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On the Equilibria and Bifurcations of a Rotating Double Pendulum

The double pendulum, a simple system of classical mechanics, is widely studied as an example of, and testbed for, chaotic dynamics. In 2016, Maiti et al. [Phys.Lett.A 380 p.408-412] studied a generalization of the simple double pendulum with equal point-masses at equal lengths, to a rotating double pendulum, fixed to a coordinate system uniformly rotating about the vertical. In this work, we have studied a considerable generalization of the double pendulum, constructed from physical pendula, and ask what equilibrium configurations exist for the system across a comparatively large parameters space, as well as what bifurcations occur in those equilibria. Elimination algorithms are employed to reduce systems of polynomial equations, which allows for equilibria to be visualized, and also to demonstrate which models within the parameter space exhibit bifurcations. We find the DixonEDF algorithm for the Dixon resultant, written in the computer algebra system Fermat, to be capable to complete the computation for the challenging system of equations that represents bifurcation, while attempts with other algorithms were terminated after several hours.