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Flexible Contact Force Sensing Device Using Metal/Polymer Multilayer Structure for Robotic Applications

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In this paper we propose and demonstrate novel flexible contact force sensing devices for 3-dimensional force measurement. To realize the sensor, polyimide and polydimethylsiloxane are used as a substrate, which makes it flexible. Thin-film metal strain gauges, which are incorporated into the polymer, are used for measuring the three-dimensional contact forces. The force sensor characteristics are evaluated against normal and shear loads. The fabricated force sensor can measure normal loads of up to 4 N. The sensor output signals are saturated against loads over 4 N. Shear loads can be detected by voltage drops in the strain gauges. The device has no fragile structures; therefore, it can be used as a ground reaction force sensor for balance control in humanoid robots. Four force sensors are assembled and placed in the four corners of a robot's sole. By increasing the bump dimensions, the force sensor can measure loads of up to 20 N. When loads are exerted on the sole, the ground reaction force can be measured by these four sensors. The measured forces can be used in the balance control of biped locomotion systems.

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