A New Analysis Method of the Mechanisms Based on the Invariant Dimension of a Pair

March, 1993

Xinhua Ye

This article presents a new analysis method of the mechanisms based on the invariant dimension of a pair. The invariant dimension of a pair mentioned here is a geometric dimension (e.g., length, area, volume, direction, etc.) which is constant in the process of relative motion between two links composing a pair. In contrast to the previous method of establishing an equation for a loop, the present method establishes analysis equations of the invariant dimension for each pair. As the equations of invariant dimension were established with the help of the finite element method, they describe the mobility of both the pair and loop at the same time. Kinematic constraints and geometric constraints can be represented with the same formal equations. The most attractive feature of this method is that the concept is simple and the convergence is rapid.

In this report,we emphasize the description of the relationships between the invariant dimension of the pair and the mobility of the mechanism, and the derivation of analysis equations according to the invariant dimension for each pair. On other hands, in this report, simple analysis method, the equivalent, and sublink method, are also proposed for the kinematics analysis of the strongly coupled loops in a lower-pair mechanism. Compared with previous method, a nonlinear, single-variable equation can be deduced by this method, and a more precise solition of the position analysis of linkages can be obtained rapidly.