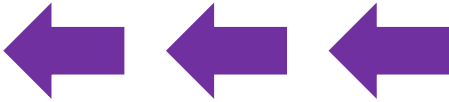# Statistical Techniques for Monitoring Industrial Processes

Lecture : Introduction to Multivariate SPM

Module : PCA-based MSPM

Course TOC

❑ Introduction to Statistical Process Monitoring (SPM)

❑ Python Installation and basics (optional)

❑ Univariate SPM & Control Charts

   ➢ Shewhart Charts

   ➢ CUSUM Charts

      • Application: Aeration tank monitoring

   ➢ EWMA Charts

❑ Multivariate SPM ⬅ ⬅ ⬅

   ➢ Fault detection using Principal Component Analysis (PCA)

   ➢ Fault detection using Partial Least Squares (PLS) regression

   ➢ Fault diagnosis using PCA/PLS contribution charts

   ➢ Strategies for handling nonlinear, dynamic, multimode systems

❑ Deployment of SPM Solutions
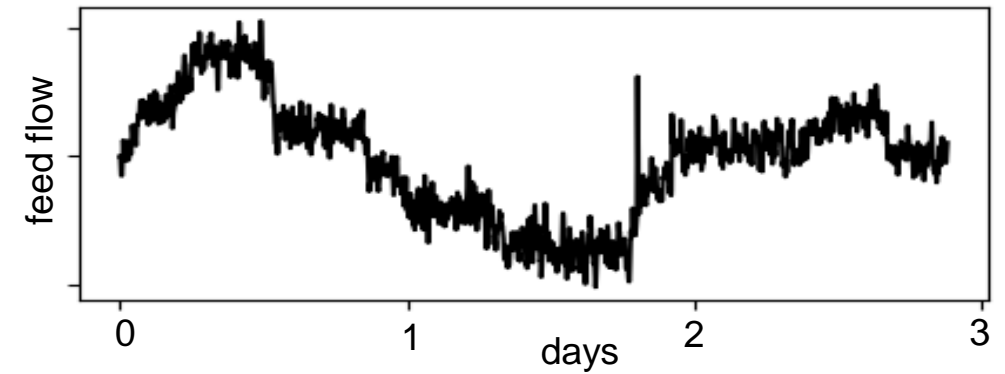
Multivariate SPM: Monitoring a plant at different levels

Plantwide monitoring

Equipment level monitoring
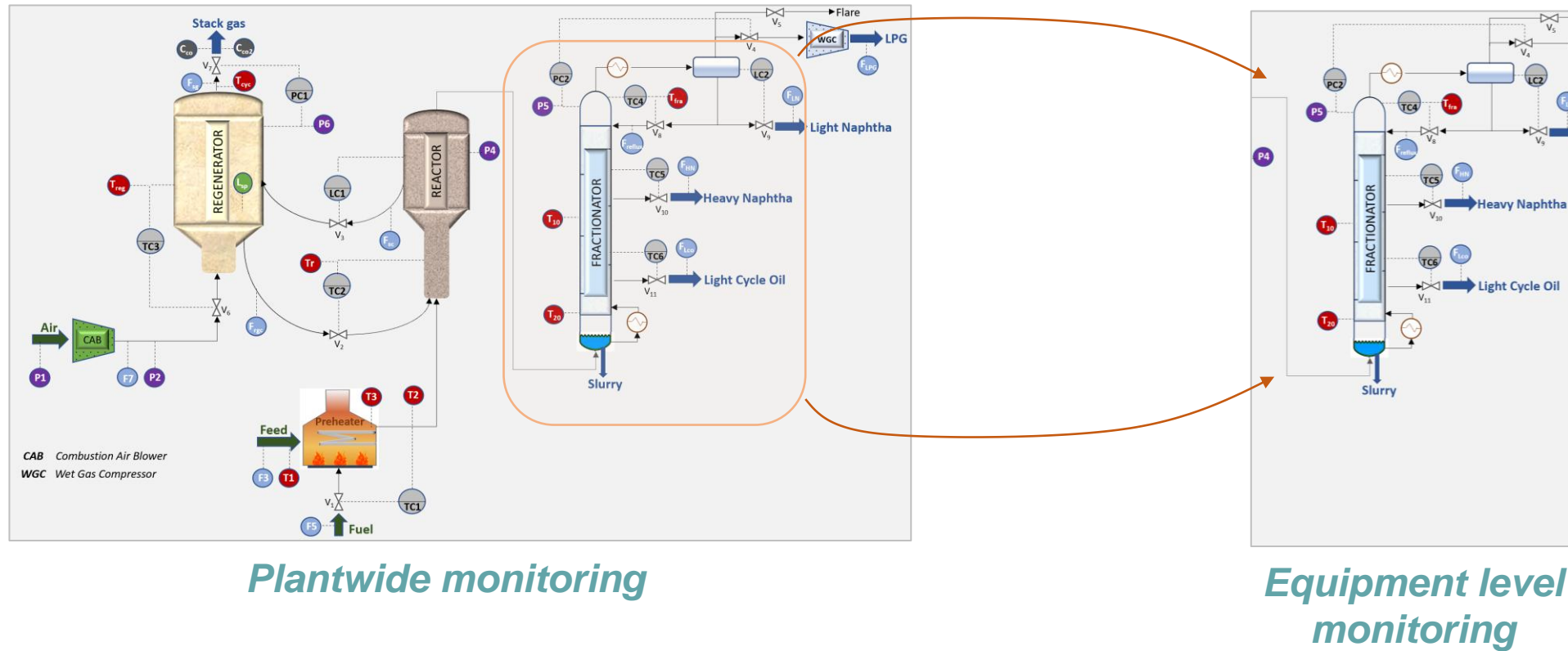
Multivariate Systems: Types of Processes
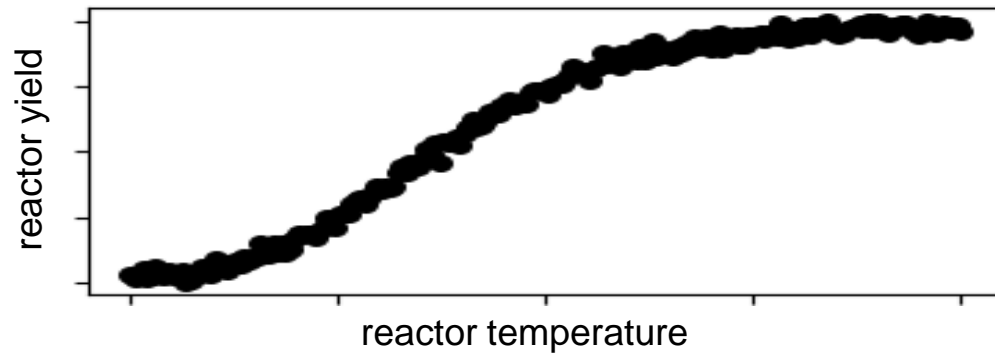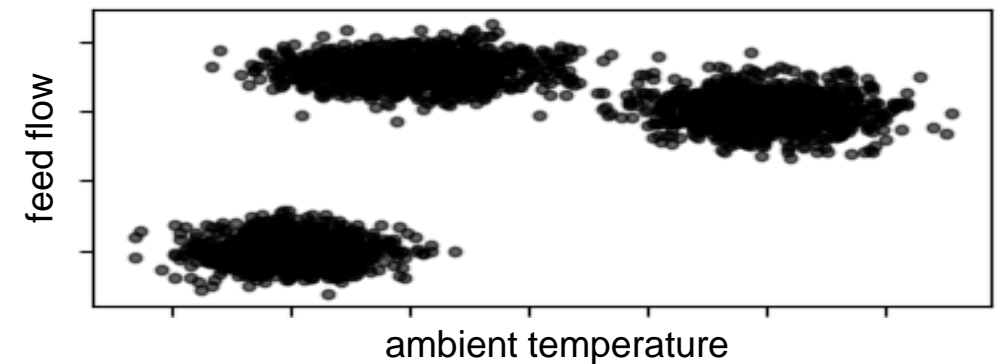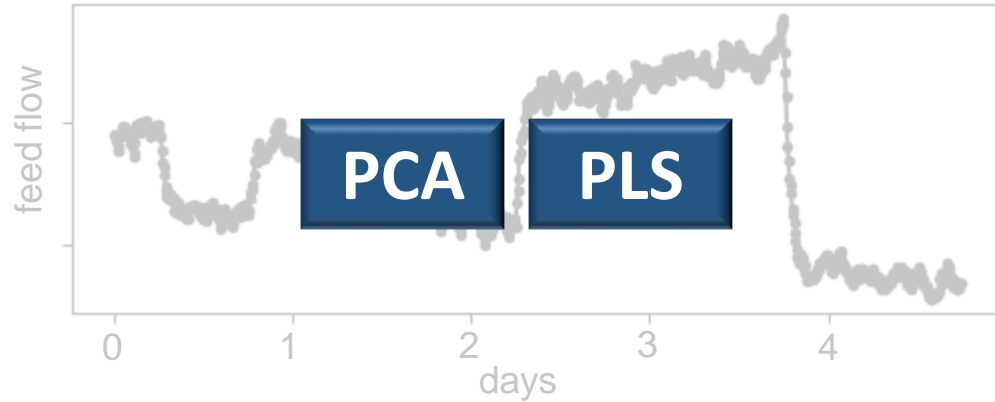

Steady-state process
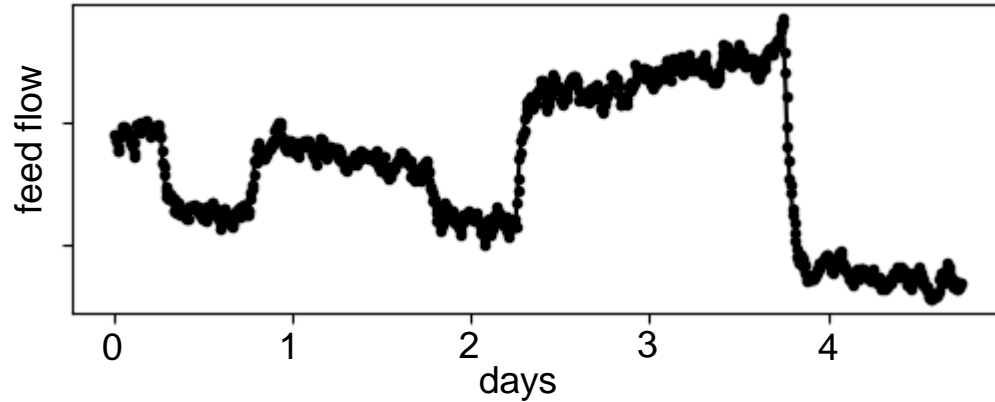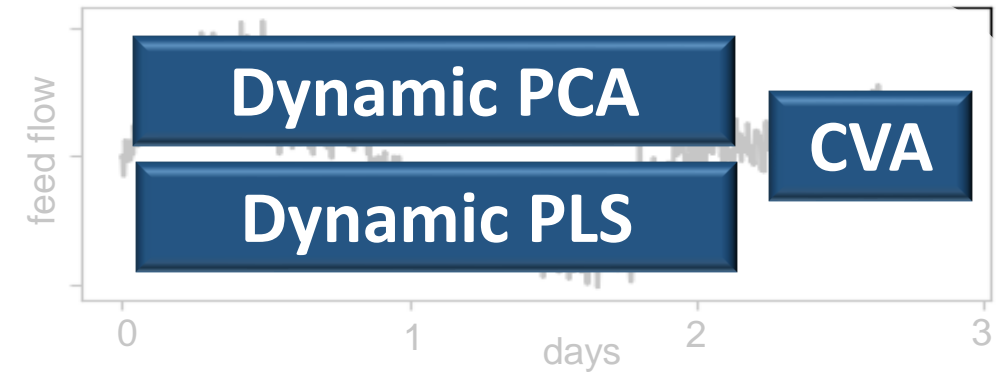
Dynamic process

Nonlinear process

Multimode process

Process Type - MSPM Techniques Mapping

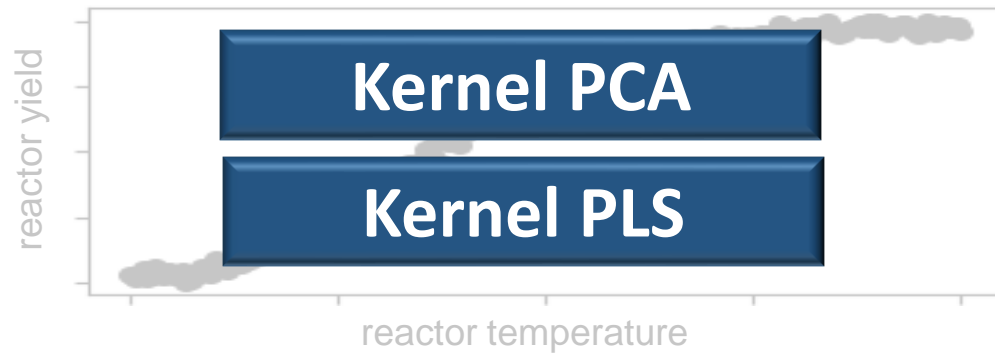**Steady-state process**
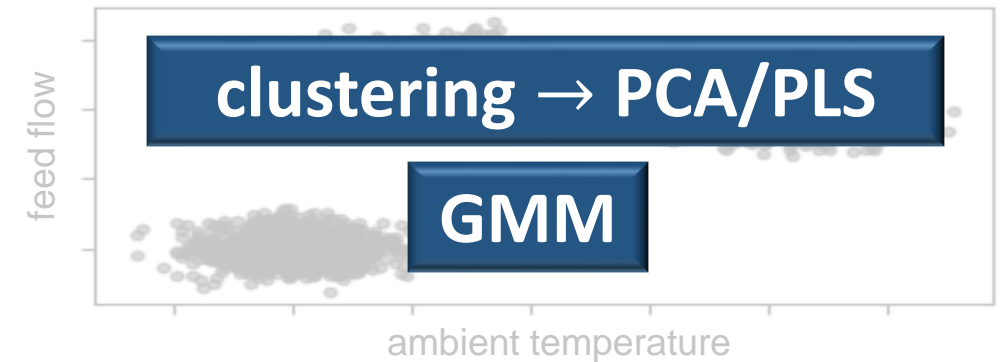
PCA | PLS

Dynamic process

Dynamic PCA | CVA
Dynamic PLS

Nonlinear process

Kernel PCA
Kernel PLS

Multimode process

clustering → PCA/PLS
GMM

Multivariate SPM: Table of Content

❑ Multivariate SPM

- ➢ Introduction to PCA and PLS

- ➢ Fault detection using Principal Component Analysis (PCA)

- ➢ Fault detection using Partial Least Squares (PLS) regression

- ➢ Fault diagnosis using PCA/PLS contribution charts

- ➢ MSPM application to FCCU and LDPE units

- ➢ Strategies for handling nonlinear, dynamic, multimode systems

Industrial applications

- ➢ **Application at Air Products[1]**

- ➢ **Application at DuPont[2]**

[1]https://www.airproducts.com/-/media/files/en/344/344-17-012-glb-predictive-analytics-capture-plants-heartbeat.pdf
[2]https://www.researchgate.net/publication/3206793_Multivariate_statistics_for_process_control

Statistical Techniques for Monitoring Industrial Processes

Next Lecture : Introduction to PCA

Module : PCA-based MSPM