An adaptive structure with a metamorphic robotic system

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ABSTRACT

Adaptive structures have the ability to alter their configuration or form in response to environmental changes. Metamorphic robotic systems are self-reconfigurable mechanisms, which are able to change their shape autonomously [1]. These systems consist mostly of rigid cubical or spherical cells which are able to reconfigure itself, but they cannot change the shape of the cells. The recently developed metamorphic robotic system PARTS [2], as shown in Fig.1a), has adaptive triangular cells (ATC) and the ability to change the shape of the cells. Through the connection of multiple cells at their side edges, the system can exactly recreate general triangular meshes. Furthermore, if using tetrahedral instead of triangular cells together with miniaturization, programmable matter can be achieved. The main part of the present contribution concerns the modelling of the triangular cells, specifically the six-bar-linkage as shown in Fig.1b) with elastic trusses and rods (for bending) to get an accurate prediction of the positioning error of the idealized prescribed movements of the underlying triangular mesh due to compliance, bearing clearance and actuator inaccuracies. The modelling of bending stiffness follows the finite segment method, which allows to use only rigid bodies and springs for the whole model [3]. In order to verify our model, the relative movements of the cells at given actuator strokes were measured with a motion tracking system and compared with the results from the model. The use of simplified models of the real kinematics of the adaptive self-reconfigurable mechanism provides the possibility to correct the linear actuators to minimize the positioning errors and to directly set the desired triangular shapes.

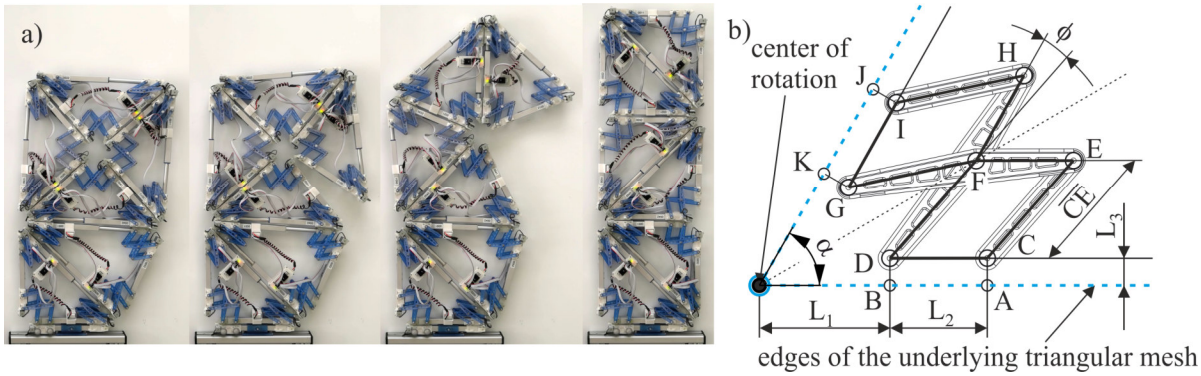

Figure 1: a) PARTS alter its form through reconfiguration of the cells; b) Top view of a six-bar-linkage.

REFERENCES

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