Schröcker, Hans-Peter; **Pfurner, Martin**; **Schadlbauer, Josef**

Constraint varieties in mechanism science. (English) Zbl 1404.70005

Sitharam, Meera (ed.) et al., Handbook of geometric constraint systems principles. Boca Raton, FL: CRC Press (ISBN 978-1-4987-3891-0/hbk; 978-1-4987-3892-7/ebook). Discrete Mathematics and its Applications, 253-272 (2019).

Summary: In this chapter we took at constraint varieties of linkages from the viewpoint of mechanism science. There, not only abstract properties of linkages like flexibility (finite or infinitesimal) or configuration space topology are studied but also quantities that pertain to a concrete realization and to applications are of relevance. Examples include transmission ratios, joint forces, stiffness, collisions, or size. Moreover, additional problems like the construction of a linkage to accomplish a certain task ("linkage synthesis") or the computation and avoidance of "singular" configurations appear. Another speciality is the relevance of linkages with several degrees of freedom and the presence of different joint types. Linkages with as many degrees of freedom as the underlying motion group (three in case of SE(3)(2), SE(3)(2) or SO(3)(3), SO(3)(3) and six in case of SE(3)(3), SE(3)(3)) are quite common. Redundant manipulators with even more degrees of freedom are an active research topic.

Mechanism science is a rewarding field for many branches of applied mathematics. Here, we mainly focus on algebraic and geometric aspects via study parameters and dual quaternions. Progress in the field of computatonal algebraic geometry made this approach popular over recent years but, of course, transitional techniques from differential geometry, vector calculus or numerical mathematics remain indispensable as well.

For the entire collection see [Zbl 1397.05005].

MSC:

70B10 Kinematics of a rigid body
52C25 Rigidity and flexibility of structures (aspects of discrete geometry)