**Sensing Location in the Pocket**
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**Goal**
Recognition of location transitions in buildings by inertial motion sensing and relaxed requirements

**Problem**
How do we tell the sensor the user's heading?
What if the orientation of the sensor drifts?

**Solution**
Exploit the body motion determining the orientation of the sensor to the body and to get the heading of the user

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**Algorithm**

*(1) Preprocessing*

**Goal:**
- Find relative orientation of the sensor to the body
- Use it as heading of the user

**Given:**
Global orientation vector and gyroscope values

**Method:**
For each timestamp t:

- **Step 1**
  PCA* of 3D-gyroscope values on a 1s-sliding window

  ![PCA Diagram]

  * Principal Component Analysis

- **Step 2**
  Select first Eigenvector as axis \( \omega(t) \)
  - Project \( \omega(t) \) onto ground plane
  - Calculate angle \( \alpha \) between \( \omega(t) \) and \( \omega(t-1) \)
  - Create normalized heading vector

**Example**
Calculation of a PCA for each window

**Sequence of headings**
Orientation of main principal component assuming constant speed

As for the hip, this works analogous for the hand.

*(2) Classification*

**Goal:**
Classified location transition

**Given:**
- Set of labeled location transition as training data
- Unknown location transition

**Method:**
K-Nearest Neighbor classifier on a rotation invariant correlation distance measure

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**Evaluation**

**Hardware**
Xsens Inertial Measurement Unit

**Data**
Floorplan
Defined locations for data recording
- Single user
- 10 typical location transitions during office day
- 4 different orientations in the pocket

- In the hand
- While on the phone or texting
  - 70 sets in total

**Results**
Accumulated sequence of headings (trajectory)

Performance of predicting location destination

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