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# GRAPH REPRESENTATION OF PRECISION FLEXURE STAGES AND THEIR APPLICATIONS

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**Abstract.** Flexure stages are compliant mechanisms that are currently used for achieving the precise tri-dimensional location and manipulation of sensors, micromirrors, laser beams, with application to mechanical and medical devices, optics, robotics, metrology, and other recent applications related to metamaterials design. The topological structures of compliant mechanisms of flexure stages can be represented by graphs. Graphs are useful algebraic structures with a strong mathematical basis and well-established computer implementation. The authors have developed several designs of parallel flexures using the Freedom, Actuation and Constraints Topology (FACT) methodology (J. B. Hopkins, Ph.D. Thesis, M.I.T., USA, 2010), which is based on Screw Theory and leads to simple structures with a good performance in accuracy for the small displacements range. In this work, the general graph structure of the compliant mechanisms is firstly presented and some particular cases are then derived, including parallel, serial, and hybrid structures. Also, the graph representation of additional structures used to compensate parasitic errors are presented. Among several applications here enumerated, this representation will be used to solve an open problem: to find the relationship between the stiffness matrix and the information related to the orientation of the flexure elements. The applications and this problem are illustrated with designs taken from the literature.

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