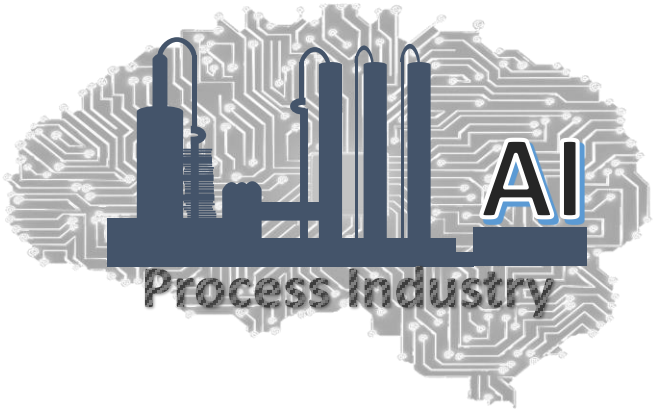
Statistical Techniques for Monitoring Industrial Processes



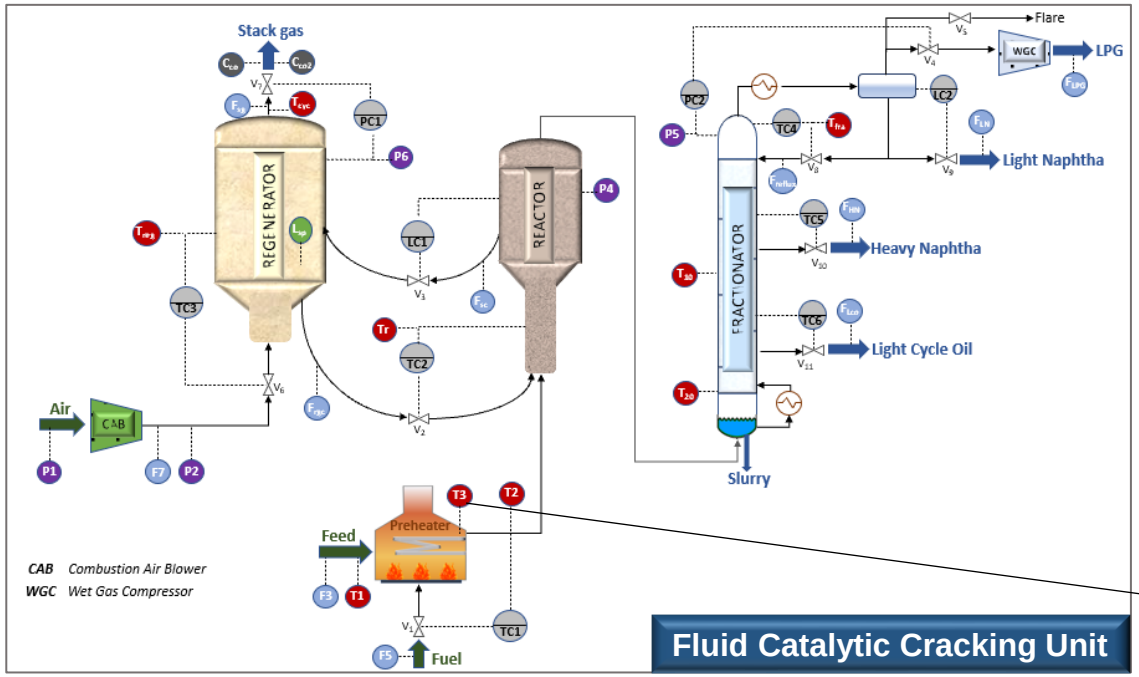
Lecture : Introduction to Univariate SPM & Control Charts

Module : Univariate SPM

Course TOC

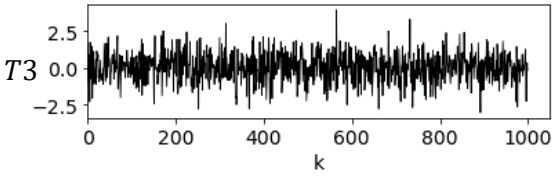
- ❑ Introduction to Statistical Process Monitoring (SPM)
- ❑ Python Installation and basics (optional)
- ❑ Univariate SPM & Control Charts
  - ➢ Shewhart Charts
  - ➢ CUSUM Charts
  - ➢ EWMA Charts
- ❑ Multivariate SPM
  - ➢ Fault detection using Principal Component Analysis (PCA)
  - ➢ Fault detection using Partial Least Squares (PLS) regression
  - ➢ Fault diagnosis using PCA/PLS contribution charts
  - ➢ Strategies for handling nonlinear, dynamic, multimode systems
- ❑ Deployment of SPM Solutions

Why Univariate SPM is needed?

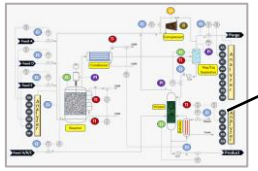


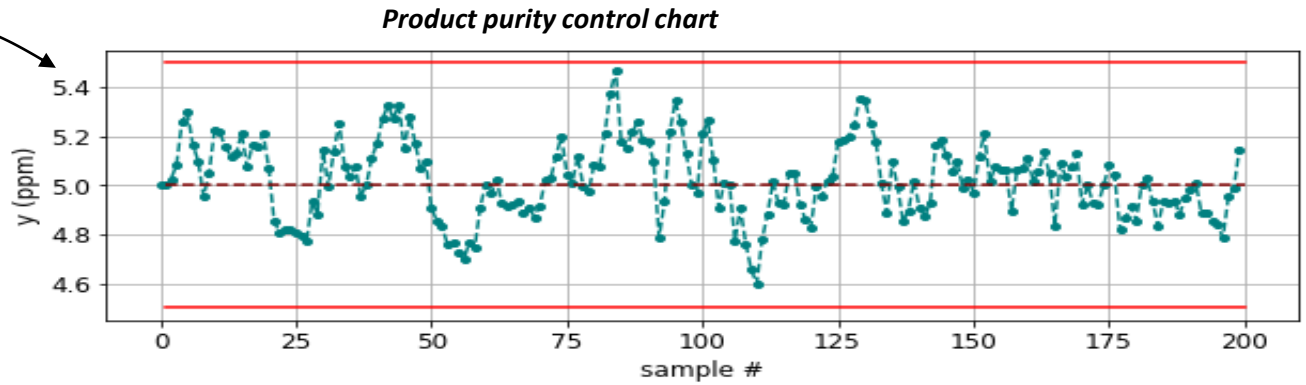
- ❑ Monitor plant performance KPI
- ❑ Monitor individual variables
- ❑ Monitor prediction residuals

$$T3 \approx \text{function}(feed\ flow)$$
$$\Delta T3 = residual = \text{actual}\ T3\ - \text{predicted}\ T3$$



Control Charts

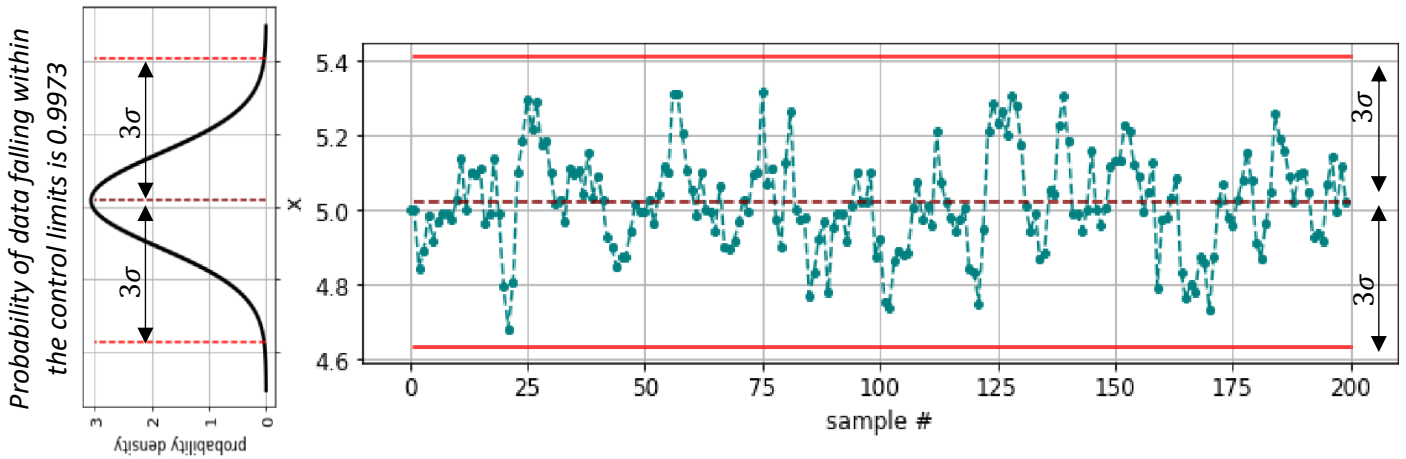




Interpretation

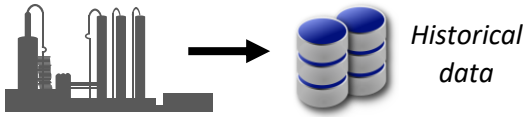
- ❑ Measurement within limits ⇒ '*in-control*' process
- ❑ Measurement outside limits ⇒ '*out-of-control*' process

Control Charts: Selection of Control Limits



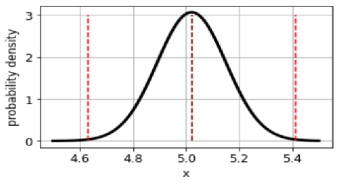
Control Charts: Construction & Deployment

Development Phase

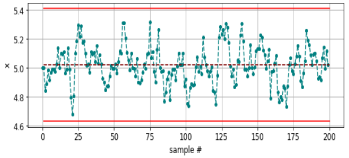


Historical data

Estimate parameters (σ, etc.) of signal distribution

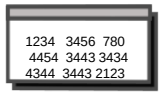


Estimate the control limits

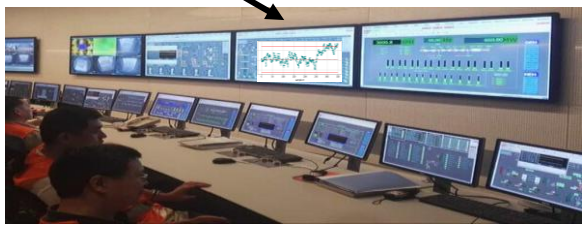


Inference Phase

Real-time data



Data plotted on control chart for real-time monitoring



Types of Control Charts

1. Shewhart control chart ← ← ← Next lecture
2. CUSUM control chart
3. EWMA control chart

Statistical Techniques for Monitoring Industrial Processes

Next Lecture : Introduction to Shewhart Control Charts

Module : Course Introduction