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NUMERICAL SIMULATION OF BEHAVIOUR AND EXPERIMENTAL VERIFICATION OF PNEUMATIC AND SMA ACTUATORS IN HYPER-MOBILE PNESTIFMATIC JOINT

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Summary: Hyper mobile joints have application in various mechanisms in which it is required to have a considerable ability of manipulability with the greatest degree of freedom possible. In our case, the PNESTIFMATIC hyper mobile joint is used as a main component of a hyper redundant robotic manipulator. The original joint mechanism is based on a US6870343 B2 patent draft, which was subsequently extended by a platform for more precise positioning and correction of the overall stiffness. Correction mechanical members and actuators consisting of SMA springs were added into the mechanism. Main content of the article is dedicated to numerical modeling, pneumatic bellows and experimental verification of SMA hyper mobile joint actuators. Numerical modeling consisted of FEM analysis of a pneumatic bellow in SolidWorks programme, in which non-linear dynamic task was solved. Hyper elastic Mooney Rivlin model was considered within the process of solving of this task. Definition of Rayleigh damping coefficients according to the work of Chowdhury and Dasgupta was also considered. Shift, velocity and acceleration values of expansion of pneumatic bellows were drawn from post processing. In the section dedicated to experimental verification of SMA actuators, verification of various SMA springs with different stiffness coefficients was carried out. It helped us to obtain dependencies of shift on the supply current and values of the induced forces.