research work proposes methodologies on dimensional synthesis of planar kinematic linkages that augment the requirements of automation industry and will facilitate in the invention of useful mechanisms that will be effective in tracing complicated paths having more number of precision points with minimum error.