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Faculdade de Ciências e Tecnologia
Universidade de Coimbra

HANDLE

Grasp type identification and gesture recognition using distributed accelerometers

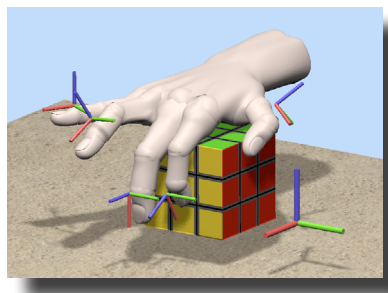**Pedro Trindade,** *PhD student*   **Jorge Lobo,** *Supervisor*

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ISR - **Institute of Systems and Robotics**
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Relative Pose with Distributed accelerometers

- Tri-axial acceleration sensors.
- Hand-distributed accelerometers with one in each finger and one in the palm.
- Observing gravity to have frame of reference.
- Method to determine the rotation between two frames of reference.
  - Based on Horn's closed-form solution for absolute orientation using unit quaternions.
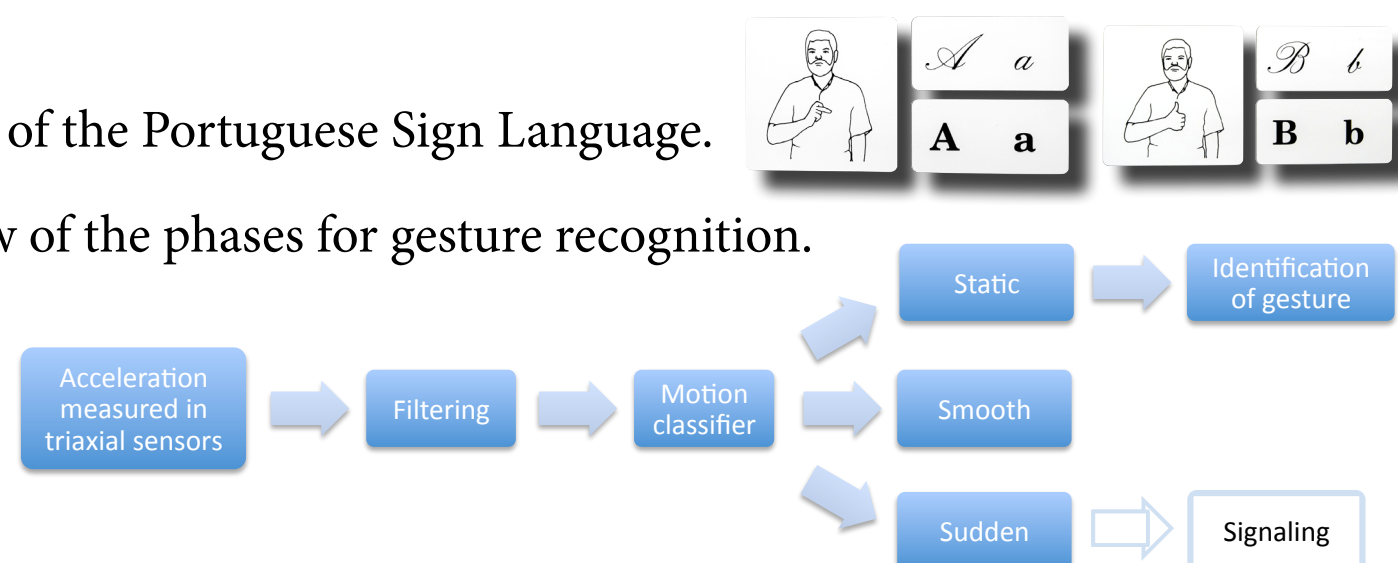- Manhattan distance used for comparison with library.

Grasp Type Identification

- Instrumented objects - Rubik Cube; Soda Can.
- Cumulative tactile force distribution on the instrumented cube, 9 sensing cells per coloured face.
- Comprehensive Grasp Taxonomy which includes 33 different grasp types:

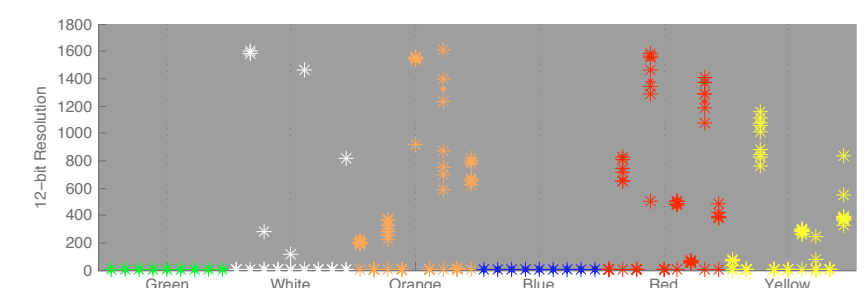## Gesture Recognition

- Gestures of the Portuguese Sign Language.
- Overview of the phases for gesture recognition.
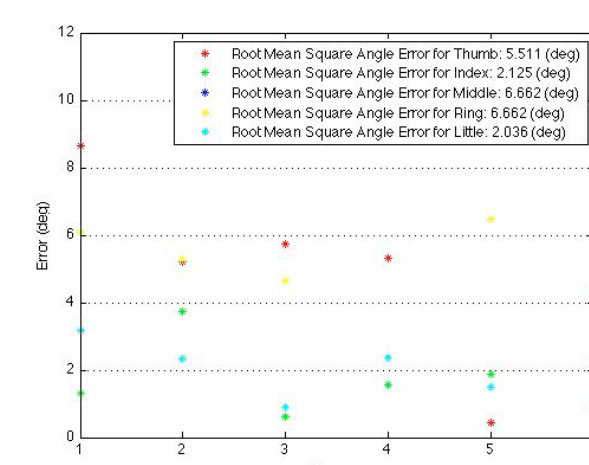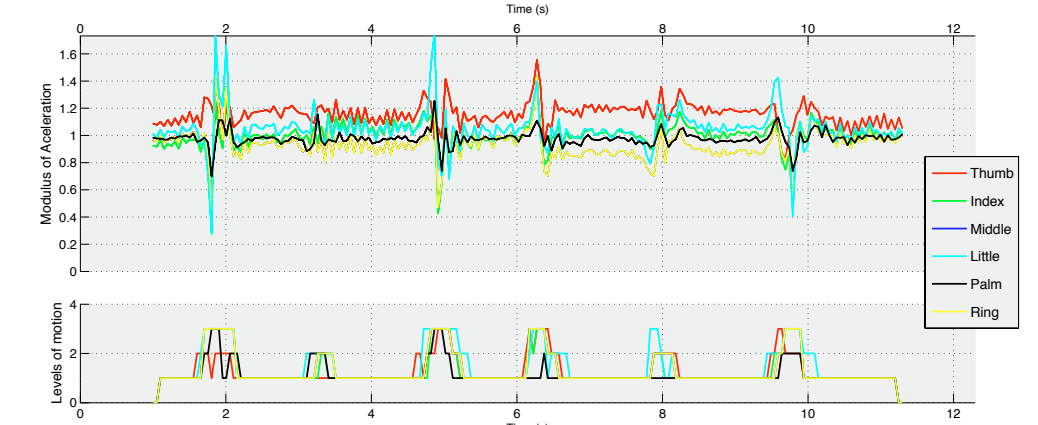

Results for Grasps

- Cumulative factile force distribution on the instrumented cube, 9 sensing cells per coloured face.:

- Result of grasp type identification test. Distance of the observed grasp to the grasps in the library, and masking of range of grasps using the tactile data. The identified grasp type is the power/palm/2-5 grasp, corresponding to the lowest value of the distance, the cell count of the trial was 17, indicating a power grasp:

Op : VF	power Pal : 2-5	power Pad: 2	power Pad: 2-3	power Pad: 2-4	prec. Pad: 2	prec. Pad: 2-3	prec. Pad: 2-5	prec. Pad: 2-5	power Pal: 2-5	int Side: 2	prec. Pad: 2-5
m., dist. (deg):	27	51	53	61	31	32	33	44	136	207	56
tactile cell cnt:	18	13	11	10	6	6	8	9	11	2	2

Results for Gesture

- Modulus of acceleration and the 3-level motion classifier. The result is a fairly static Level-1 which is used to identify the relevant frames.

- Rotation reprojection error after the calculation of the quaternions of rotation. The reprojection error is relatively very small making the method valid for estimating the relative angular pose between the fingers and the backpalm of the hand.

- Manhattan distances comparing a gesture against the library. The result is correct.

Gesture	G	H	K	L	O	Q	R	S	T	U	V	W
Distance	6.0	**3.1**	4.2	3.9	4.2	5.2	5.3	5.6	4.3	4.2	7.0	4.4

Gesture	X	Y	Z	1	2	3	5	6	7	8	9
Distance	7.4	4.0	5.0	6.0	3.9	6.2	5.5	6.3	4.3	6.4	5.1	4.2

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