

# The Qualitative Synthesis of Parallel Manipulators

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As shown in this paper, when designing parallel manipulators for tasks involving less than six degrees of freedom, the topology can be laid out by resorting to qualitative reasoning. More specifically, the paper focuses on cases whereby the manipulation tasks pertain to displacements with the algebraic structure of a group. Besides the well-known planar and spherical displacements, this is the case of displacements involving: rotation about a given axis and translation in the direction of the same axis (cylindrical subgroup); translation in two and three dimensions (two- and three-dimensional translation subgroup); three independent translations and rotation about an axis of fixed direction, what is known as the *Schönflies subgroup*; and similar to the Schönflies subgroup, but with the rotation and the translation about the axis of rotation replaced by a screw displacement. For completeness, the fundamental concepts of motion representation and groups of displacements, as pertaining to rigid bodies, are first recalled. Finally, the concept of  $\Pi$ -joint, introduced elsewhere, is generalized to two and three degrees of freedom, thereby ending up with the  $\Pi^2$ - and the  $\Pi^3$ -joints, respectively.