

A global approach for the redefinition of higher-order flexibility and rigidity

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Abstract: The famous example of the double-Watt mechanism given by Connelly and Servatius [Higher-order rigidity - What is the proper definition? *Discrete & Computational Geometry* 11:193-200, 1994] raises some problems concerning the classical definitions of higher-order flexibility and rigidity, as they attest the cusp configuration of the mechanism a third-order rigidity, which conflicts with its continuous flexion. Some attempts were done to resolve the dilemma but they could not settle the problem. According to Müller [Higher-order analysis of kinematic singularities of lower pair linkages and serial manipulators. *Journal of Mechanisms and Robotics* 10:011008, 2018] cusp mechanisms demonstrate the basic shortcoming of any local mobility analysis using higher-order constraints. Therefore we present a global approach inspired by Sabitov's finite algorithm for testing the bendability of a polyhedron given in [Local Theory of Bendings of Surfaces. *Geometry III*, pp. 179-250, Springer, 1992], which allows us (a) to compute iteratively configurations with a higher-order flexion (e.g. all configurations of a given 3-RPR manipulator with 3rd-order flexion) and (b) to come up with a proper redefinition of higher-order flexibility and rigidity.