01_01_Overview_of_Iterative Control

1. Intuition

Simple Repetitions improve performance in prototypical motions

2. Introduction

Architecture

2D time!

$$\bar{y}^k$$

$$u_j^k \longrightarrow \boxed{\text{System}} \longrightarrow y_j^k \quad - \quad e_j^k$$
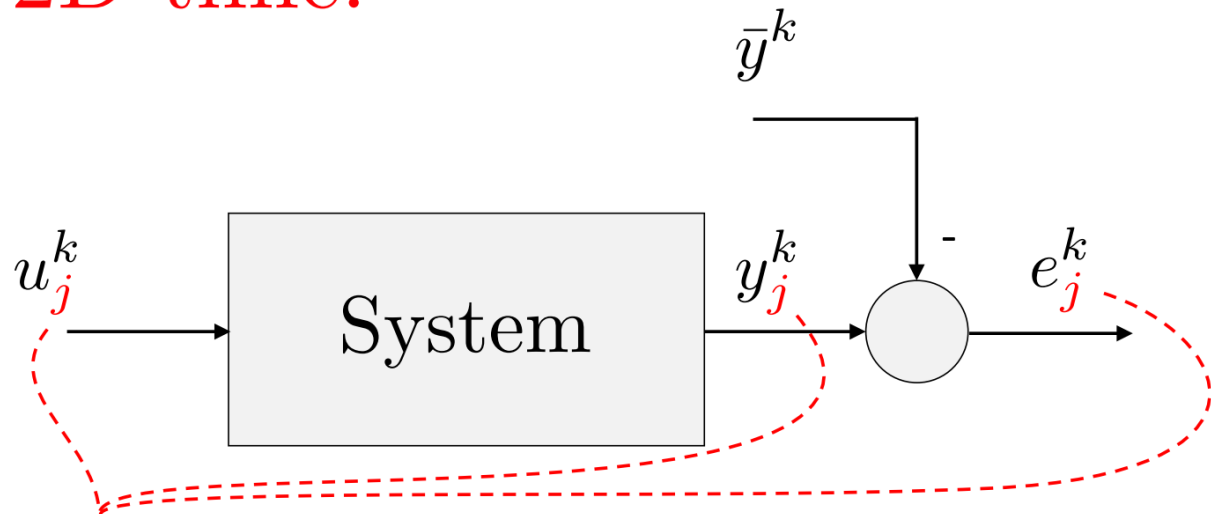
Iterations (trials, attempts, repetitions, ...)

Iterative Learning Control (ILC)

Control Signal

0 | 0 | N−1 Sample Time
1

Error

0 | 1 | N Sample Time
1

L

+ +

Q

j

j+1

P

+ −

Iteration

Disturbance Reference
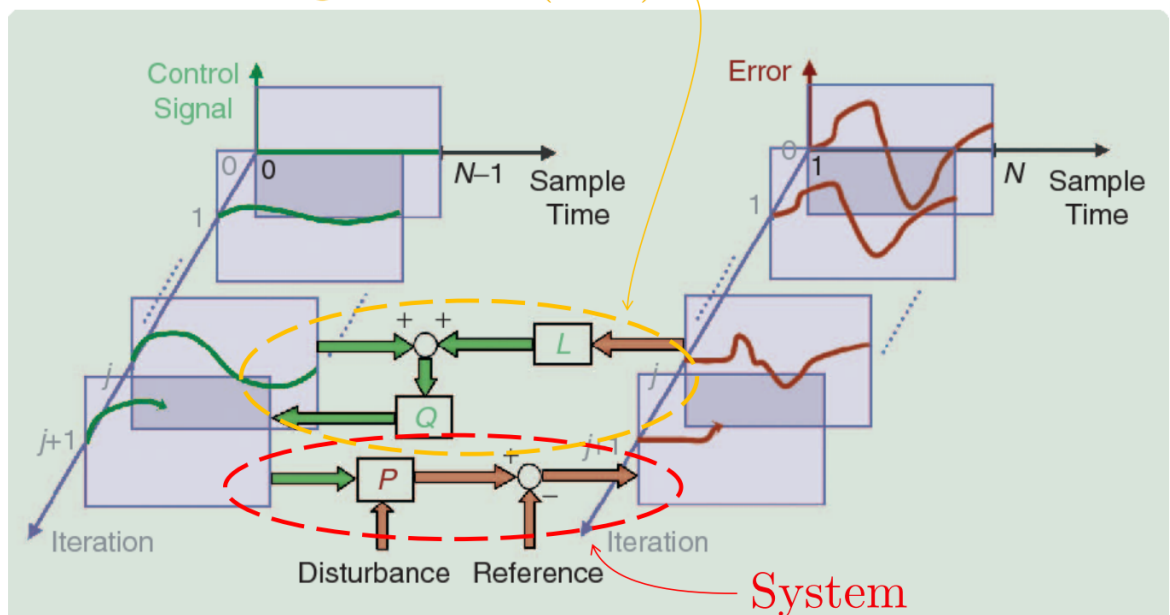
Iteration

System

Model

Given **Desired Trajectory:** $\bar{y} : \{1 \dots N\} \to \mathbb{R}^m$

Find a **Learning Rule:** $u_{j+1}^k = F\left(u_j^k, e_j^k\right)$

s.t. For system

$$x_j^{k+1} = A(k)x_j^k + B(k)u_j^k$$
$$y_j^{k+1} = C(k+1)x_j^{k+1} + D(k+1)u_j^{k+1}$$

with

$$x_j^0 = x_{j+1}^0, \quad \forall j$$

Then (**Asymptotically perfect execution**)

$$\lim_{j \to \infty} y_j^k = \bar{y}^k, \quad \forall k \in 1 \dots N$$

Summary

Iterative Control try to update input u **based on previous** u **and previous error** e to make the system **asymptotically perfect execution**