# Automated Full Line Excursion Analysis using Time Resolved FDC with PAnaMA

Motivation

Yield detractor/Excursion root cause analysis is often a time consuming challenge:
• **distributed data storage** in different and sometimes proprietary databases (yield-data, electrical, inline metrology data and FDC data)
• **missing common key information** (material context) for the correct merge of the data from different sources
• **great effort before starting the analysis itself** - data acquisition, pre-processing, validation and data merging
• **low sensitivity analysis techniques used** - the discovery of yield influencing process operations is often based merely on major equipment differences (ANOVA)
• **rarely used high sensitivity analysis of equipment parameters** (in particular time resolved FDC raw data) due to difficult to handle large amount of data

- the entire picture -

FDC Data · Inline Data · Electr. Data · Yield Data
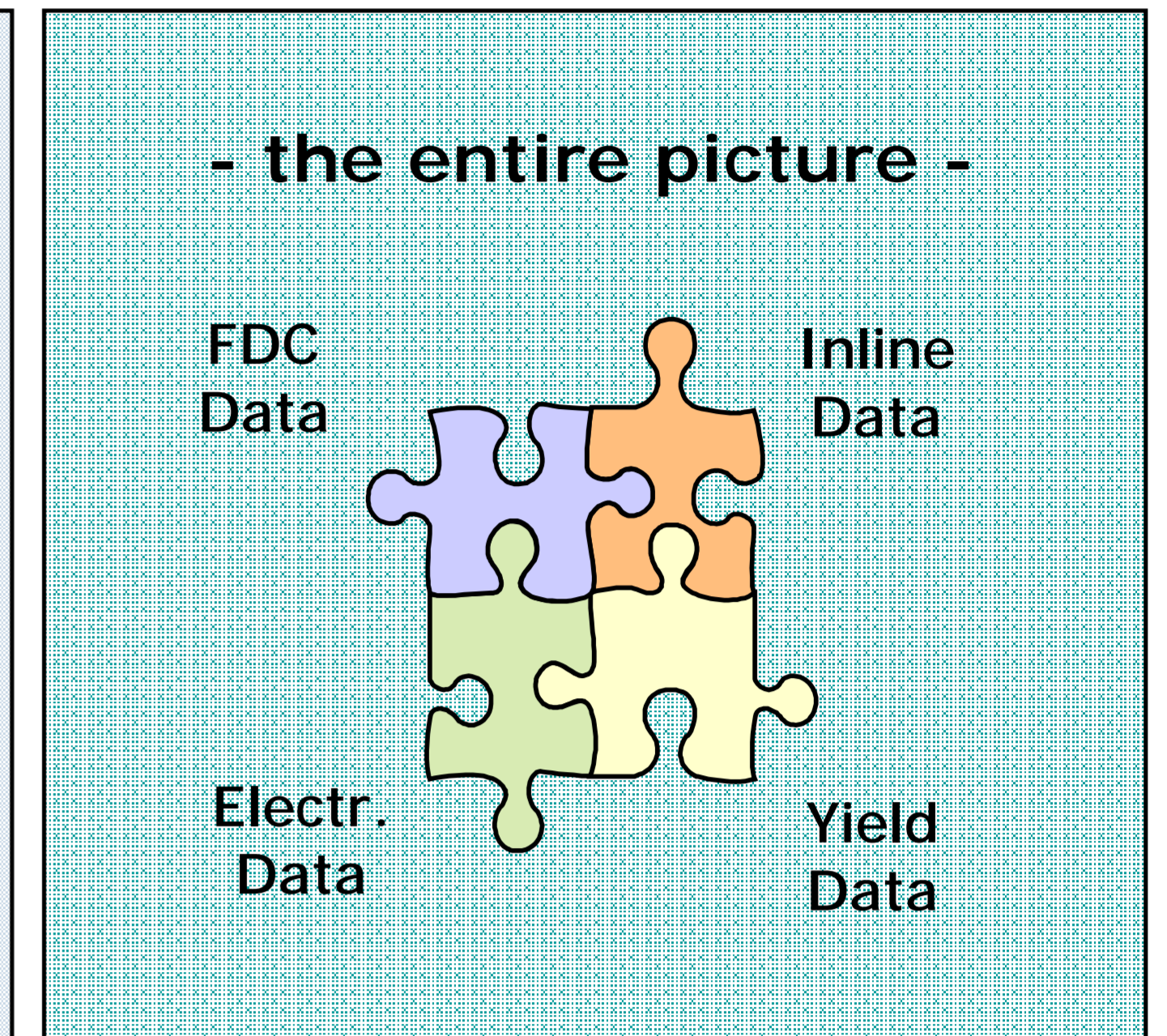
Description of Approach – PAnaMA

• provide easy to use **Engineering Database** for common data storage from different data sources like wafer based indicators from FDC, Yield, electr. Parameters and Inline Data, Chip-Data and FDC Trace Data.
• provide a **Front End Application** for automated, high volume, and fast data acquisition, exploratory visualization and enhanced analysis functions, called "PAnaMA" – *(Parameter Analysis using Matlab)*
• PAnaMA architecture enable **Fast Prototyping** for implementations and testing of new analysis algorithms

*examples for exploratory visualization features*
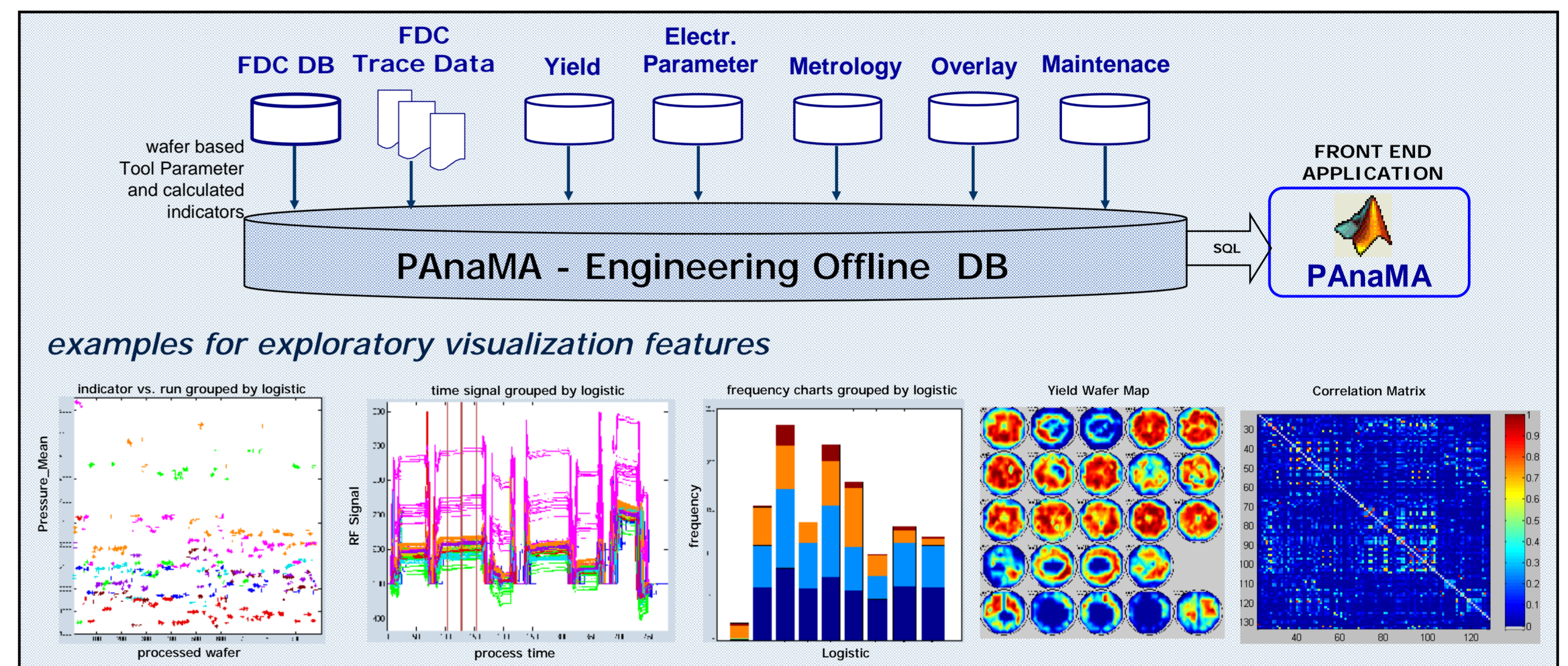
Methods of Feature Extraction

• most commercial FDC solutions calculate indicators for steps within a single process (e.g. mean, range, median);
as a consequence a huge amount of highly correlated indicators is calculated
• the objective is to tailor the indicators in such way that they optimally explain the target of our investigation
• PAnaMA provides an innovative framework to implement own methods for extracting sophisticated indicators from the time resolved FDC data

Analysis Flow
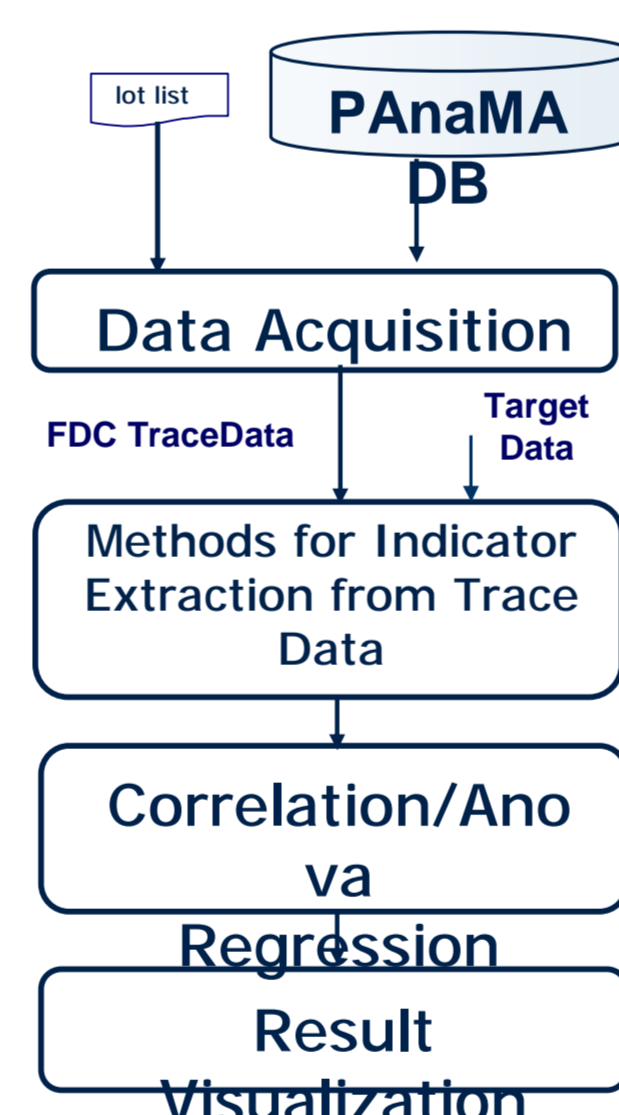
Example: Trace PCA - calculate the PCA decomposition for each trace channel, the scores of the decomposition are used as new indicators
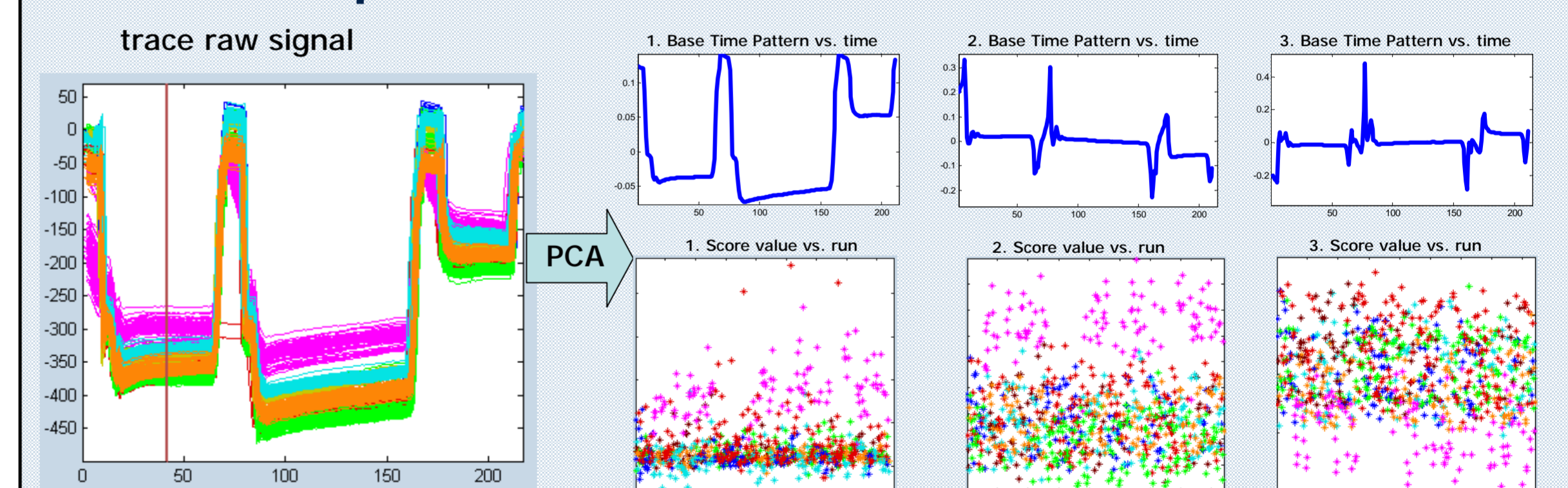
PCA is useful for separation of different curve shapes and signal outliers

Full Line Scan Analysis

Scope: find out the root cause of a production excursion problem over the full production line using time resolved FDC data
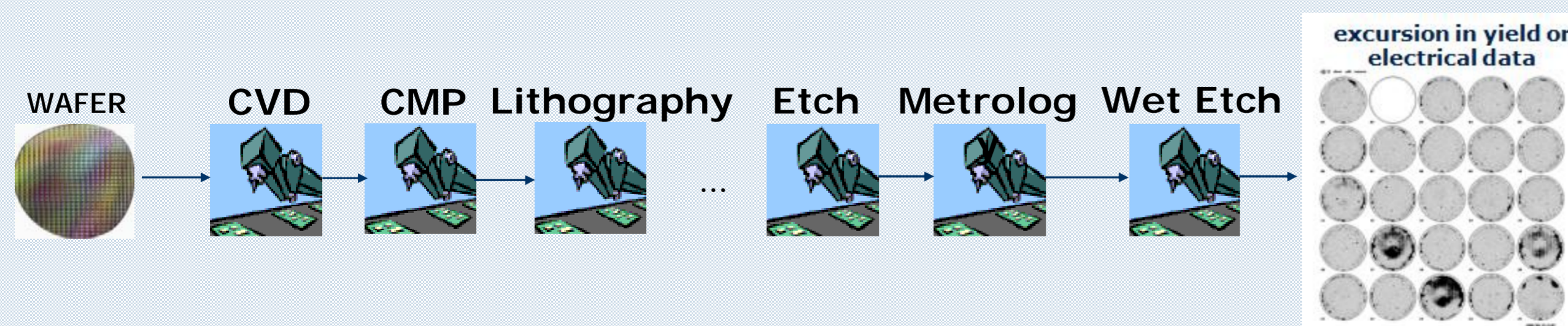
Solution:
• a good/bad wafer list or a continuous parameter can be used as excursion response parameter
• the root cause analysis can be calculated on different granularities, e.g. operation, tool or recipe
• an interactive and user friendly visualization of the detected hints enables fast drill down to more data

Example
• find out the root cause of outliers within an electrical parameter for 1500 wafers
• scan all process and metrology operations, acquire and process FDC and Metrology data and correlate with multiple electrical data as target
• a list containing all univariate hints ranked by correlation coefficient allows a rapid and interactive drill down
• a subsequent modeling step using analysis results allows multivariate process modeling and validation

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