Admittance Controller

Advanced Robotics Assignment

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# Gain selection

Given a **second order system** on the form

the **poles** that characterize the system behavior are parameterized in terms of the **damping ratio** , and **natural frequency** , where

For a **critically damped system**, the poles must be on the real axis, such that

To select the **impedance parameters**, some choices must be made; for example, the **stiffness** can be defined in terms of the maximum desired displacement in **steady state** for a given force , as

Then, given some desired mass , the damping can be computed as

# Implementation

The moment in desired frame is computed from the wrench as

where

is the adjoint matrix for some transformation , and denotes the skew-matrix operator.

## Quaternion-based controller

Given a unit quaternion

for some orientation of angle around a unit vector . Furthermore, (normalized).

The angular velocity must be integrated into a unit quaternion, as

where denotes a quaternion product, and is defined as

Given a unit quaternion , the (orientational) compliant frame is obtained as

Given that , then . Likewise, for a quaternion

## Euler-based controller

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In order to overcome the problems that arise when integrating angular velocities, the motion model can be described in terms of Euler angles instead, in which the compliant quantities can be solved for by integrating

Definiton of euler angles used

The chosen euler angles in this assignment to be used are the Tait-Bryan angles, given in the sequence “XYZ”.

T matrix (optional: and why)

As given by equation (26), the wrench applied to the end effector given in base frame, must be transformed into an equivalent quantity expressed in euler angles.

Given

Where

Integration of Euler angles (pleb method)

Compliant frame from phi\_cd

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Compliant frame from phi\_cd