My two-minute presentation

Bruno Vilhena Adorno

University of Montpellier 2 / LIRMM

CoTeSys-ROS

ASSIST project

Two-arm manipulator $\longrightarrow$ assistant robot for quadriplegic people

- Consortium:
  LIRMM, ISIR, CEA-LIST, LAAS
  and Union Mutualiste Propara

Introduction

- Different control modes:
  - Servovisual control for reaching the object
  - One arm control interacting with an object: position/force
  - Two arm coordination/manipulation
- Rigid motions represented by dual quaternions $\rightarrow$ singularity-free

Dual positions in the dual task-space

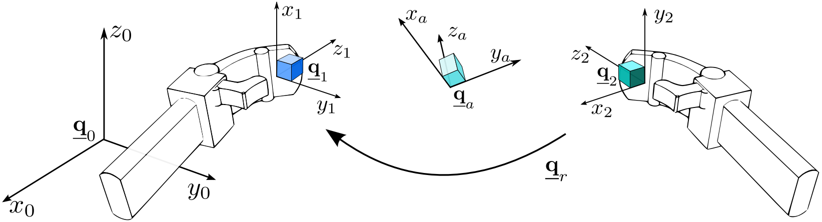
Definition

The relative and absolute dual positions can be defined as

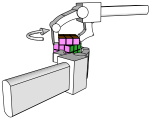
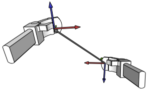
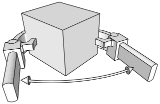
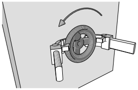
$$\underline{\mathbf{q}}_r = \underline{\mathbf{q}}_2^* \underline{\mathbf{q}}_1$$

$$\underline{\mathbf{q}}_a = \underline{\mathbf{q}}_2 \underline{\mathbf{q}}_{\frac{r}{2}}$$

where $\underline{\mathbf{q}}_{\frac{r}{2}}$ corresponds to “half” of $\underline{\mathbf{q}}_r$



Control strategies for dual position control

- Basic idea:
  - Define the variables to be controlled;
  - Use the Hamilton operators to commute the terms;
  - Write the the input derivative as

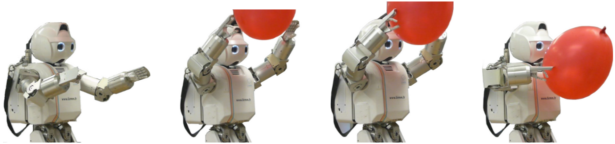
$$\dot{\vec{u}}_d = \mathbf{J}_{\text{task}} \dot{\vec{\theta}}_R$$

  - Control law: Jacobian-based methods. Ex:

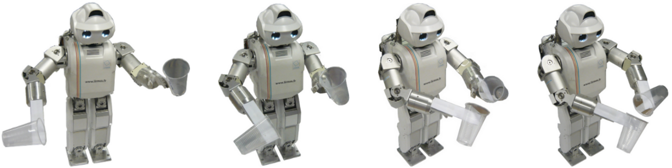
$$\dot{\vec{\theta}}_R = \mathbf{J}^{+}_{\text{task}} \mathbf{K}_{\text{arm}} \left(\vec{u}_{\text{desired}} - \vec{u}_{\text{measured}} \right) \tag{1}$$

Examples

- Grabbing a common object:

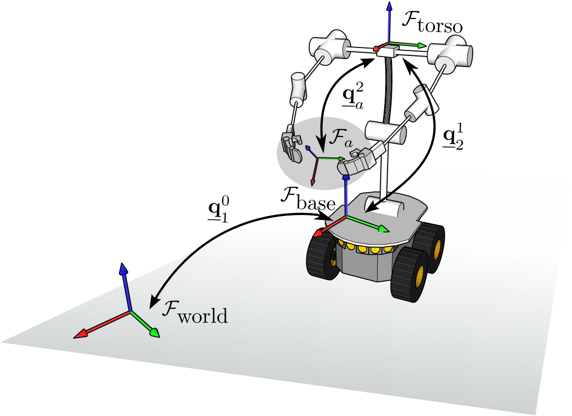


- Water pouring:



Generalized cooperative task-space

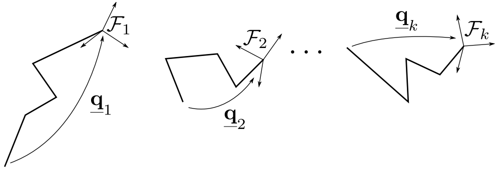
- The task is still defined in terms of $\underline{\mathbf{q}}_a$ and $\underline{\mathbf{q}}_r$, but...



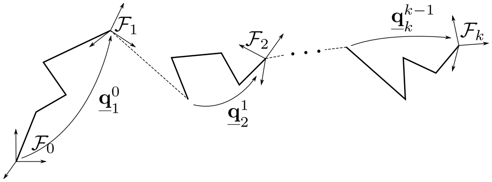
- How can we control the cooperative dual task-space variables using the whole body?

Serially coupled kinematic systems

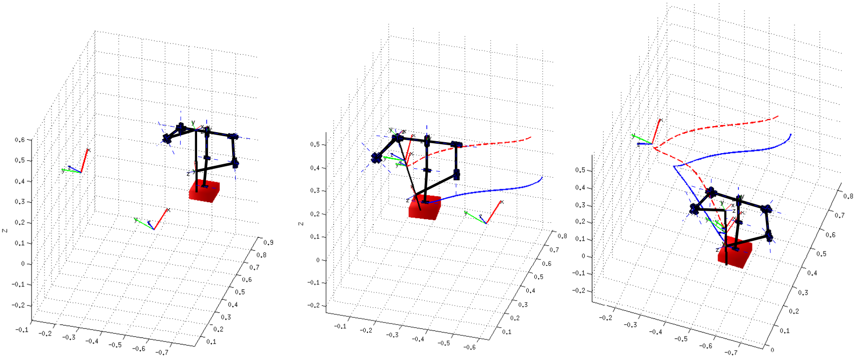
Each kinematic subsystem i being described by an intermediate rigid motion $\underline{\mathbf{q}}_i$:



These subsystems are coupled serially:



Example



For more information

www.lirmm.fr/∼adorno