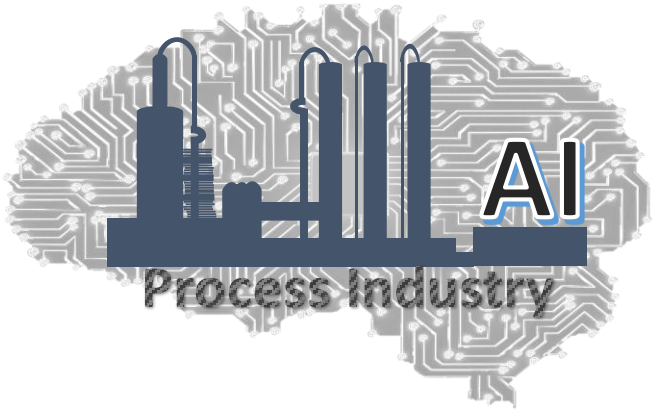
Statistical Techniques for Monitoring Industrial Processes



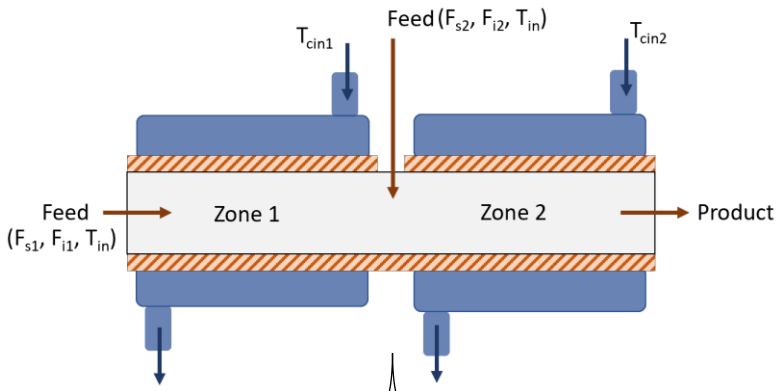
Lecture : PLS – Fault Detection

Module : PLS-based MSPM

Course TOC

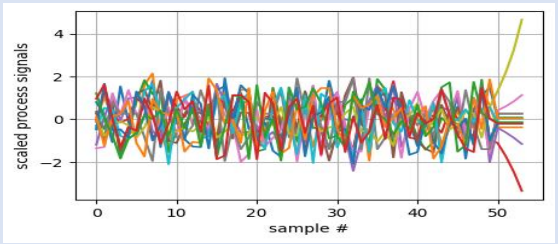
- ❑ Introduction to Statistical Process Monitoring (SPM)
- ❑ Python Installation and basics (optional)
- ❑ Univariate SPM & Control Charts
  - ➢ Shewhart Charts
  - ➢ CUSUM Charts
  - ➢ EWMA Charts
- ❑ Multivariate SPM
  - ➢ Principal Component Analysis (PCA)-based MSPM
  - ➢ Partial Least Squares (PLS) regression-based MSPM
    - ➢ Fault detection & diagnosis (FDD) using PLS
    - ➢ Application to a LDPE reactor monitoring
  - ➢ Strategies for handling nonlinear, dynamic, multimode systems
- ❑ Deploying SPM solutions

LDPE Dataset

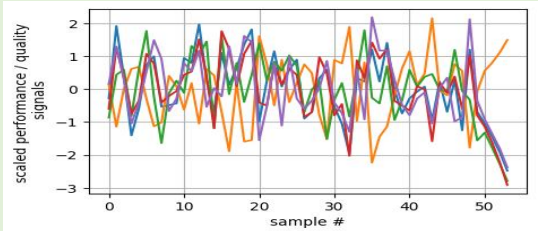


- **54 samples**
- **Last 4 samples known to be from faulty process**

Process Signals

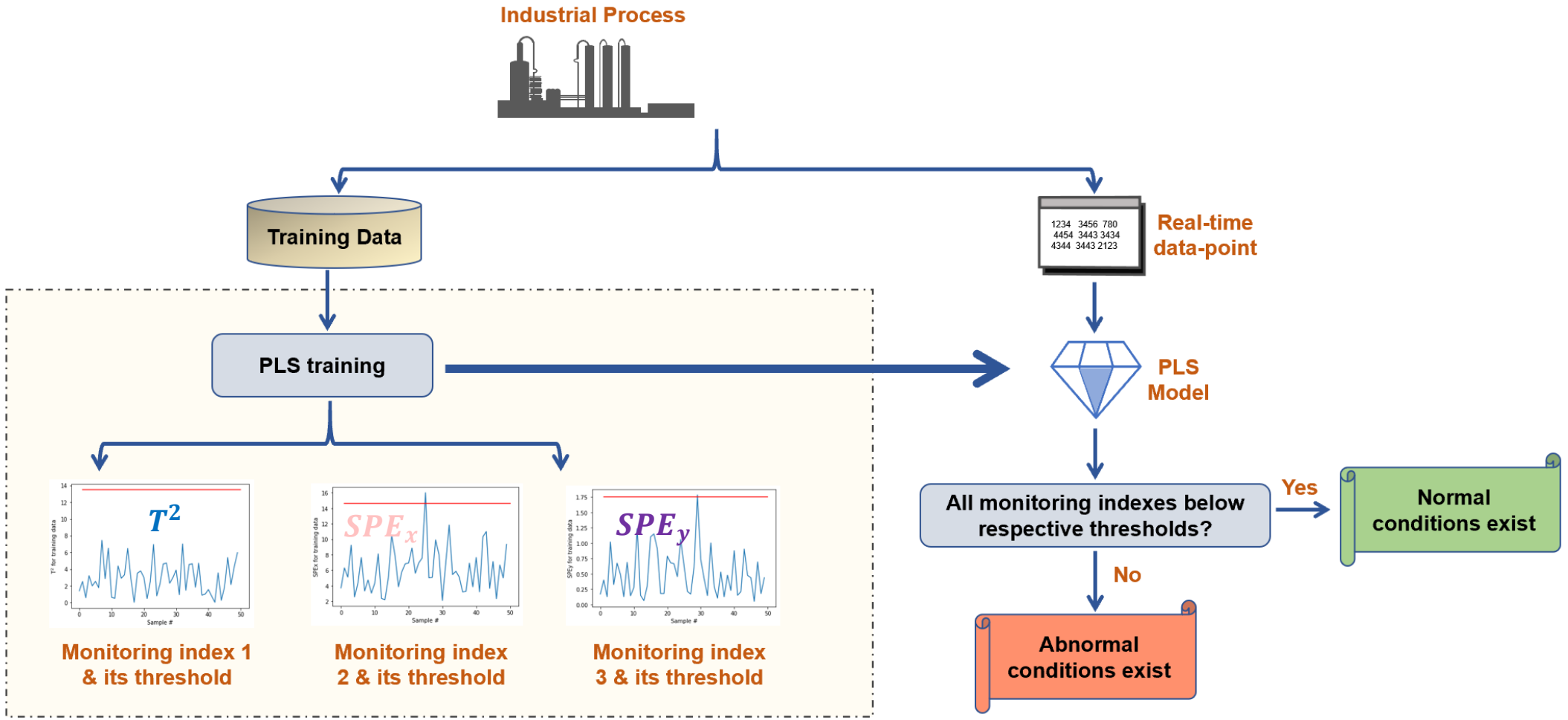


Performance / Product quality measures

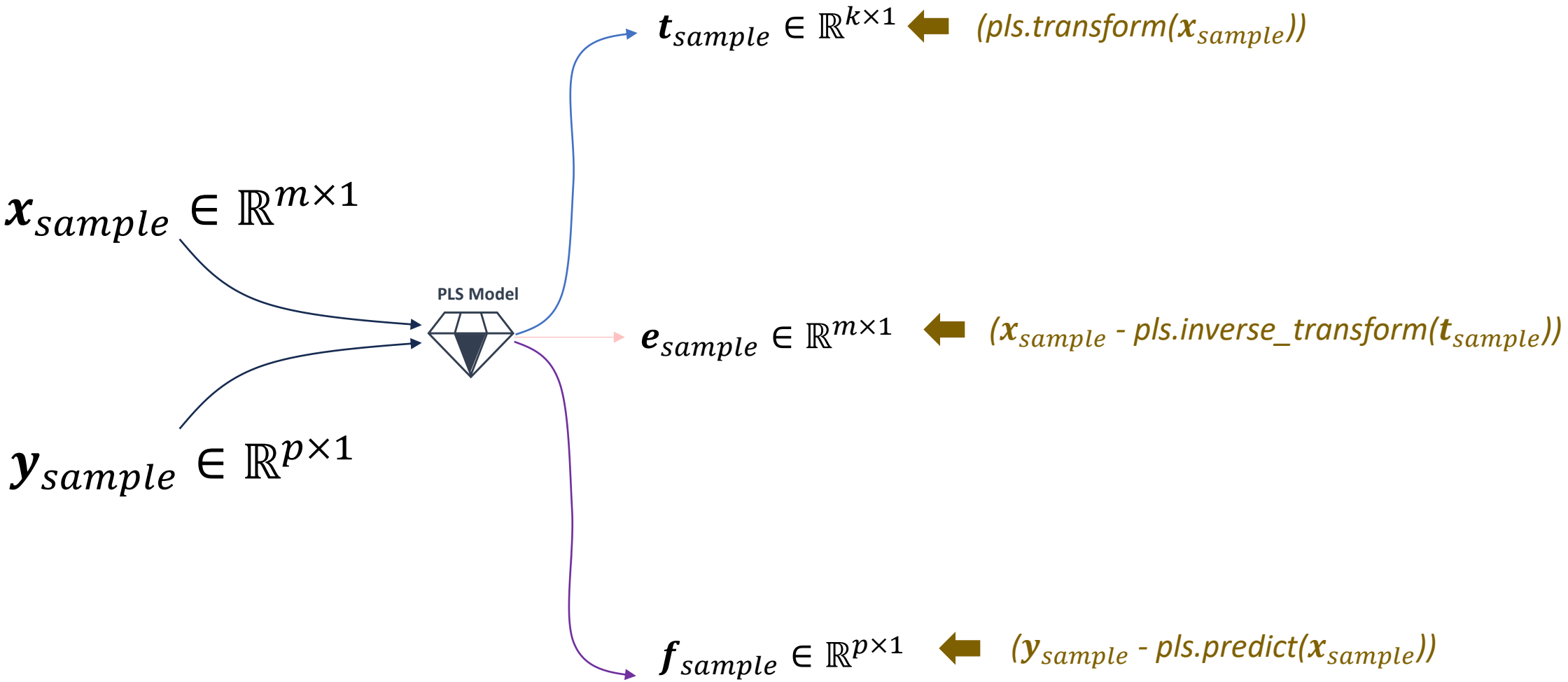


Objective: Build a PLS-based tool to detect the fault (and subsequently find the faulty signals)

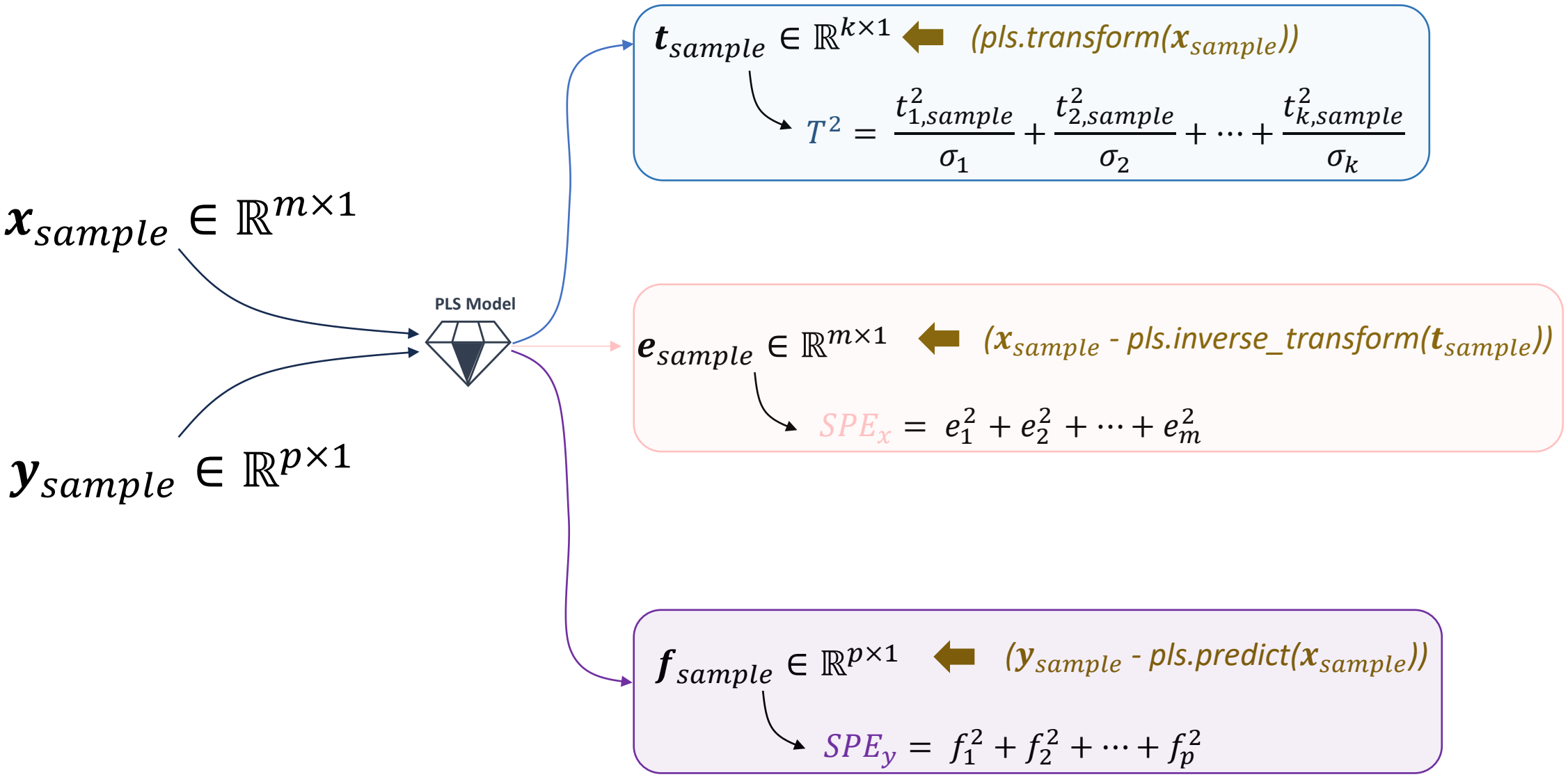
PLS-based Fault Detection Workflow



PLS Fault Detection Indices

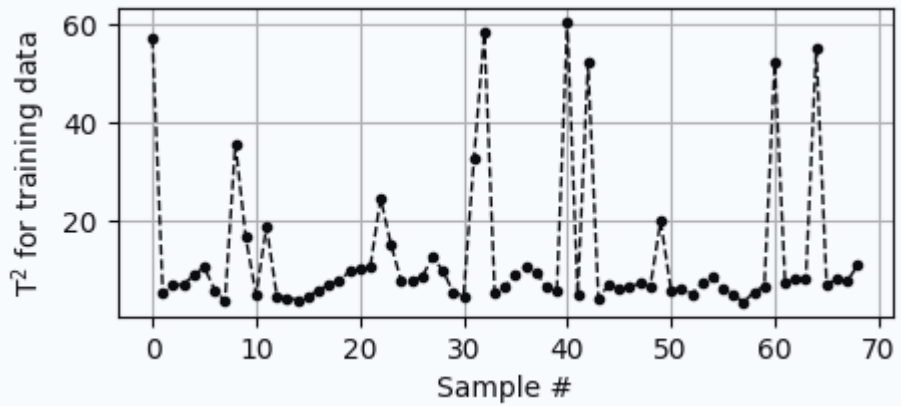


PLS Fault Detection Indices



PLS Fault Detection Indices: Alert Threshold

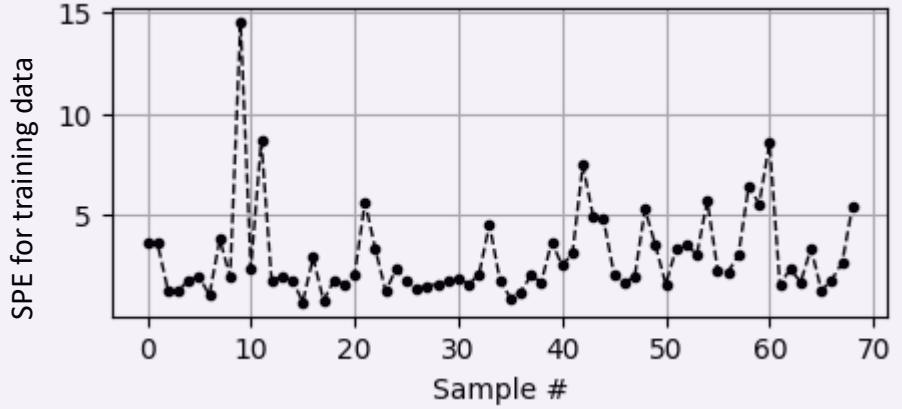
T^2



T^2_{CL} = np.percentile(T2_values, 99) # alpha=0.01

- Control limit is simply the 99th percentile of the T^2 values for the training samples

SPE_x or SPE_y



SPE_{CL} = np.percentile(SPE_values, 99) # alpha=0.01

- Control limit is simply the 99th percentile of the SPE values for the training samples

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Next Lecture : PLS – Fault Diagnosis

Module : PLS-based MSPM