Pattern Recognition

Coursework Overview 2025

Coursework

- Work in pairs
- 4 page report (overleaf template provided)
- Non-key figures can be placed in appendix (please reference carefully)
- Submit Matlab code
- Deadline – 14th February 23:59

- Topic – **Robotics** & **Haptics**
- This session we'll talk about the **background** and **motivation** for the coursework

Haptics

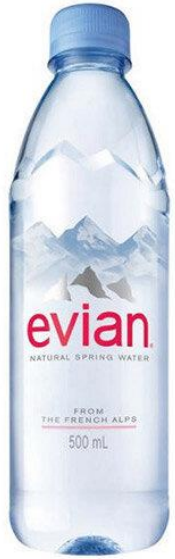
Science and Technology related to the
Sense of Touch

Haptics

Kinaesthetic

Tactile

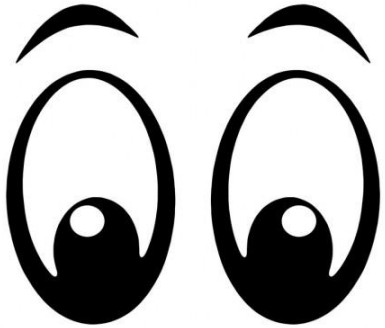
Looking for keys



Haptics

- Haptics can help us when vision fails
- He can **augment** the **occluded view** by using his sense of touch to identify key-like object properties
  - Hard
  - Cold
  - Articulated (keys can move independently to key ring)

Haptics



- We often use **vision** to identify objects and infer information

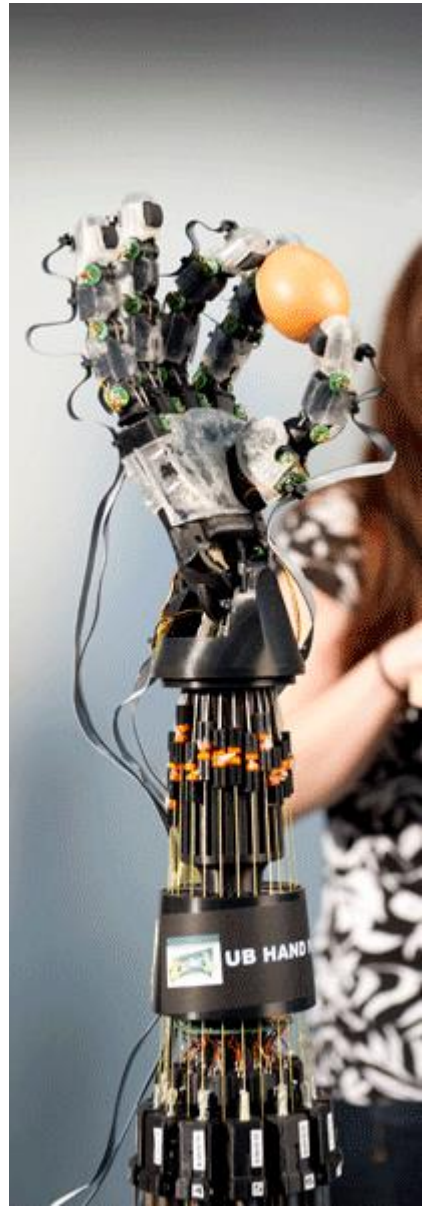
- Touch has generally been much less researched than vision in artificial systems
- Touch gives us different types of information
- Touch sensing is often associated with manipulation

Haptics

- Some properties cannot be determined only by vision
- For example, how soft something is
- It’s hard to guess which towel is the softest only from this image
- It’s natural to want to touch items when choosing them

Robots + Haptics

- Robots that can perform haptic sensing is a growing area of interest
- Close local control loops
  - Grasping & manipulation
- Make up for otherwise incomplete sensory data about the world
  - Identify objects by touch
  - Identify object properties by touch
    - E.g. weight, firmness, inertia



Haptics is an active sense

- You can watch stuff passively
- Time for an experiment…
- Find any nearby object

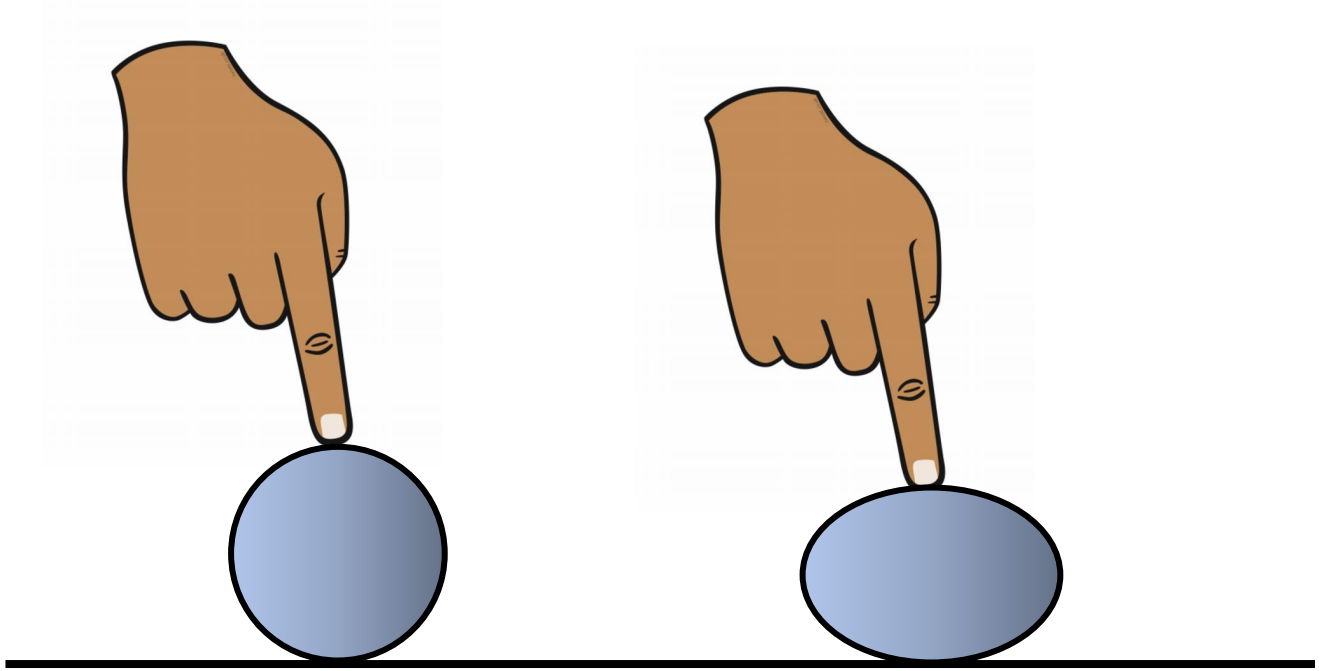
1. Put a finger on it
   - What do you feel?
2. Push / Squeeze it
   - What do you feel?
3. Slide your finger back and forth
   - What do you feel?

Time Series (Haptic) Data

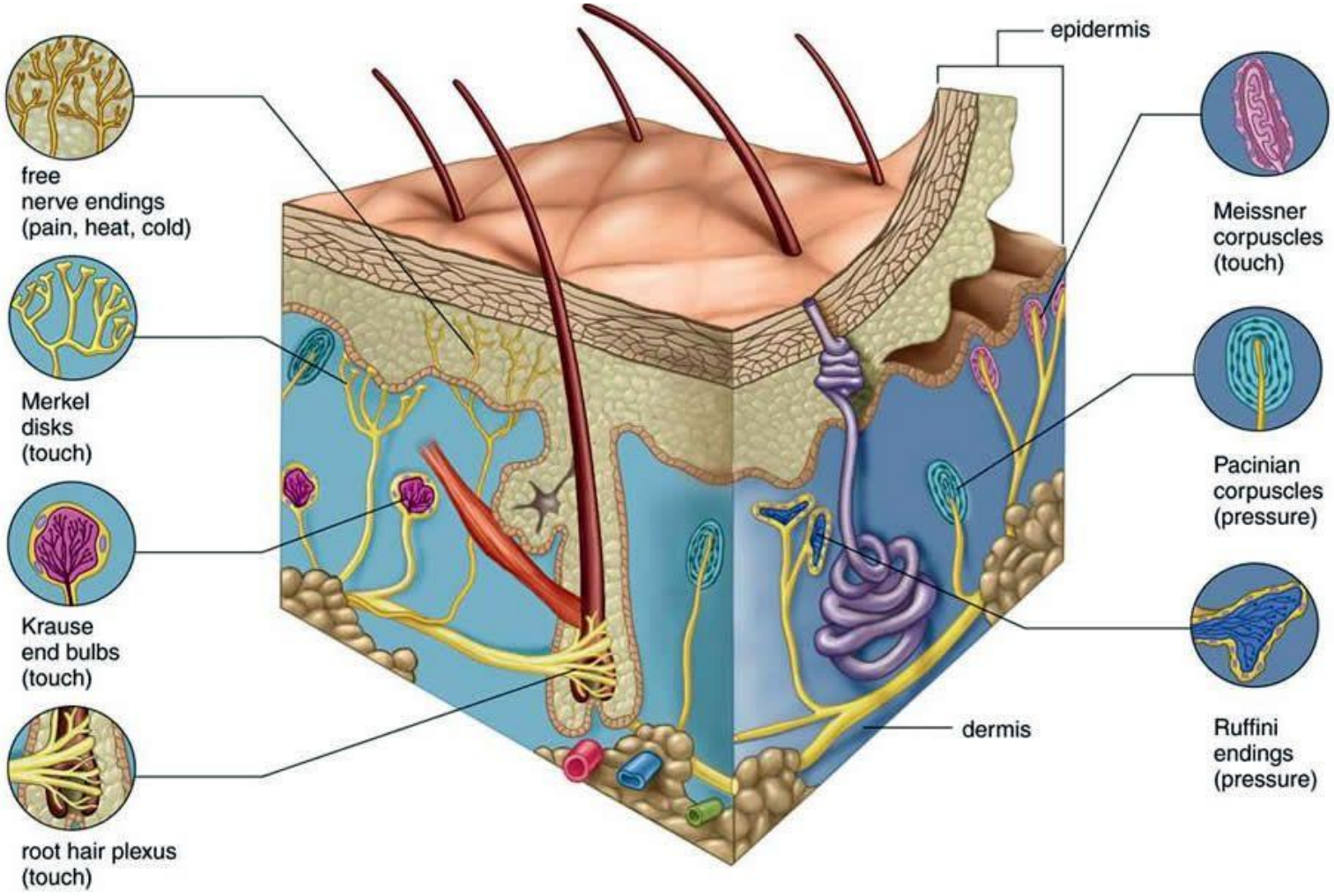
- Touch is an active sense
- The *way* we touch something affects what we feel

Time Series (Haptic) Data

- Different objects affect haptic sensation
- Different stages of touch affect haptic sensation
- Different stages of touch happen at different **times**

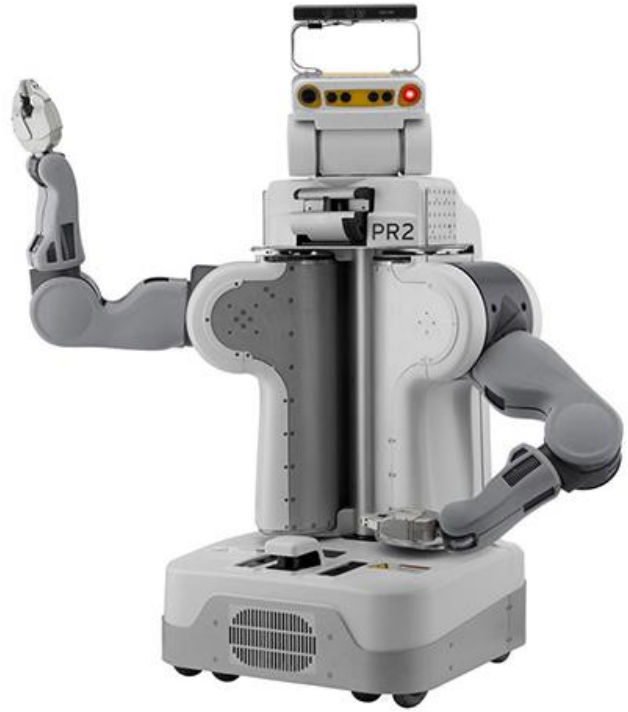


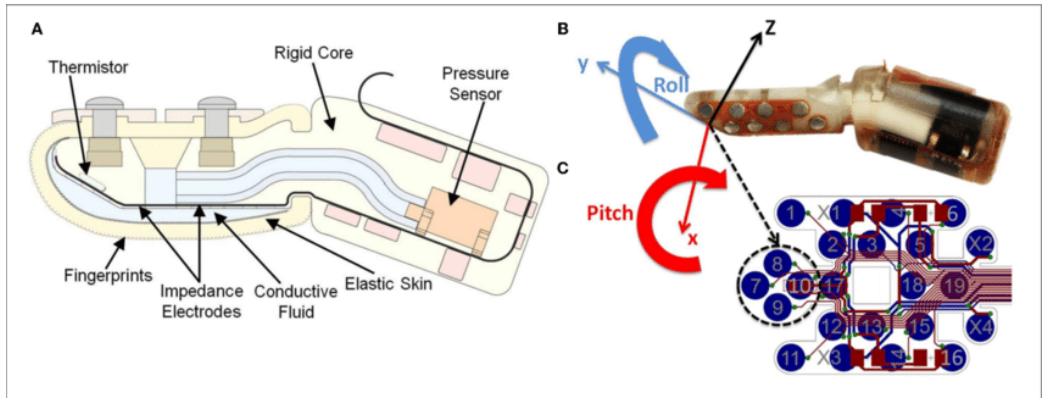
Human tactile sensors (note the plural!)

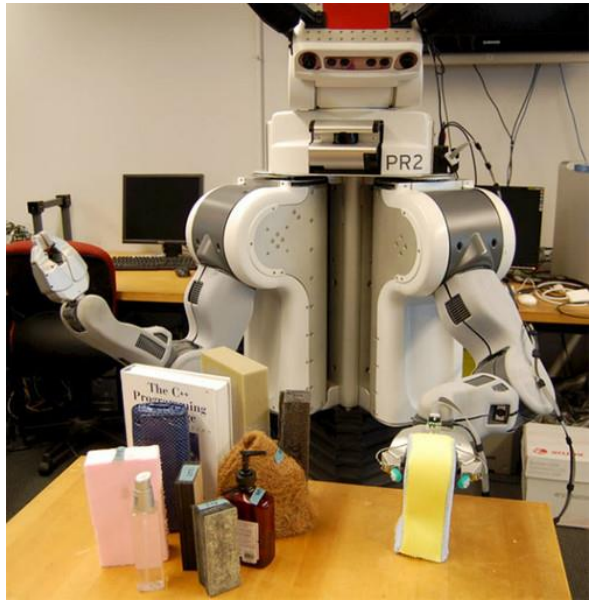


Previous Years

- **PENN Haptic Adjective Corpus**
- A PR2 robot performs five exploratory procedures
- On 51 objects
- Using multi-modal tactile sensors
- The researchers were mostly interested in adjective labelling





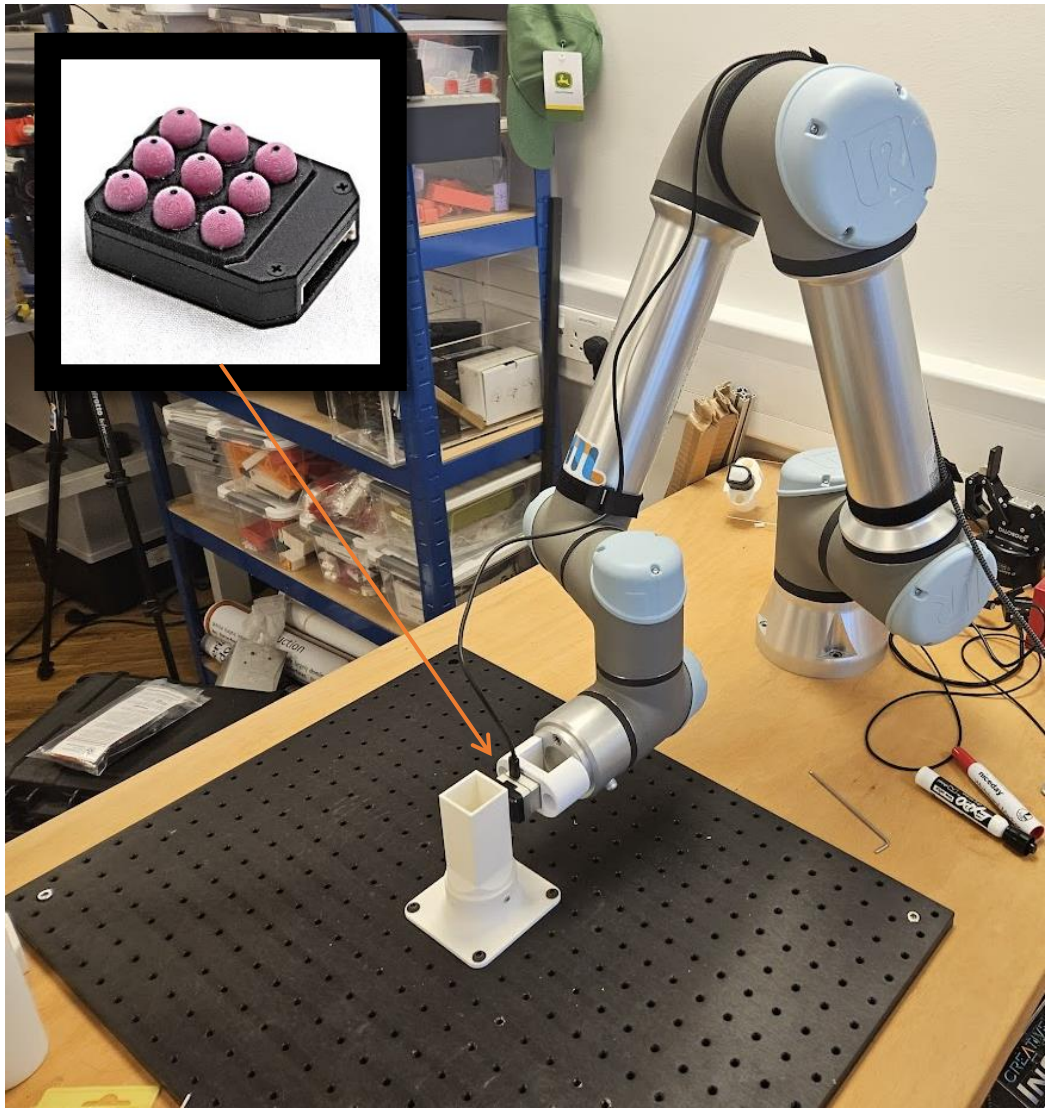


This Year

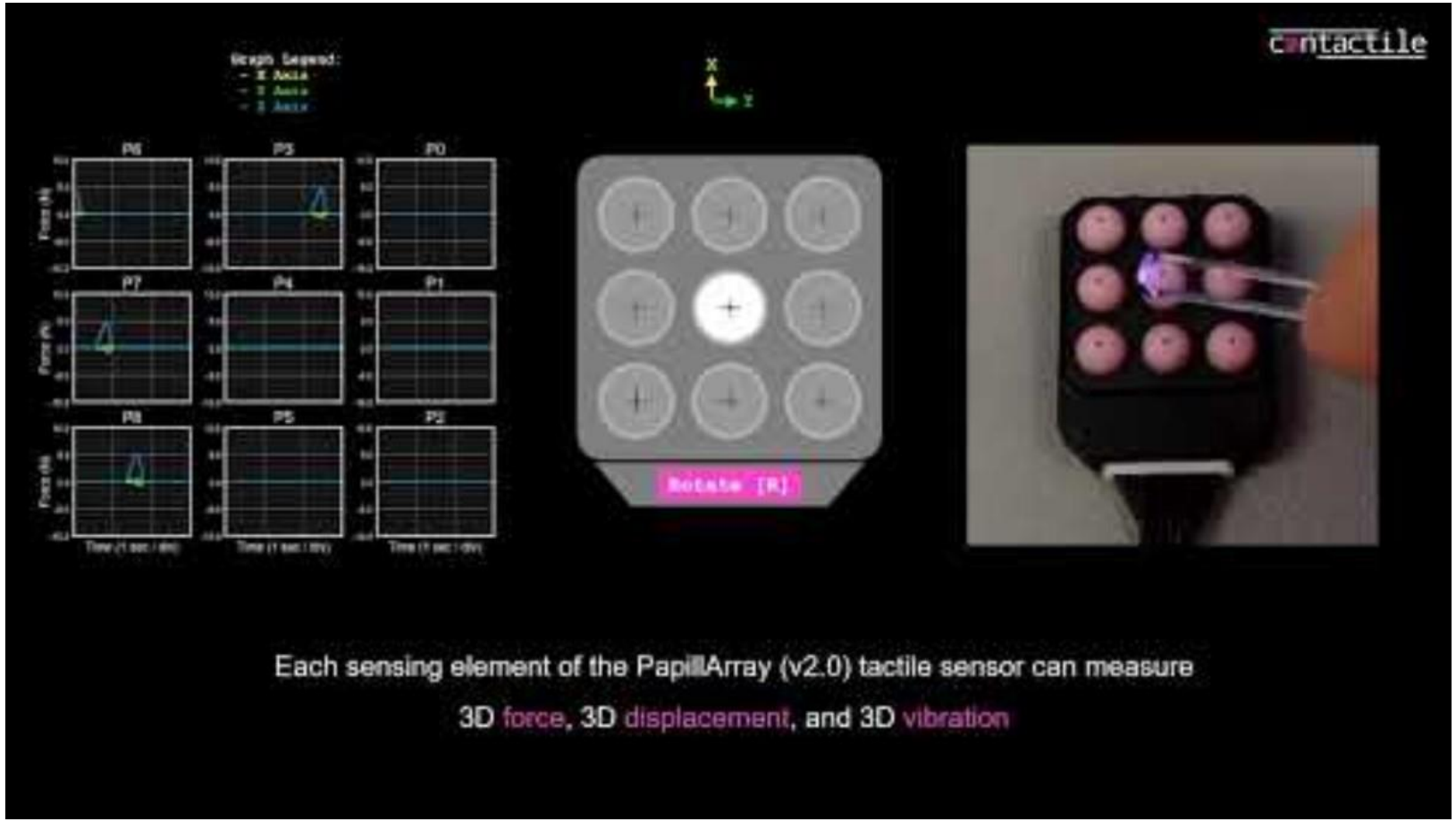
- Brand new dataset
- Created in the MTL (my lab)
- Sponsored by the Royal Society

New Dataset

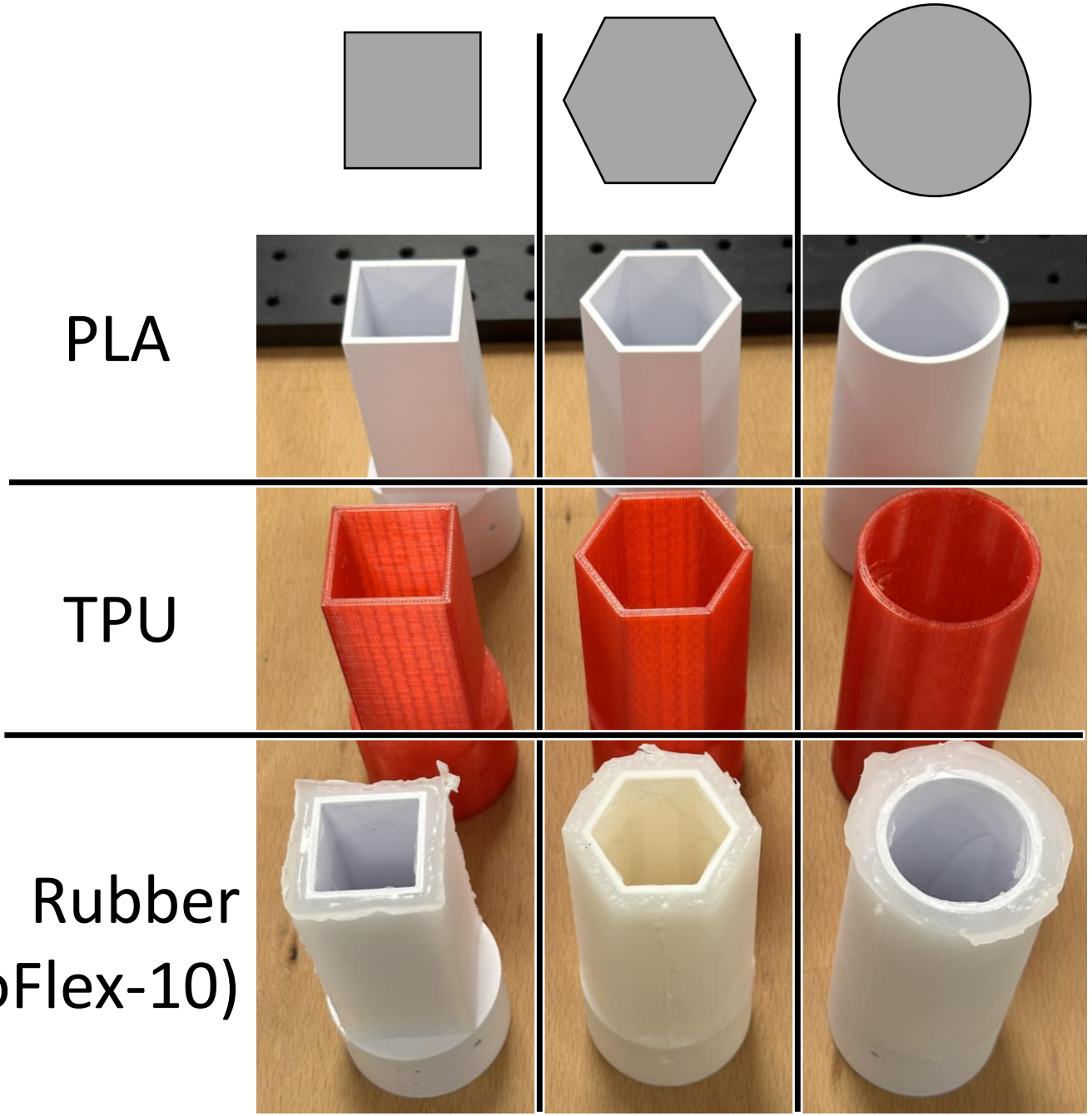
- UR5e robot
  - 6D Force / Torque sensor in the wrist
- Contactile Tactile Sensor
  - 9 individual papillae (pink domes)
  - Each papillae has 3D force and displacement sensing



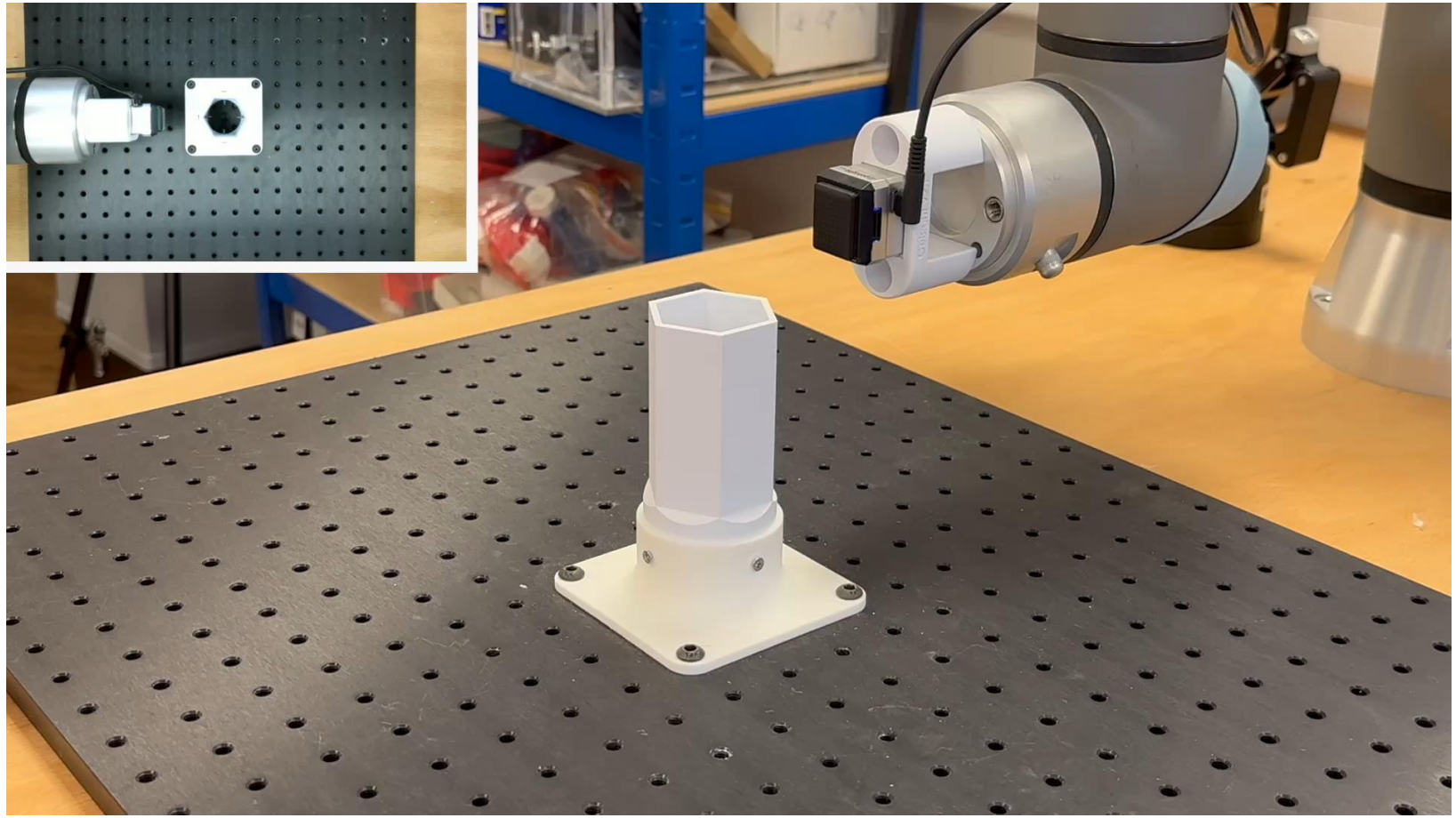
Contactile Sensor



Objects



An example trial (different tactile sensor)



Other Points

- You can use Matlab's built in functions for the coursework
- You cannot use functions downloaded from Matlab File Exchange
  - It is a wild west of bad code

Pattern Recognition **Course & Coursework** Outline

Part 1 (on Blackboard now)

1. Data Preparation
2. Visualisation
3. Principle Component Analysis (PCA)
4. Linear Discriminant Analysis (LDA)

Part 2 (coming next week)

1. Clustering
2. Bagging and Boosting
3. Decision Trees
4. Confusion Matricies

Questions?