EngOpt2018 - 6th International Conference on Engineering Optimization
Instituto Superior Técnico, Lisbon Portugal • 17-19 September, 2018
Editors: H.C. Rodrigues, J. Herskovits, C.M. Mota Soares, et al.

Abstract ID 1128

NODE TO NODE REQUIREMENTS ON THE SYNTHESIS OF MECHANISMS USING MINIMUM DISTANCE APPROACH

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Keywords: Linkages,Optimization,SQP

Abstract: The minimum distance method for the synthesis of mechanism is a versatile method able to help in the dimensional design of mechanisms with any kind of requirements. In previous work, this method was designed with node to point and node to line requirements, which allows one to afford function generation, path generation, solid guidance and any combination of them. It can also tackle problems with prescribed and unprescribed timing. The method is based on the minimum distance problem, which can be defined as obtaining the configuration of the mechanism (position of all the elements) which delivers the lower distance to the requirements. This problem is solved for each of the precision points defined for the synthesis and, the summation of all the minimized distances is used as the error function for the mechanism synthesis. This is, thus, a two-scale minimization problem, where the error function itself consists on several optimization problems. The aim of this presentation is to show a method for the introduction of node to node requirements in the dimensional synthesis of mechanisms when using the minimum distance approach. The presented method allows one to introduce a requirement on the distance of two points belonging to different elements of the linkage, which has multiple practical applications such as the design of grippers. In order to do so, the minimum distance into both nodes is included in the error function for each synthesis point including these kind of requirements. The minimization of the minimum distance function is performed with a sequential quadratic programming algorithm. The required derivatives are obtained analytically to reduce computational cost and improve on convergence. The minimization of the synthesis problem is also solved here using an SQP method, but the error function has been developed taking into account the possibility of applying other methods such as genetic algorithms. The requirement is introduced as an additional term in the minimum distance function, thus allowing one to combine it to other types of requirements, such as node to point or node to line. Although in an initial stage of development, the method shows a good behavior in terms of convergence and computational efficiency. In order to demonstrate this, several examples of both the minimum distance problem resolution and also the synthesis resolution are presented.