Low voltage driven dielectric electro active polymer actuator with integrated piezoelectric transformer based driver - DTU Orbit (27/12/2018)

Low voltage driven dielectric electro active polymer actuator with integrated piezoelectric transformer based driver

Today’s Dielectric Electro Active Polymer (DEAP) actuators utilize high voltage (HV) in the range of kilo volts to fully stress the actuator. The requirement of HV is a drawback for the general use in the industry due to safety concerns and HV regulations. In order to avoid the HV interface to DEAP actuators, a low voltage solution is developed by integrating the driver electronic into a 110 mm tall cylindrical coreless Push InLastor actuator. To decrease the size of the driver, a piezoelectric transformer (PT) based solution is utilized. The PT is essentially an improved Rosen type PT with interleaved sections. Furthermore, the PT is optimized for an input voltage of 24 V with a gain high enough to achieve a DEAP voltage of 2.5 kV. The PT is simulated and verified through measurements on a working prototype. With the adapted hysteretic based control system; output voltage wave forms of both impulse response and sinusoidal shapes up to 2.5 kV are demonstrated. The control system, together with a carefully designed HV output stage, contributes to low power consumption at a static DEAP force. The HV stage consists of a HV measurement circuit and a triple diode voltage doubler optimized for low leakage current drawn from the DEAP. As a result, a 95 mm x 13 mm x 7 mm driver is integrated in a 110 mm x 32 mm actuator, forming a low voltage interfaced DEAP actuator.

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