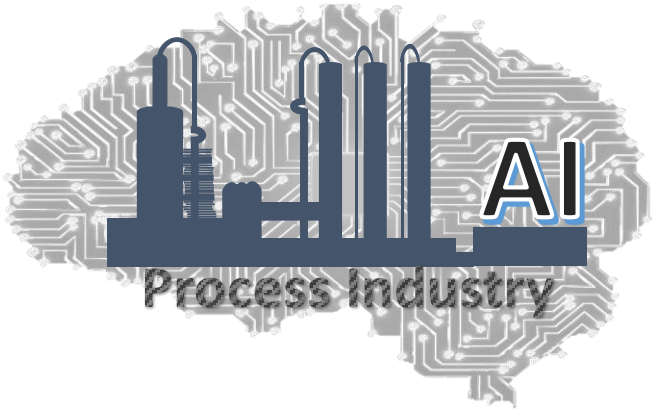
Statistical Techniques for Monitoring Industrial Processes



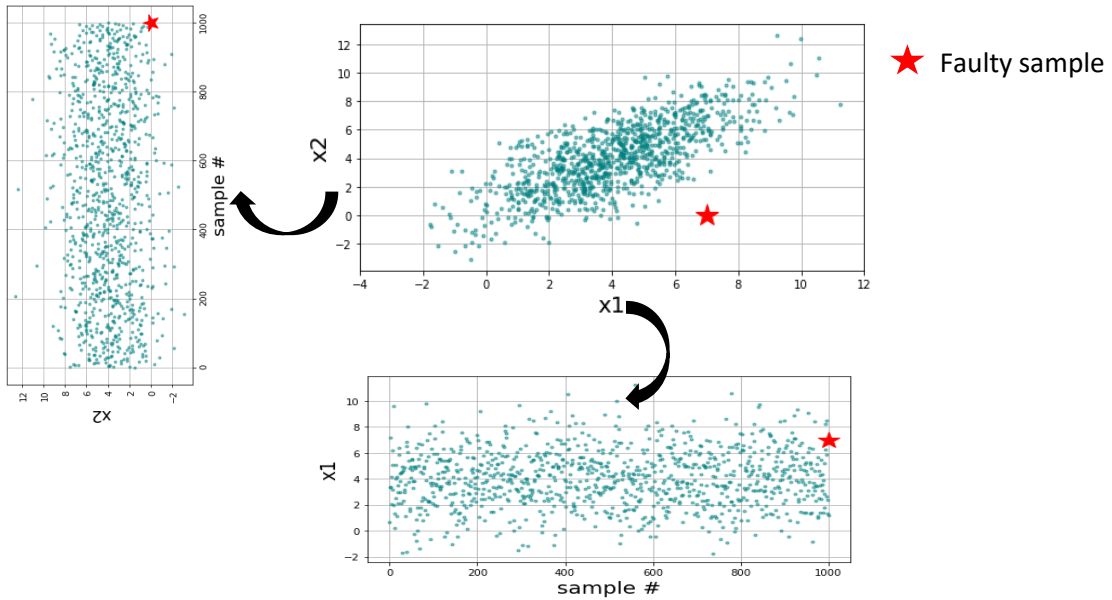
Lecture : Shortcomings of Classical Control Charts

Module : Univariate SPM

Course TOC

- ❑ Introduction to Statistical Process Monitoring (SPM)
- ❑ Python Installation and basics (optional)
- ❑ Univariate SPM & Control Charts
  - ➢ Shewhart Charts
  - ➢ CUSUM Charts
    - Application: Aeration tank monitoring
  - ➢ Assessing Performance of Control Charts
  - ➢ EWMA Charts
  - ➢ Shortcomings of Classical Control 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

Shortcoming of Univariate SPM: Handling multivariate system

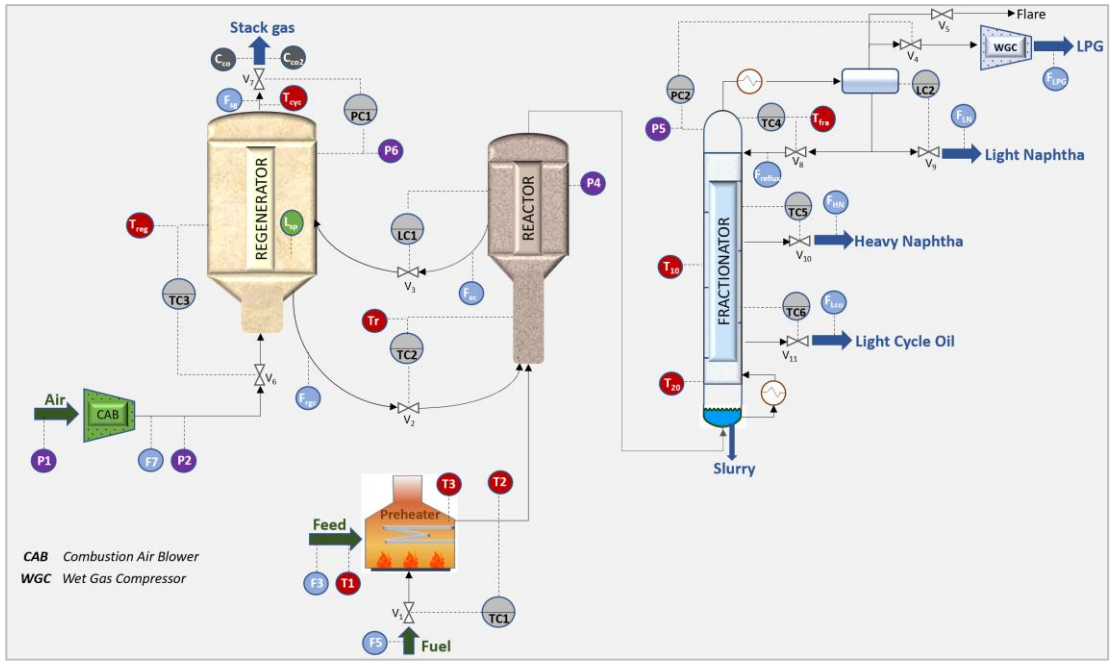


Solution?

- ❑ Multivariate Shewhart chart (Hotelling's T^2 chart)
- ❑ Multivariate CUSUM chart
- ❑ Multivariate EWMA chart

Not popular for handling correlated high-dimensional data

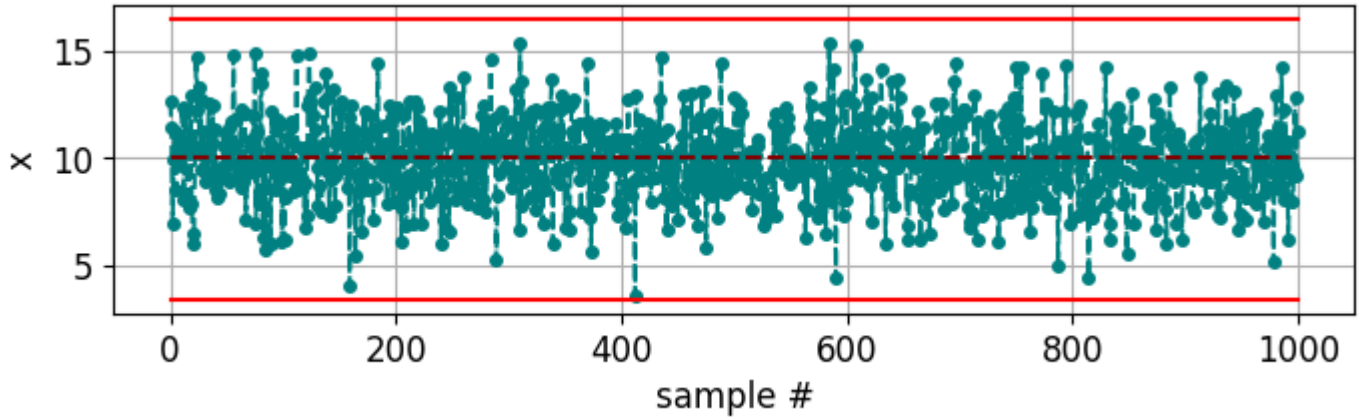
Shortcoming of Univariate SPM: Handling multivariate system



Interested in monitoring the whole plant?

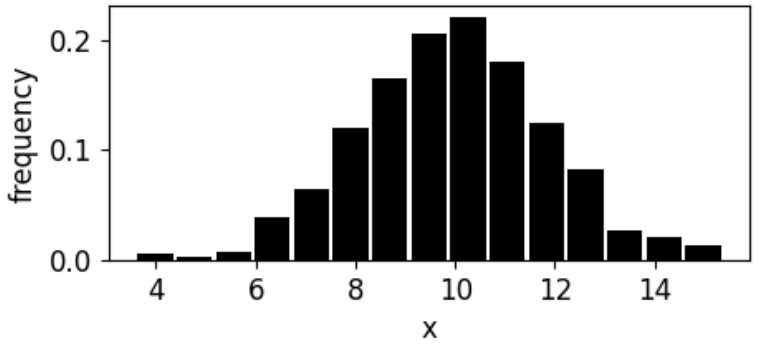
- ❑ PCA
- ❑ PLS
- ❑ ICA

Shortcoming of Univariate SPM: Handling autocorrelated signal

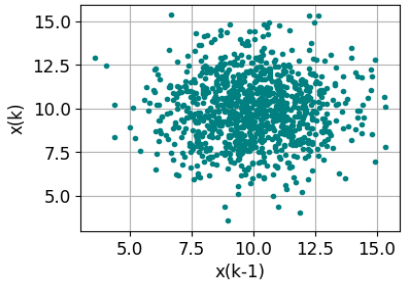


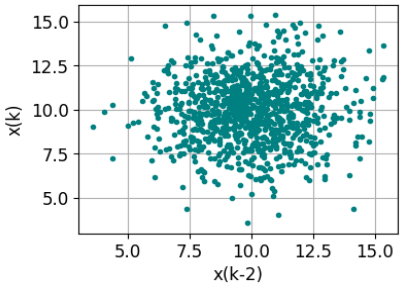
Assumptions

- signal is Gaussian distributed



- Observations are independently distributed and therefore uncorrelated





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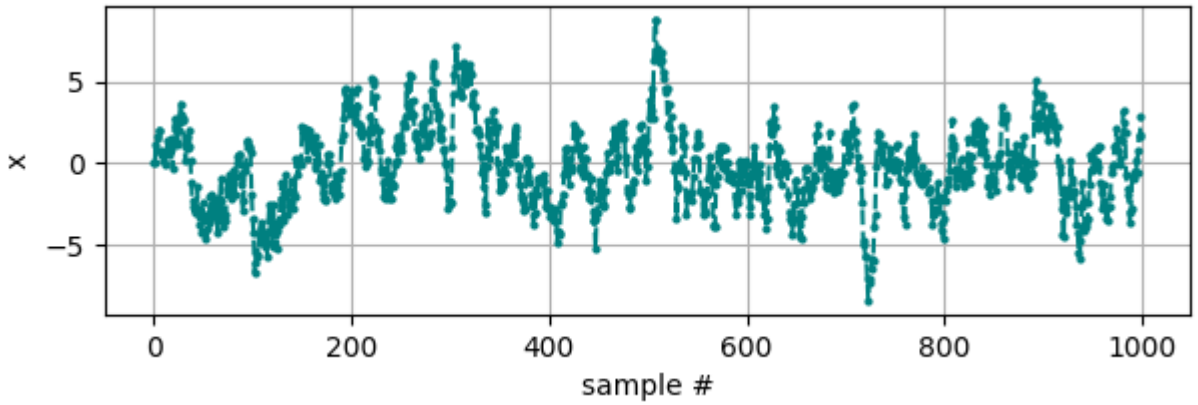
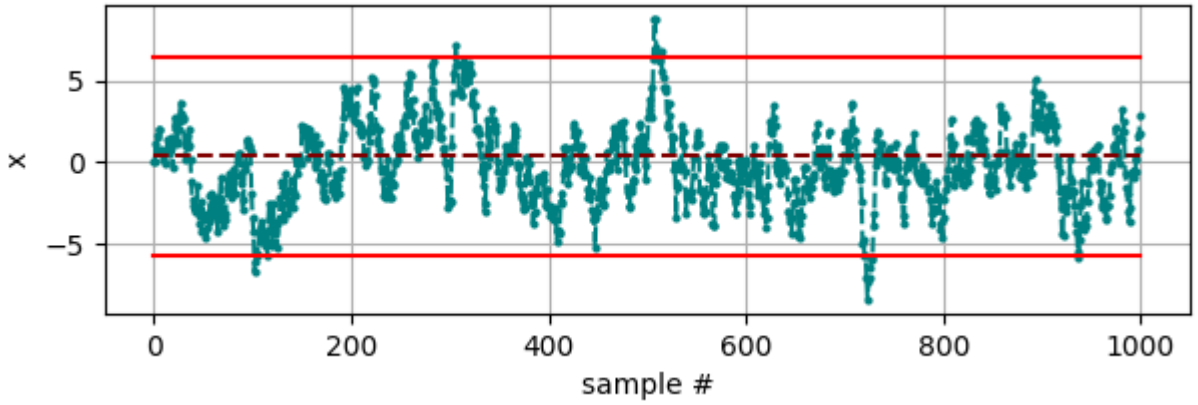
Shortcoming of Univariate SPM: Handling autocorrelated signal

$$x(k) = 0.9x(k-1) + e(t)$$

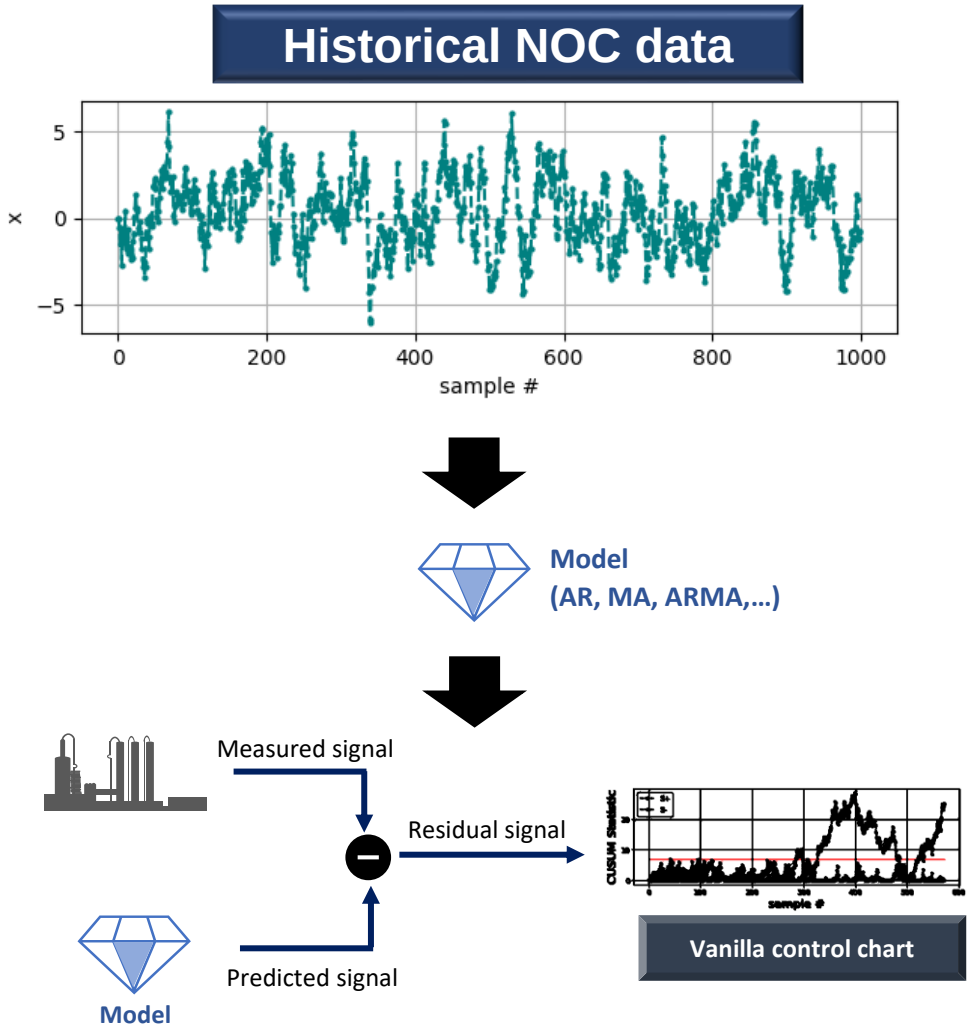


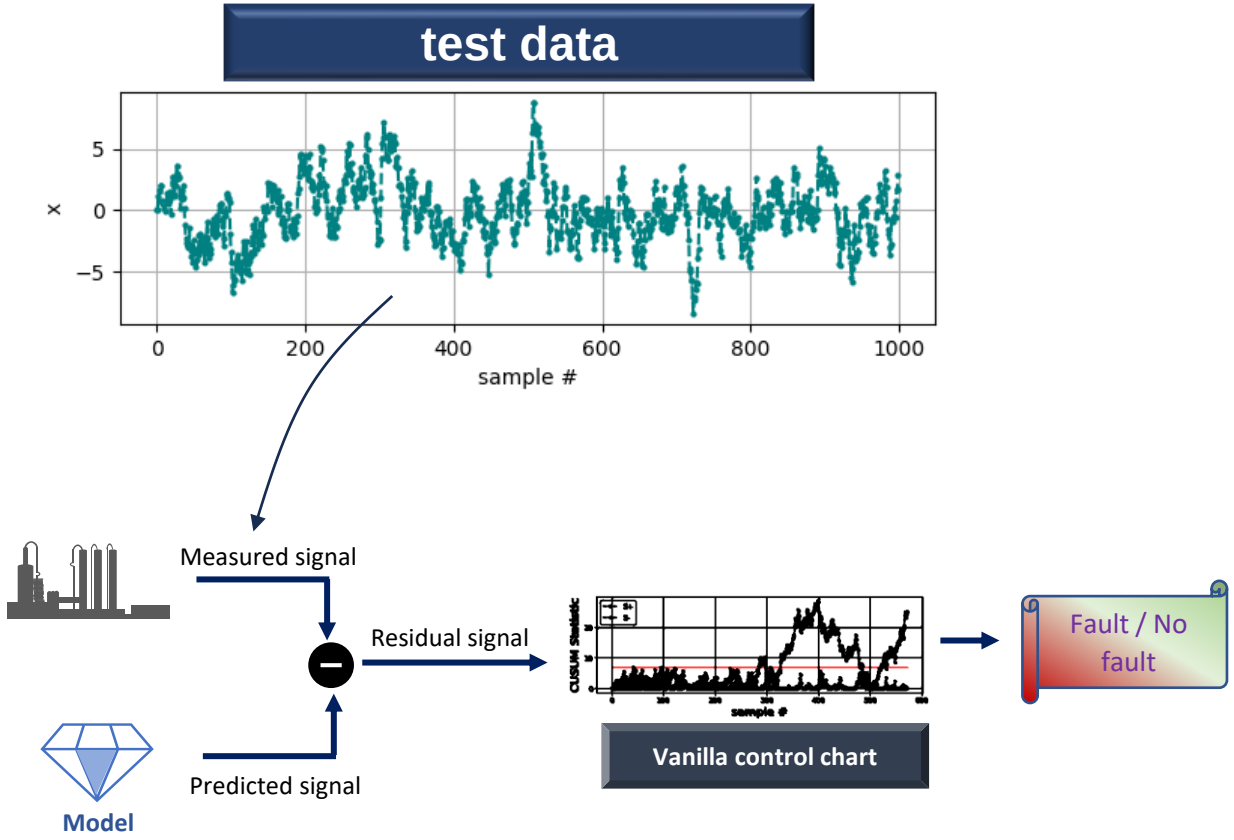
3σ Shewhart chart



$FAR = 1.8\% >$ (expected) 0.27%

Shortcoming of Univariate SPM: Handling autocorrelated signal





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Next Lecture : Introduction to Multivariate SPM

Module : Multivariate SPM