INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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SHORT ABSTRACT

We built prototypes of scissor linkages where it was noticed that angled-plane scissor linkage has significantly smaller lateral sway when compared with parallel-plane scissor linkage. It was further noticed that this observation has not received any attention in the literature and we took it up for mechanics-based investigation. Our approach involved first considering an ideal scissor linkage where the links are rigid, the revolute joints are perfect and the assembly of links and joints is also perfect. In such an ideal case, the scissor linkage would not have lateral sway no matter whether it is angled-plane scissor linkage or parallel-plane scissor linkage. To such an ideal scissor linkage, what non-ideality should be added so that significantly different lateral sway could be deduced from equations of mechanics? As an answer to this motivating question, in this thesis, we show that if the revolute joints are allowed to undergo a limited misalignment, then the significantly different lateral sway could be demonstrated both numerically and analytically using equations of kinematics. This constitutes the central and the original contribution of the thesis. One of the ways in which rigid multibody systems are modelled is that the rotational and the translational variables of each rigid body together constitutes a set of variables and every joint contributes to a set of constraints. When we allow limited misalignment, some of the equality constraints take slack variables and the slack variables themselves are limited to a small range of values. When we model a parallel-plane or an angled-plane scissor linkage in this manner, we have variables, equality constraints and inequality constraints. We also define an objective as the average displacement of the topmost points of the scissor linkage along their respective swaying directions. With this we have an optimization problem. It is through numerical solution or linearized analytical analysis of this optimization problem that we deduce the results. One of the interesting analytical results is that as the number units in a scissor linkage is increased, the lateral sway in the case of parallel-plane scissor linkage increases in arithmetic progression whereas in the case of angled-plane scissor linkage, it increases in an often-converging geometric progression. The prototyping exercise also involved static balancing the scissor linkage. There are more than one static balancing methods. In order to rationally rank them, we explored if the frictional effort in different methods could be used. All these auxiliary results are tied to the main contribution in the sense that all these results have roots in the prototyping exercise.