ABSTRACT

Recognition of kinematic chains and mechanisms fall under the area of structural synthesis. The development studies of kinematic chains and mechanisms come into existence since past several years and researchers have been renovating along with significant improvement in the branch of structural synthesis. The fundamental plan of structural synthesis is to choose an appropriate mechanism for performing a particular kind of task at the conceptual phase of design. Structural synthesis includes the detection of isomorphism among the kinematic chains. The isomorphism recognition has discussed by various researchers and found to be exceptionally tedious task during the period of development of kinematic chains. The methods suggested so far by the other researchers in the past are mostly based upon characteristic polynomial of (0, 1) adjacency matrix, a few code-based approaches, distance and path based approaches and artificial intelligence approaches and so forth. The majority of these approaches are distinctness, or several contradictory examples have seen in literature. Hence, there is a scope of improvement and need to build up a computationally efficient and optimized approach for identifying isomorphism in kinematic chains and their resulting mechanisms.

In the present study, the skeleton matrix [S] and recognition of isomorphism between the planar kinematic chains (KCs) with the help of the identification strings (IS) are introduced. If isomorphism exists between the KCs, the resultant IS would be the same for the respective chains or vice versa. In order to detect isomorphism among the KCs, the IS considered as an invariant string of a KC. These invariants/identification codes enable the detection of isomorphism between the kinematic chains. The proposed method is easy, efficient, and accurate. Only a single identification string for a given kinematic chain is enough to recognize isomorphism as it fulfils both primary and secondary conditions for precisely detecting

isomorphism. Finally, the isomorphism problem among the KCs is demonstrated with the help of examples to reveal the reliability and credibility of the suggested method. No counter-argument has been seen to identify isomorphism up to 12 links planar KC. The square shortest link path [SSLP] matrix and classification string (CS) is established to recognize the distinct mechanisms resulted from the particular kinematic chain as well as for isomorphism recognition. First, square shortest link path [SSLP] matrix and classification string (CS) formulated. If isomorphism exists between the KCs, the CS would be the same for the respective chains or vice versa. Hence, the complete CS for KC is treated as the invariant to recognize isomorphism. When the corresponding row and column elements of [SSLP] matrix are replaced to zero turn by turn, therefore n-[SSLP-i] matrices are obtained that are a representation of n-mechanisms. Now the new structural invariants that called as the sum of absolute eigenvalues are obtained from [SSLP-i] matrices using the Matlab software. These invariants are treated as identification codes and enable the determination of unique mechanisms. The procedure explained with the help of illustrated examples and results of distinct mechanisms derived from kinematic chains up to 10 links, validated with the results discovered by other researchers (Mruthyunjaya, 1984), (Tischler et al., 1995), (Vijayananda,1994) and (Mohammad, 2006). The method tested for 8-links 1 dof, 9-links 2 dof and10-links 1dof KCs and the results displayed in the Tabular form (Tables7.1, 7.2 & 7.3).

The [SSLP] matrix is the map of the kinematic chain and mechanism hence the associated structural invariant also represent of the kinematic chain and mechanism. Therefore, the structural invariant absolute eigenvalues |ES| are represented on the Radar Chart, and structural similarity and dissimilarity examined with the help of superimposed Radar Chart of the two kinematic chains. These invariant have some inherent physical properties, but the mathematical proof is difficult to achieve.