MULTIVARIABLE CONTROL

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Introduction

- In independent control, control laws were derived for each joint of manipulator based on a SISO model
- Coupling effects were regarded as disturbances
- In reality complex nonlinear and multivariable system

The Effect of Joint Flexibility

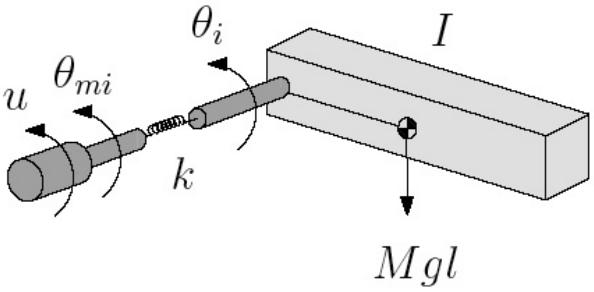

Figure 8.1: A single link of a flexible joint manipulator. The joint elasticity is represented by a torsional spring between the link angle θ_i and the motor shaft angle θ_{mi}.

Inverse Dynamics Control

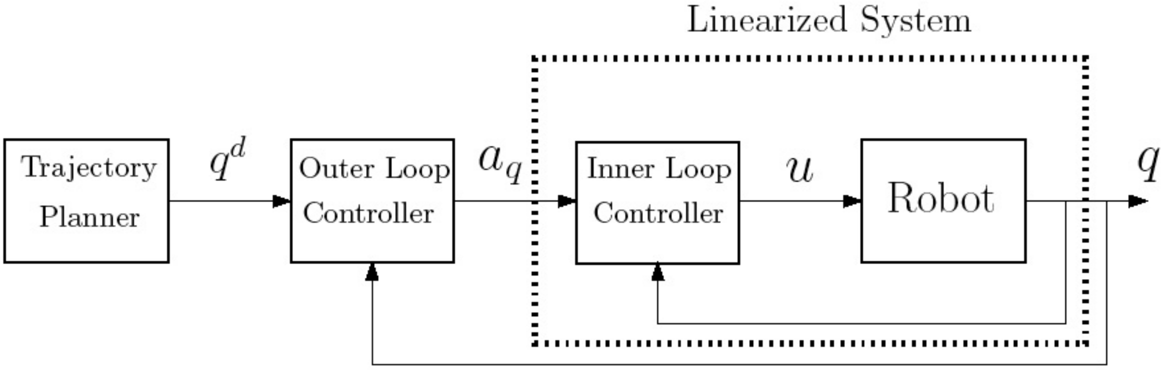

Figure 8.2: Inner-loop/outer-loop control architecture. The inner-loop control computes the vector u of input torques as a function of the measured joint positions and velocities and the given outer-loop control in order to compensate the nonlinearities in the plant model. The outer-loop control designed to track a given reference trajectory can then be based on a linear and decoupled plant model.

Robust and Adaptive Control

- For inverse dynamic control, parameters of the system must be known exactly
- If the parameter are uncertain, for example when the manipulator picks up an unknown load, then the ideal performance of the inverse dynamics controller is no longer guaranteed
- The goal of both robust and adaptive control is to maintain performance in terms of stability, tracking error despite parametric uncertainty, external disturbances, unmodeled dynamics, or other uncertainties present in the system.
- Robust controller is a fixed controller designed to satisfy performance specification over a given range of uncertainties
- Adaptive controller incorporates some sort of online parameter estimation