Name: Ashok Kumar Dargar

Supervisor: Prof. R. A. Khan

Co- Supervisor: Dr. Ali Hasan

Faculty/Centre: Faculty of Engineering & Technology, JMI, New Delhi

Title of Thesis: Some Studies on Isomorphism and Inversions of Compound Kinematic Chains

ABSTRACT

Design of mechanisms is an important branch of mechanical design. For the invention and innovation of mechanisms structural synthesis and analysis of mechanisms are very important. Structural synthesis of kinematic chains usually involves the creation of a complete list of kinematic chains, followed by isomorphism detection. Detection of isomorphism is important, so that unnecessary duplication and omission of a potential useful chain may be avoided. Thus, it is essential to detect isomorphism from the point of view of time saving and correct synthesis of mechanism kinematic chain. Many methods are available to detect isomorphism among chains and inversions but each has its own shortcomings.

The work presented in this dissertation deals with an approach to develop easy, reliable and efficient methods to detect isomorphism among compound kinematic chains and among inversions of given kinematic chain and has been divided into two parts.

In the first part, two methods are developed for detection of isomorphism among single and multi degree of freedom kinematic chains. The first method is based on code approach in which using the second order adjacency of links and the loop characteristics of kinematic chains a new topological description the extended adjacency string [EAS], is proposed.

The second method is based on spectral approach in which kinematic chains are presented in the

form of a link connectivity matrix. Eigenvalues of these link connectivity matrices are used to detect isomorphism among kinematic chains.

The proposed methods have been found successful in distinguishing all known 1F, 6 links, 8 links, 10 links, 2F, 9 links and 3F, 10 links kinematic chains. Even the kinematic chains having co-spectral graphs are also distinguished with the proposed methods.

In the second part, two methods are developed to determine distinct mechanisms of compound kinematic chains. In the first method two structural invariants for each link, called as Direct adjacency link value [DALV] and, Extended adjacency link value [EALV] are proposed to detect distinct mechanisms of a kinematic chain. These invariants can be used as the composite identification number of a kinematic chain mechanism. The number of distinct mechanisms derived from 1F, 6, 8 and 10 links kinematic chains having simple joints are 5, 71 and 1832 respectively. The number of distinct mechanisms derived from 2F, 9 links and 3F, 10 links kinematic chains are 254 and 674 respectively.

In the second method eigenvectors of corresponding links derived from the link connectivity matrix are used to detect distinct mechanisms of a kinematic chain**.** The number of distinct mechanisms derived from 1F, 6, 8 and 10 links kinematic chains having simple joints are 5, 71 and 1842 respectively. The number of distinct mechanisms derived from 2F, 9 links and 3F, 10 links kinematic chains are 259 and 674 respectively.