Simultaneous optimization of structure and electrode layouts for in-plane piezoelectric sensors and actuators

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A systematic procedure to simultaneously design the shape of the structure and the electrode layout, in a piezoelectric sensor o actuator moving in-plane, is described. The technique allows maximizing any electromechanical coupling or output efficiency of the transducer. Either the output current collected at the electrodes when a mechanical force is applied (sensors), or the in-plane displacement when a given voltage is applied to the electrodes (actuators) can be optimized. The method can be applied to both static and dynamic responses. Besides force and displacement sensors, due to the reciprocal relationship between piezoelectric sensors and actuators, many MEMS-based actuators like micro-grippers, surface probes, or micro-optical devices can be optimized following this procedure [1,2]. A similar approach has been desmonstrated previously in modal sensors/actuators, although restricted to the design of the electrode layout for a given structure [3]. The novel method allows the simultaneous optimization of both shapes, for electrode and structure.

Finally, it is important to point out that the situation treated to date can be considered as the previous case of a more general and interesting problem in the context of modal filtering to be dealt with in the near future.

References

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