Piezo actuators are used for various applications such as aerospace vibration control, precision flow control, fuel injection system, ultrasonic transducer, energy harvesting etc. The advantages of these actuators are fast response time, precise displacement control, repeatability, non-interference, low energy consumption, miniature in size etc.

**Capabilities**

- Fabrication of multilayered PZT stacks into usable forms of devices.
- Fabrication of different types of amplified PZT actuators.
- Measurement of strain / elongation %, linear piezo-coefficient, etc.

Multilayered stacks are fabricated by tape casting technique. Few fabricated multilayered stacks and amplified actuators are given below.

**Specification of ML stack**

- No. of active layers: 120
- Layer thickness: 100 μm
- Height: 10 mm
- Weight: 9.4 g
- Area (l x w): 132 mm²
- Block Force: 5200 N
- Displacement: 10-12 μm

**APA-2**

- Displacement: 28 μm
- Amplification factor: ~ 2.5
- Applied Voltage: 150 V

**APA-4 slim**

- Gross Weight: 19.50gms
- Displacement of APA: 80 μm
- Amplification factor: ~ 4.00
- Applied Voltage: 195 V

**APA-6 slim**

- Gross Weight: 26.50gms
- Displacement of APA: 173 μm
- Amplification factor: ~ 4.32
- Applied Voltage: 175 V

**APA-4**

- Gross Weight: 50.89gms
- Displacement: 112 μm
- Amplification factor: ~ 4.3
- Applied Voltage: 150 V

**Test set up for displacement measurement of ML stacks**

**Displacement characteristic of APA-6 slim**
Characterization of an Amplified Actuator (APA 6)

- Actuator was characterized at different frequency (100 Hz - 1 kHz) and different AC voltages (20V- 40V).
- The performance of the APA was found very well over this frequency range without attenuation of the signal.
- Capacitance of the APA was 2.66 µF similar to imported actuator.

The frequency responses recorded by an oscilloscope at 40 volts maximum sinusoidal peak-to-peak amplitude.

- The stack is responding quite well for low level inputs from a frequency of 125 Hz onwards.
- Both the waveforms namely, input to the stack actuator and accelerometer output is showing no distortion thereby indicating the stack actuator assembly is behaving linearly in the present experimental conditions.

![Actuator response at 125 Hz](Image)

![Actuator response at 250 Hz](Image)

![Actuator response at 500 Hz](Image)

![Actuator response at 1 kHz](Image)

**Future Directions**

To develop various types of actuators / sensors (Amplified actuators, multi-morphs and other special type actuators) catering to the needs of aerospace, defence, automotive and other industries.

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