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主 論 文 の 要 旨

論文題目 Polymer-micromachined Table-shaped Flexible Tactile Sensor （ポリマーマイクロマシニング技術を用いたテーブル型フレキシブル触覚センサに関する研究）

氏 名 LEE Jeong Il

論 文 内 容 の 要 旨

This thesis describes the development of a flexible tactile sensor that has a three-dimensional table-shaped sensing part for equipment on an intelligent robot ' s fingertips. We proposed a sensing principle and experimentally demonstrated a new type of tactile sensor that can detect three-dimensional forces and has suitable flexibility and good sensitivity. We developed required polymer-micromachining technology applicable for the sensor.

To amplify the contact signal, a three-dimensionally designed table-shaped sensing element was attempted. A table-shaped epoxy sensing plate with four legs was built on top of a flexible and thin polymer substrate. This structure could effectively convert an external acting force into the concentrated internal stress. The normal and tangential forces could be detected by combining responses from metal strain gauges on the polymer substrate. Triaxial force detection was calculated by combining two-dimensional mapping data on the basis of strain distribution calculated by finite element analysis (FEA) simulation. The external loads applied to the sensor could be detected as a function of the strain-gauge responses. To fabricate a three-dimensional structure of polymer-based sensor, we propose a new fabrication method in polymer-micromachining technologies such as thermo-compatible layer-by-layer process and thick sacrificial layer without wet or dry etching process. Moreover, three-dimensional structure patterning of up to 60-μ m thickness was achieved by using a photo-definable lithography process with a photoresist material as a thick sacrificial layer.

The fabricated flexible tactile sensor was calibrated under normal and tangential forces by using the evaluation apparatus. The sensor showed the sensitivity in terms of normalized resistance. Furthermore, normal and tangential force components showed good linearity to applied force.