Training Tactile Sensors to Learn Force Sensing From Each Other

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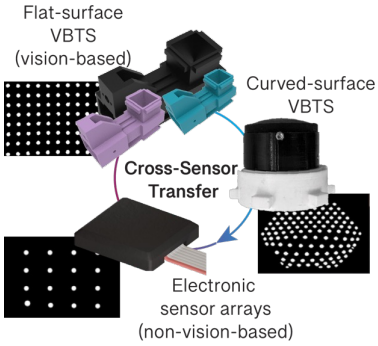
Videos & Project page

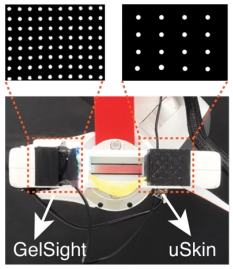
Abstract

Humans achieve stable and dexterous object manipulation by coordinating grasp forces across multiple fingers and palms, facilitated by a unified tactile memory system in the somatosensory cortex. This system encodes and stores tactile experiences across skin regions, enabling the flexible reuse and transfer of touch information. We present **GenForce**, **the first framework that enables transferable force sensing across diverse tactile sensors in robotic hands**. GenForce unifies tactile signals into shared marker representations, allowing force prediction models trained on one sensor to be transferred to others without the need for exhaustive force data collection. We demonstrate that GenForce generalizes across both homogeneous sensors with varying configurations and heterogeneous sensors with distinct sensing modalities and material properties. This transferable force sensing capability is also demonstrated in robot manipulation including daily-object grasping, slip detection and compensation with multi-sensor force coordination. Our results highlight a scalable paradigm for cross-sensor robotic tactile sensing.

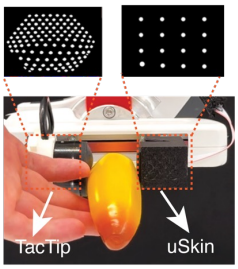


Highlight

1. **Unified tactile representation:** Binary marker image
2. **Transfer direction:** Many-to-many, bidirectional
3. **Material:** Flat and curved surfaces, varied materials
4. **Scalability:** Scales to new sensors within one model
5. **Generalizability:** Homogeneous & heterogeneous
6. **Applicability:** Real-time multi-sensor force control

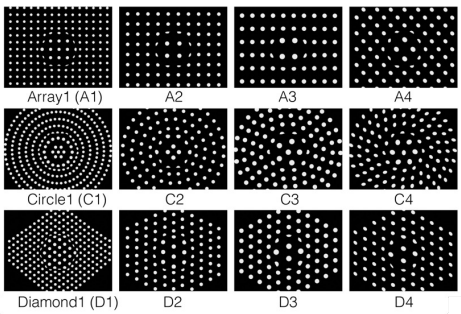


Robot grasping

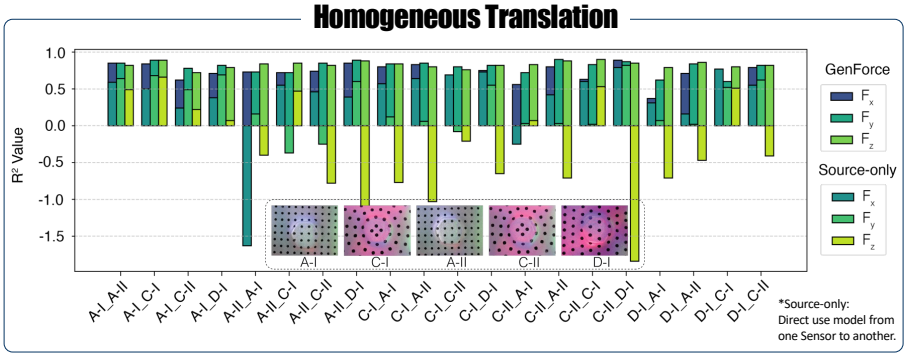


Slip Compensation

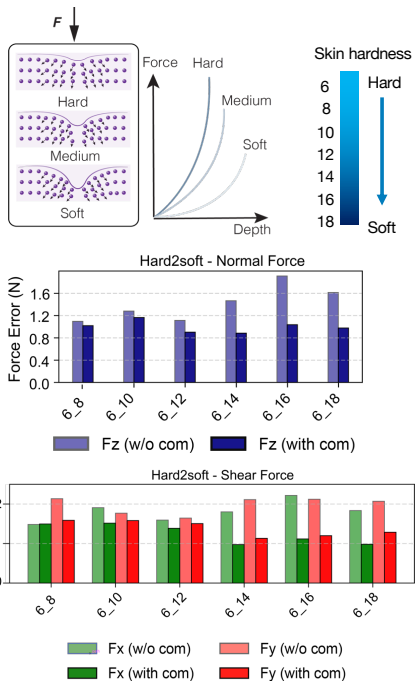
Arbitrary Marker Translation-Simulated



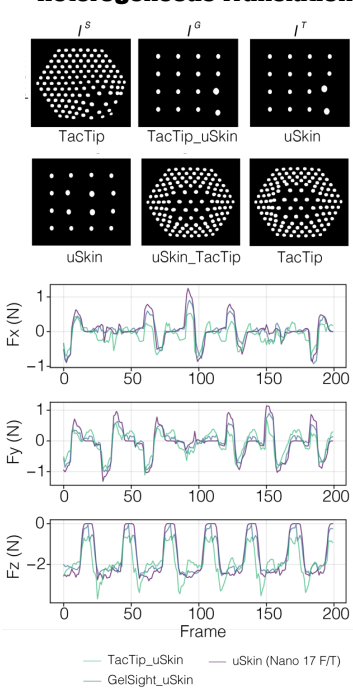
Homogeneous Translation



Material Compensation



Heterogeneous Translation



Robot Manipulation – Multi-sensor Coordination