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STRUCTURAL TOPOLOGY OPTIMIZATION OF A MODULAR SNAKE-LIKE MANIPULATOR

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This contribution concerns a snake-like robotic manipulator arm proposed first in [1]. The manipulator is composed of linearly but nonaxially joined identical modules with a possibility of relative twist, which amounts to one degree of freedom per module. It is an example of an extremely modular system [2], and its advantages are: economization (due to modularity and possible mass production) and robustness (easy repair by replacement of a failed module). The hitherto research involved the possible geometric transformations of the manipulator arm [3], but not its structural optimization. However, structural design of the involved modules is a challenging task, as the process has to take into account the relative position of the module along the arm, as well as the variety of global configurations of the deployed manipulator. It leads to a multi-load structural optimization problem with a significantly large number of loads. This contribution considers topology optimization of such a modular manipulator structure. Due to the large variety of possible load conditions, the initial analysis involves a 2D model of the structure with a discrete set of two possible relative arrangements of adjacent modules. Such a formulation allows the proposed approach to be preliminarily explored, tested and optimized in a numerically manageable simplified environment.

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References

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