Robot Learning & Interaction Group

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Example Program

<table>
<thead>
<tr>
<th>PIK_PART</th>
<th>JOINT 10 %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/12</td>
<td></td>
</tr>
<tr>
<td>1 :</td>
<td>! This program picks up a part</td>
</tr>
<tr>
<td>2 : J</td>
<td>P [1 : Near part pickup] 100% CNT90 ;</td>
</tr>
<tr>
<td>3 :</td>
<td>MESSAGE [WAIT FOR GRIPPER OPEN] ;</td>
</tr>
<tr>
<td>4 :</td>
<td>Open hand 1 ;</td>
</tr>
</tbody>
</table>
Learning from demonstration as an intuitive interface to transfer skills to robots
Generation of adaptive movements
Learning & control challenges

(a) Multiple demonstrations
Reproduction in new situation

(b) Motion observed from different perspectives

(c) Re-use of the learned model in a new situation
By exploiting the extracted task variations

(d) Input: \( \mathcal{N}(\hat{x}_t, \hat{\Sigma}_t^x) \)
The estimated variability is used to determine how strongly the robot should track the estimated path with optimal control.

\( \text{Output: } \hat{K}_t^p, \hat{K}_t^y \)
Compliant skill acquisition
Collaborative Projects

**TACT-HAND**

**I-DRESS**
SNSF, CHIST-ERA (2015-2018)

Adaptation to new situations

Collaboration with users

Semi-autonomy and shared control

**DexROV**
User adaptation for prosthetics

Two exploitations of tactile sensing:
• Forearm bracelet worn by the amputee
• Fingertip and palm sensing for the prosthetic hand
User adaptation for prosthetics

Surface electomyography (sEMG)

Tactile sensing

Commercial prosthetics
Robotic dressing assistance

Dressing assistance for:
- Putting on a coat
- Putting on shoes
Robotic dressing assistance
Teleoperation with ROVs

Direct Teleoperation

video feeds telemetry

\( q \)  
\( \hat{q} \)
Teleoperation with ROVs

Mixed Teleoperation

\[ \{A_i, b_i\}_{VR}^{1...n} \xrightarrow{q} \hat{q} \]

\[ \{A_i, b_i\}_{CE}^{1...n} \xrightarrow{q} \hat{x} \rightarrow \hat{q} \]
Teleoperation with ROVs

Recognition & synthesis of motion primitives

Semi-autonomous teleoperation as a form of human-robot collaboration