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The title of the series of lectures: The G_F Set Theory for Type Synthesis of Parallel Robotic Mechanisms

Abstract:

The topological design of robotic mechanisms has been one of the most important research issues for many years. There are many challenging problems in the topological design of robotic mechanisms, such as, what kind of mathematics is suitable for type synthesis of robots; what kind of performance criteria can be used for describing and evaluating the characteristics of end-effectors of robots; what kind of the basic laws for kinematic mobility can be utilized for establishing the computing rules for topology design of robotic mechanisms; how to search for the solutions defining the topologies for robotic mechanisms based on the performance criteria and the assumed laws? The series of lectures is going to introduce the performance criteria describing mechanism topologies law for kinematic mobility, the algorithms producing intersections of G_F sets, the design of kinematic limbs with specific G_F sets, the number synthesis model of parallel robots, the topology design of parallel robotic mechanisms and the applications of parallel robots.

Lecture 1:
G_F set definition and the basic laws as well as properties for topological design of parallel robotic mechanisms

Lecture 1 introduces the merits and demerits of several kinds of methods for topological design of parallel robotic mechanisms, such as Graph Theory, Group Theory, Screw Theory, Linear Transformation, Position & Orientation Characteristics Equations, and so on; the definition and classification of G_F Sets, the laws for kinematic mobility of rotations of robotic end-effectors, and properties of G_F Set Intersections.

Lecture 2: Algorithms producing Intersections of G_F sets

Lecture 2 introduces the intersection algorithms of the 1st Class G_F Sets only with tanslational characteristics, the intersection algorithms of the 1st Class G_F Sets with 1, 2 and 3 dimensional rotations, respectively; the intersection algorithms of the 1st and 2^{nd} class G_F Sets with 1, 2 and 3 dimensional rotations, respectively; the intersection algorithms of the 2nd Class G_F Sets with 1, 2 and 3 dimensional rotations, respectively.

Lecture 3: Number Synthesis and Design of Kinematic Limbs with Specific G_F sets

Lecture 3 introduces the relationship between the number of limbs, the dimension of the

end-effectors for parallel topologies, the number of actuators in the limbs and the number of passive limbs; the synthesis with specific G_F Sets; the theorems of axis movement in 2-D Plane and 3-D space, respectively; the kinematic limbs with specific G_F Sets.

Lecture 4: Topology Design based on G_F Set Theory and Some Applications of Parallel Robotic Mechanisms

Lecture 4 introduces the steps that have to be taken to design a parallel robotic mechanisms through replacing the specific G_F sets by corresponding kinematic limbs that have the same characteristics of the G_f sets.; some applications of parallel robotic mechanisms, such as 2-, 4- and 6-legged walking robots with parallel joints, 6-axis micro force and torque sensor with Stewart structure, 6-axis mouse based on force and torque control for virtual reality, 6-dof micro parallel manipulator with decoupled structure, 5-axis 5-dof horizontal parallel machine tool, device for micro-cutting and micro-manipulating chromosomes, parallel earthquake simulator with redundant inputs, 165mn heavy hydraulic forging press machine, 200t & 400t-m heavy forging manipulator etc.