# Part II

# OVERVIEW OF INDUSTRIAL MPC TECHNIQUES

# Contents

# Chapter 1

# INTRODUCTION TO MODEL PREDICTIVE CONTROL

## 1.1 BACKGROUND FOR MPC DEVELOPMENT

Two main driving forces for a new process control paradigm in the late 70's ∼ early 80's:

- Energy crisis + global competition + environmental reg.

  $$\Downarrow$$

  - process integration
  - reduced design / safety margin
  - real-time optimization
  - tighter quality control

  $$\Downarrow$$

  *higher demand on process control.*

- (Remarkable) advances in microprocessor technology.

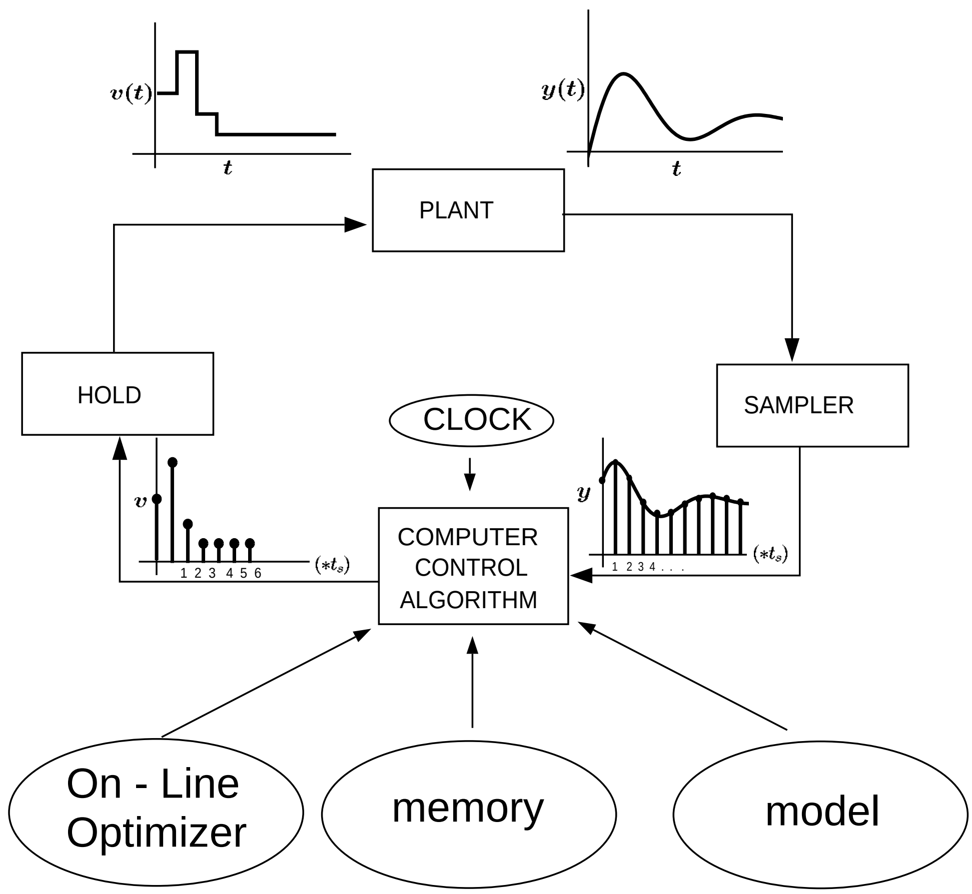
– cheap, fast and reliable medium for implementation.

– network environment(e.g., DCS) conductive to hierarchical approach.

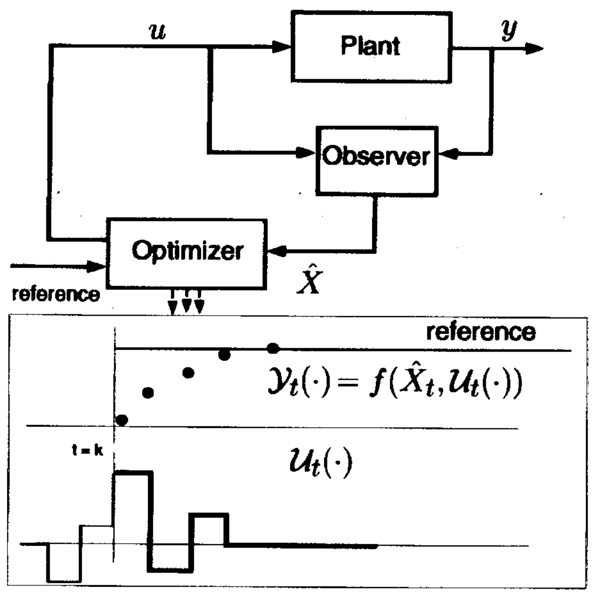
Industry's response ⇒ MPC

## 1.2 WHAT'S MPC

It's a computer control system.



It's a computer control system consisting of an observer & an optimizer.




$$\min_{\mathcal{U}_t(\cdot)} \int_t^{t+p} l_1[\text{Error}(\tau)] + l_2[\text{Input}(\tau)]d\tau$$

$$\mathcal{U}(\cdot) \in U, \quad \mathcal{Y}_t(\cdot) \in Y$$

The optimization is based on prediction of future behavior of y.

MPC(software packages) is sold under different names:

- DMC (Dynamic Matrix Control, now AspenTech)
- IDCOM (Setpoint, now AspenTech)
- SMCA (Setpoint, now AspenTech)
- RMPCT (Honeywell)
- PCT (Profimatics)

- HEICON (Adersa)
- OPC (Treiber)
- MAC
- IMC
- GPC
- GMC
- UPC

⋮

It's major features are

- model based
- *explicit* prediction of future system behavior
- *explicit* consideration of constraints
- use of on-line mathematical programming
- receding horizon control : repeated computation of open-loop optimal trajectory with feedback update ⇒ implicit *feedback* control.

## 1.3 WHY MPC?

Difficult elements for process control:

- delay, inverse response
- interaction