Optimize the synthesis error in an 8-bar Peaucellier-Lipkin mechanism using an objective function maximisation approach and application to load lifting.

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Abstract

This work deals with optimizing the synthesis error in an 8-bar Peaucellier - Lipkin mechanism, for its dimensional synthesis and applications in load-lifting machines. A new method for the formulation of the problem of maximizing the objective function is proposed and makes it possible to obtain from the PSO algorithm a minimum synthesis error e_{min}= 9.07E-06 mm for the generation of the straight trajectory when the search interval for the lengths of the bars is and a minimum error e_{min}= 1.47E-04 mm when the search interval is . For 10 simulations in case 1 the average convergence time is t_m = 55 s with the largest iteration at 10 (for t = 159 s); for 100 simulations in case 2, the t_m = 229 s with the largest iteration at 136 (for t = 2294 s). The minimum error of case 1 is compared with the results of authors in the literature on the generation of the right trajectory because the search space is approximately equal. In the literature, e_{min}= 0.648358 mm with the GA-DE algorithm in 2010, e_{min} = 2.3667E-005 mm with the MKH algorithm in 2016, e_{min} = 0.027145 mm with the SAP-TLBO algorithm in 2017, e_{min} = 3.7E-4 with the GA algorithm in 2019. This new method brings a plus, because even when the search space is very large, the algorithm converges quickly and it allows the study to be extended to the generation of circular trajectories by just modifying the ratio between the frame bar and the crank bar. The results of the post-design FEM analysis show that for a 1.4571 steel ($X_6CrNiMoTi_{17}$- 12- 2) with a thickness of 50 mm and a joint with a radius of 500 mm, the mechanical device obtained can support a load of 1500 kg.

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