16-848: Reference list for Monday, April 3rd

Today we started with a detailed look at the following paper, which attempts to reconstruct both object state and object geometry during in-hand manipulation:

Suresh, Sudharshan, Haozhi Qi, Tingfan Wu, Taosha Fan, Luis Pineda, Mike Lambeta, Jitendra Malik et al. "Neural feels with neural fields: Visuo-tactile perception for in-hand manipulation." *arXiv preprint arXiv:2312.13469* (2023).
https://suddhu.github.io/neural-feels/

For more on how the manipulation policy was created, see this paper:

Qi, Haozhi, Brent Yi, Sudharshan Suresh, Mike Lambeta, Yi Ma, Roberto Calandra, and Jitendra Malik. "General in-hand object rotation with vision and touch." In *Conference on Robot Learning*, pp. 2549-2564. PMLR, 2023.
https://haozhi.io/rotateit/

The Neural Feels project used the DIGIT sensor. You can find out more here:
https://digit.ml/
https://pages.gelsight.com/digit-tactile-sensor

We then took a look at sensing in fully soft body pneumatic robots. This paper describes an algorithm for proprioceptive sensing using an internal camera:

Yoo, Uksang, Hanwen Zhao, Alvaro Altamirano, Wenzhen Yuan, and Chen Feng. "Toward zero-shot sim-to-real transfer learning for pneumatic soft robot 3d proprioceptive sensing." In *2023 IEEE International Conference on Robotics and Automation (ICRA)*, pp. 544-551. IEEE, 2023. https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=10160384

Proprioception can also be accomplished through audio sensing with a microphone array, as in this paper:

Yoo, Uksang, Ziven Lopez, Jeffrey Ichnowski, and Jean Oh. "POE: Acoustic Soft Robotic Proprioception for Omnidirectional End-effectors." *arXiv preprint arXiv:2401.09382* (2024).
https://arxiv.org/abs/2401.09382

We discussed how GelSight style contact sensing can be done with such a robot as well by mounting an arrangement of internal LED lights (work in progress).

We then turned to an examination of impedance based sensing with the BioTac. Here are two references to start with:

Lin, Chia Hsien, Todd W. Erickson, Jeremy A. Fishel, Nicholas Wettels, and Gerald E. Loeb. "Signal processing and fabrication of a biomimetic tactile sensor array with thermal, force and microvibration modalities." In *2009 IEEE International Conference on Robotics and Biomimetics (ROBIO)*, pp. 129-134. IEEE, 2009.
https://ieeexplore.ieee.org/abstract/document/5420611

Wettels, Nicholas, Jeremy A. Fishel, and Gerald E. Loeb. "Multimodal tactile sensor." *The Human Hand as an Inspiration for Robot Hand Development* (2014): 405-429.
https://link.springer.com/chapter/10.1007/978-3-319-03017-3_19

Interpreting the sensor signals can still be a challenge, as shown in this paper:

Narang, Yashraj S., Balakumar Sundaralingam, Karl Van Wyk, Arsalan Mousavian, and Dieter Fox. "Interpreting and predicting tactile signals for the syntouch biotac." *The International Journal of Robotics Research* 40, no. 12-14 (2021): 1467-1487.
https://journals.sagepub.com/doi/full/10.1177/02783649211047634

We then turned to magnetic sensing, with a look at this paper:

Bhirangi, Raunaq, Abigail DeFranco, Jacob Adkins, Carmel Majidi, Abhinav Gupta, Tess Hellebrekers, and Vikash Kumar. "All the Feels: A dexterous hand with large-area tactile sensing." *IEEE Robotics and Automation Letters* (2023).
https://ieeexplore.ieee.org/abstract/document/10295987

Lastly, we had a look at a 3D printed hand with built-in capacitive (proximity) and air-pressure sensing

Sean Taylor, Kyungseo Park, Sankalp Yamsani, and Joohyung Kim, “Fully 3D printable Robot Hand and Soft Tactile Sensor based on Air-pressure and Capacitive Proximity Sensing,” IEEE International Conference on Robotics and Automation (ICRA2024),
https://publish.illinois.edu/kimlab2020/publications/
https://www.youtube.com/watch?v=nfkQoAKzq0U