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Fractional order control of a soft robotic neck

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In this work we describe the fractional order control approaches tested in a soft robotic neck with two Degrees of Freedom (DOF), able to achieve flexion, extension, and lateral bending movements similar to those of a human neck. The design is based on a cable-driven mechanism consisting of a NinjaFlex link acting as a cervical spine and three servomotors actuated tendons that allow the neck to reach all desired inclinations and orientations.

The prototype was manufactured using a 3D printer. Two control approaches are proposed and tested experimentally: a motor position approach using encoder feedback and a tip position approach using Inertial Measurement Unit (IMU) feedback, both applying fractional order controllers. The platform operation is tested for different load configurations so that the robustness of the system can be checked.

Besides, the results from the integration of the neck in the real humanoid robot TEO are presented, together with those from the replacement of the servomotors by Shape Memory Alloy (SMA) actuators.

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