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# Wearable Fingertip Force Measurement Device based on Fingertip Deformation using a Single 3-axis Force Sensor

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***Abstract*—This demo presents an estimation approach utilizing a single 3-axis force tactile sensor to measure and predict fingertip forces and deformations during actual operations, facilitating skill transmission and tactile simulation in precision assembly tasks.**

## I. INTRODUCTION

In traditional craftsmanship training and precision assembly tasks, fingertip force and deformation are crucial factors. Precisely measuring and predicting fingertip forces and deformation during actual operations can significantly enhance the assessment and teaching of skill quality.

In this demonstration, we present a wearable fingertip deformation sensor utilizing a single 3-axis MEMS force sensor. MEMS technology allows the integration of compact sensors directly onto the fingertip, enabling accurate measurement of fingertip force and skin deformation. The advantage of using a single, miniaturized sensor over previous dual-sensor setups provides greater freedom under natural contact conditions, facilitating precise measurement during delicate manual tasks (Fig.1).

## II. DEMONSTRATION

The demonstration consists of three main steps:

(1) wearing the device and ensuring a stable sensor position,

(2) performing calibration by pressing and tilting against a flat surface

(3) executing a target task such as writing or object manipulation.

The recorded lateral force signals are applied to the user-specific model to compute predicted deformation and normal force. Attendees can observe the real-time motion alongside the post-processed estimation output.

In this demonstration, a customized 3D-printed finger fixture is used to secure the sensor on the lateral side of the fingertip, enabling the real-time acquisition of force signals during natural finger movements (Fig.2). The measured lateral force is processed through a pre-identified transfer function model to estimate the corresponding deformation at the fingertip contact surface. Prior to the demonstration, each user undergoes a brief calibration procedure to derive a personalized transfer function, which is then applied for subsequent estimation.

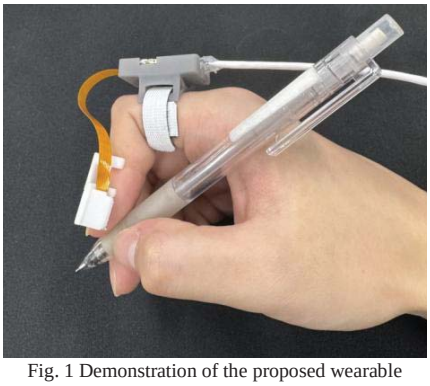

Fig. 1 Demonstration of the proposed wearable tactile sensor in a writing task

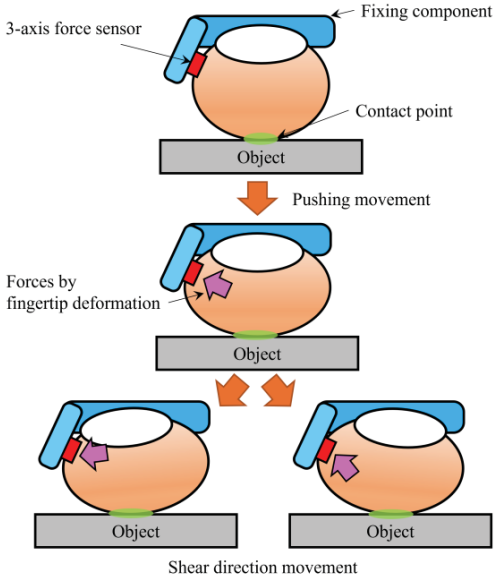


Fig. 2 Deformation estimation process

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