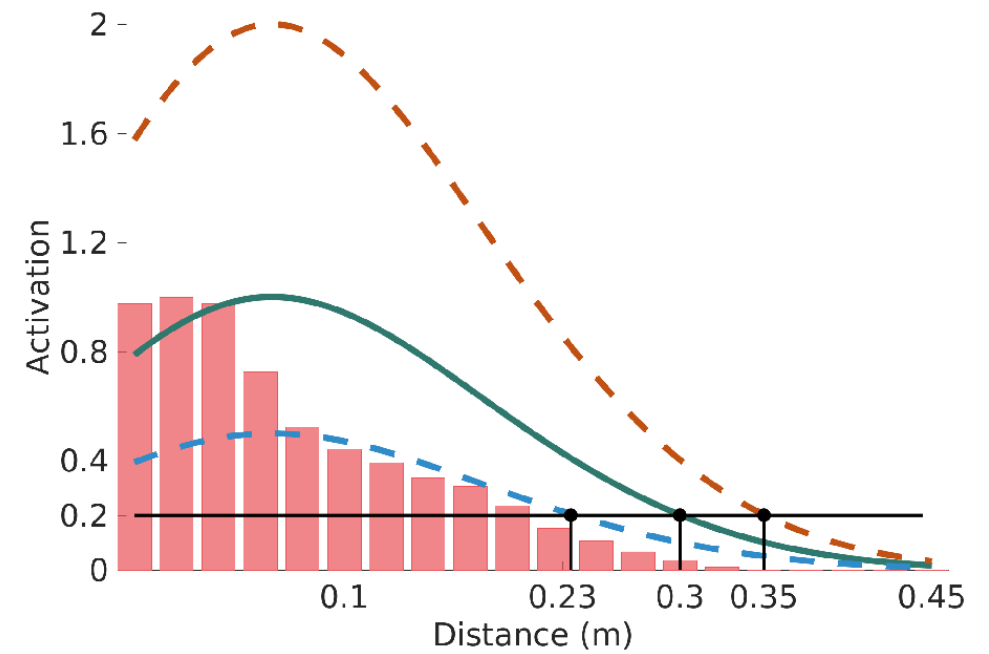# A PPS Model On iCub

Visuo-tactile Reactive Controller for pHRI
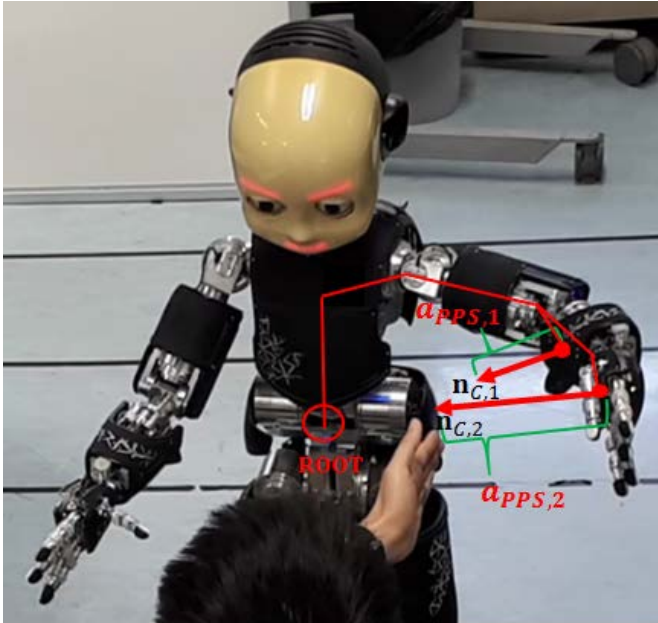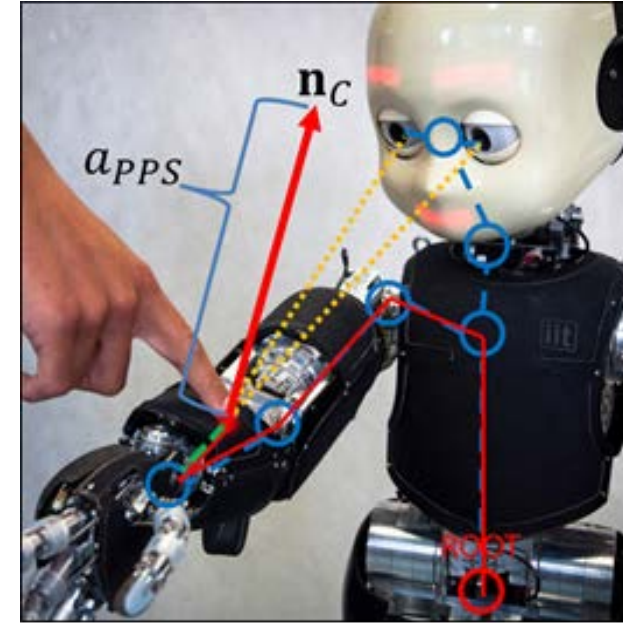

Visual activation through PPS

Tactile activation detected with skin

Local constrained minimization

$$\dot{\mathbf{q}}^* = \underset{\dot{q} \in \mathbb{R}^n}{arg\,min} \left[\left\| \mathbf{x}_{EEd} - (\bar{\mathbf{x}}_{EE} + T_S \mathbf{J}(\bar{\mathbf{q}})\dot{\mathbf{q}}) \right\|^2 \right]$$

$$\text{s.t.} \begin{cases} \mathbf{q}_L < \bar{\mathbf{q}} + T_S \dot{\mathbf{q}} < \mathbf{q}_U \\ \dot{\mathbf{q}}_L < \dot{\mathbf{q}} < \dot{\mathbf{q}}_U \end{cases}$$
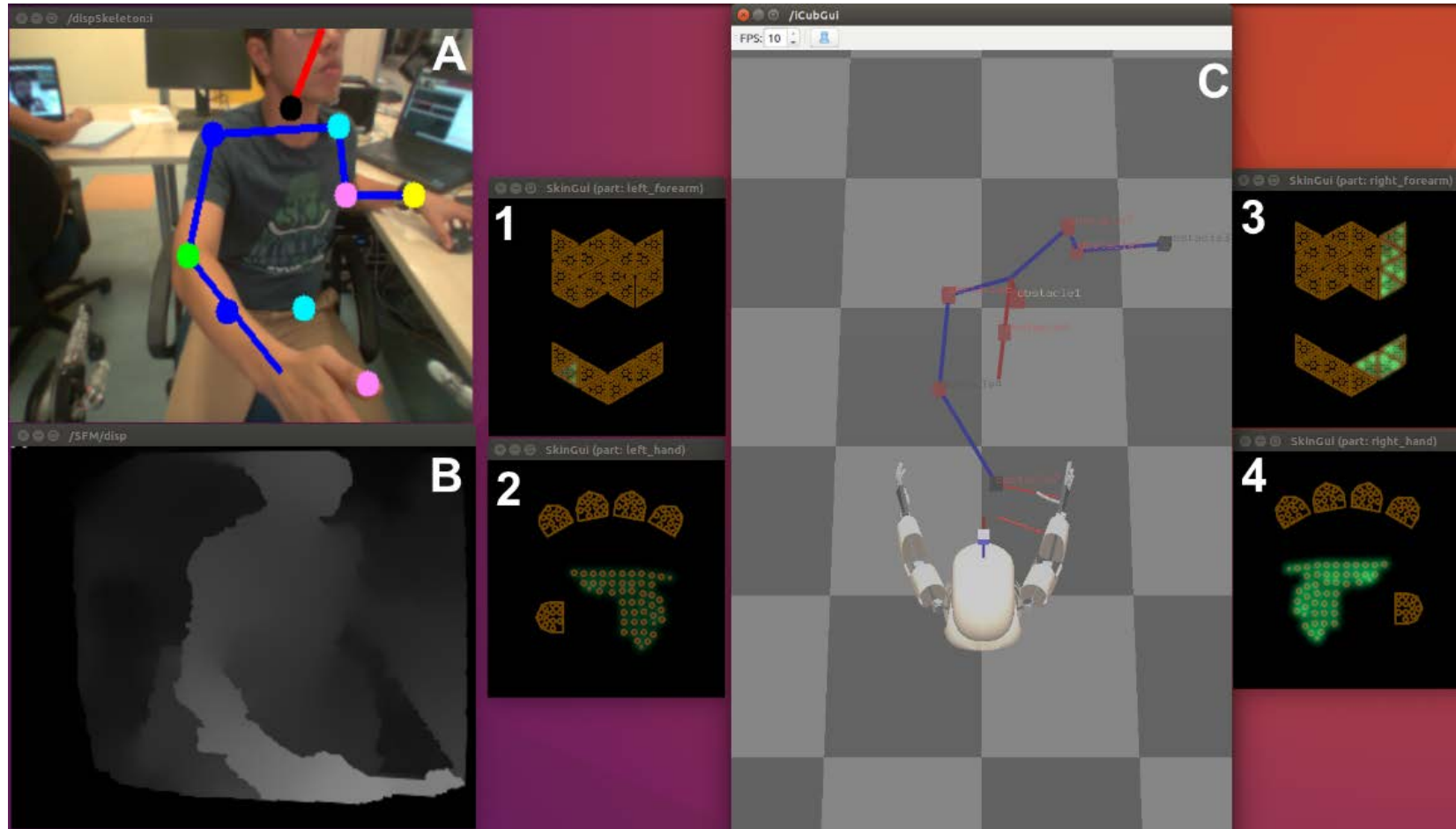
Remapping the *Cartesian* "repulsive vectors" into joint space

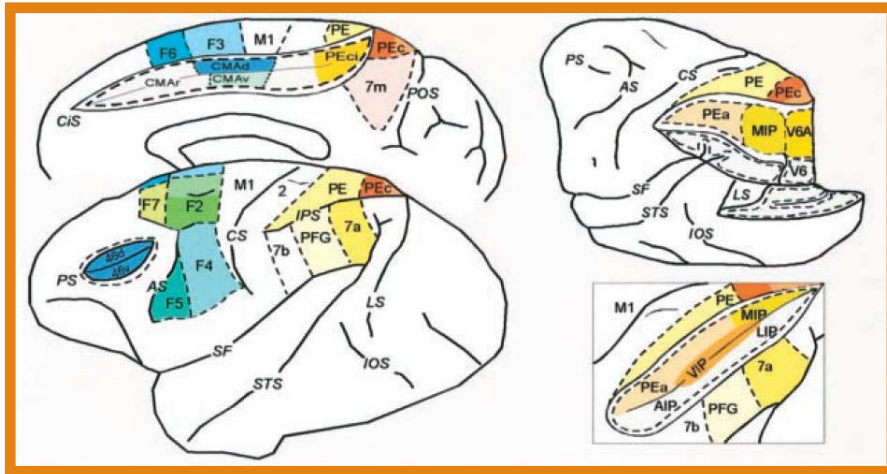$$\mathbf{s} = -\mathbf{J}_C^T \cdot \mathbf{n}_C \cdot V_C \cdot K \cdot a_{PPS}$$

$$\dot{\mathbf{q}}_{L,j} = \max \left\{ V_{L,j}, s_j \right\}, \quad s_j \geq 0$$
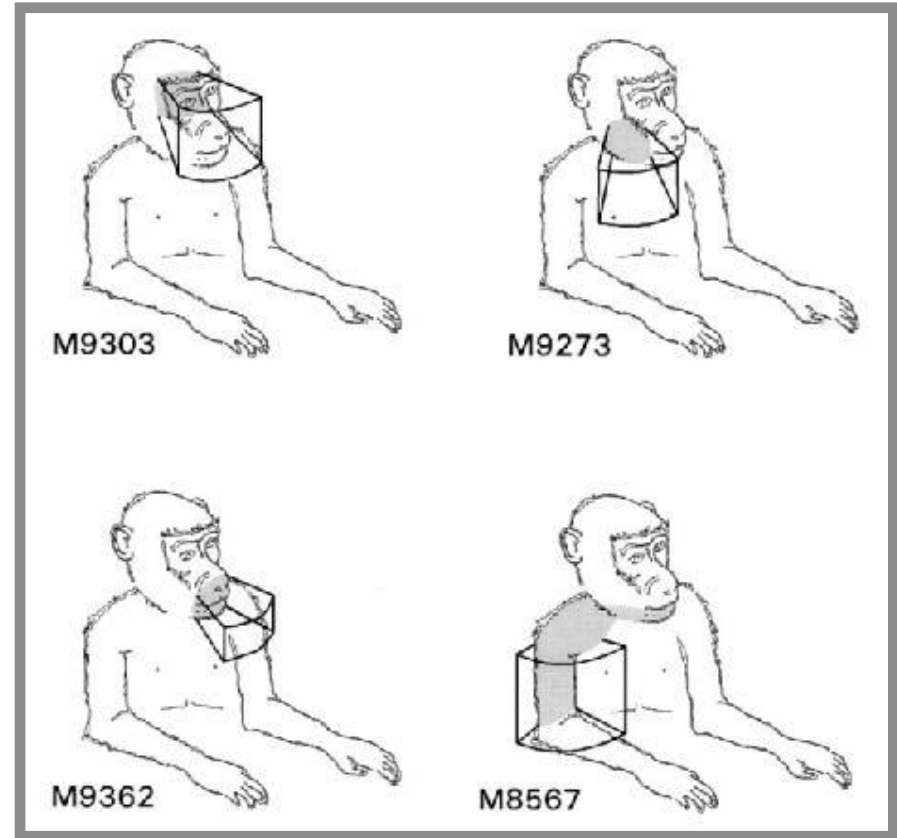
$$\dot{\mathbf{q}}_{U,j} = \min \left\{ V_{U,j}, s_j \right\}, \quad s_j < 0$$
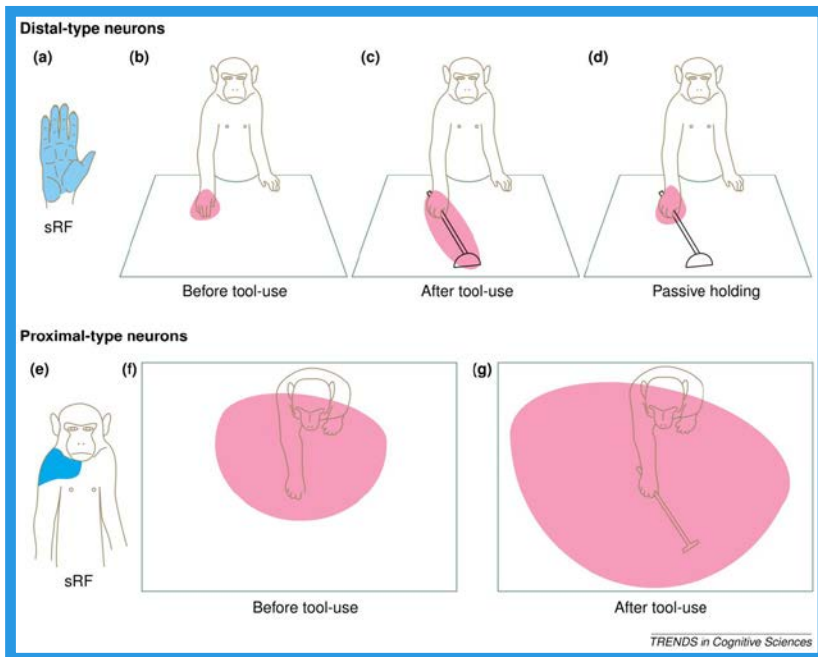
Integration with Body Pose Estimation

1

2

Fogassi (1996)

3

Iriki (2004)