This paper presents an overview of the widely used conventional linear actuator technologies and existing electroactive polymer based linear and rotary actuators. It also provides the conceptual, control and driver design considerations for a new dielectric electro-active polymer (DEAP) based incremental actuator. The DEAP incremental actuator consists of three independent DEAP actuators with a unique cylindrical design that potentially simplifies mass production and scalability compared to existing DEAP actuators. To accomplish the incremental motion, a high voltage (HV) bidirectional DC-DC converter, independently charges and discharges each capacitive DEAP actuator. The topology used for the HV driver is a peak current controlled bidirectional flyback converter. The scalability of the proposed DEAP incremental actuator is discussed, and different scaled designs are provided. The estimated speeds and forces for various scaled incremental actuator designs are provided. The HV drivers are experimentally tested with a prototype of the DEAP incremental actuator. The energy efficiency measurement results of one of the HV driver are presented. The DEAP incremental actuator prototype achieved bidirectional motion with a maximum velocity of 1.5 mm/s, at 2.87 Hz incremental driving frequency, when all actuators are driven with 1.8 kV. Finally, two new improved concepts of DEAP based incremental actuators are presented.

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