Abstract

This thesis attempts to reimplement a Cosserat beam model implementation called PyCTR of the mechatronics group of Technische Universiät Ilmenau in a low-level programming language to improve computation time without losing correctness and accuracy. The implementation is based upon Rucker's mathematical model of concentric tube robots that uses the Cosserat rod theory. Two numerical approximation methods are used to solve the initial value problems (IVPs) of the model. The explicit Euler and classical Runge-Kutta methods are inspected to determine the better option for faster yet accurate implementation. A single tube simulation is performed, and the data are used to inspect the behavior of each IVP solver. Position and rotation of the tube's tip in a specific test case are used as a convergence criterium for the numerical solver. The classical Runge-Kutta method shows better accuracy at a smaller computational burden. This bachelor thesis lays the foundation for implementing the complete elasto-static behavior in C++ programming language. It is desirable to continue working on the implementation of the elasto-static problem for future work.

Keywords: concentric tube robots, continuum robots, low-level implementation, Cosserat beam, elasto-static behavior.