CNC MACHINES
DATA ANALYTICS

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Factories of the Future

Sustainable Business | Connected Operations | Industry 4.0+ Technology

CNC 5C DATA TRANSFORMATION

CONNECT

To begin your digital transformation journey we need to establish a digital connection to the CNC machines

COLLECT

Collect data from established connections using drivers/adapters based on OPC UA/ MT Connect

COMPUTE

Perform any necessary evaluations of the data - converts raw data to appropriate units, calculates fault states, runs timers, etc.

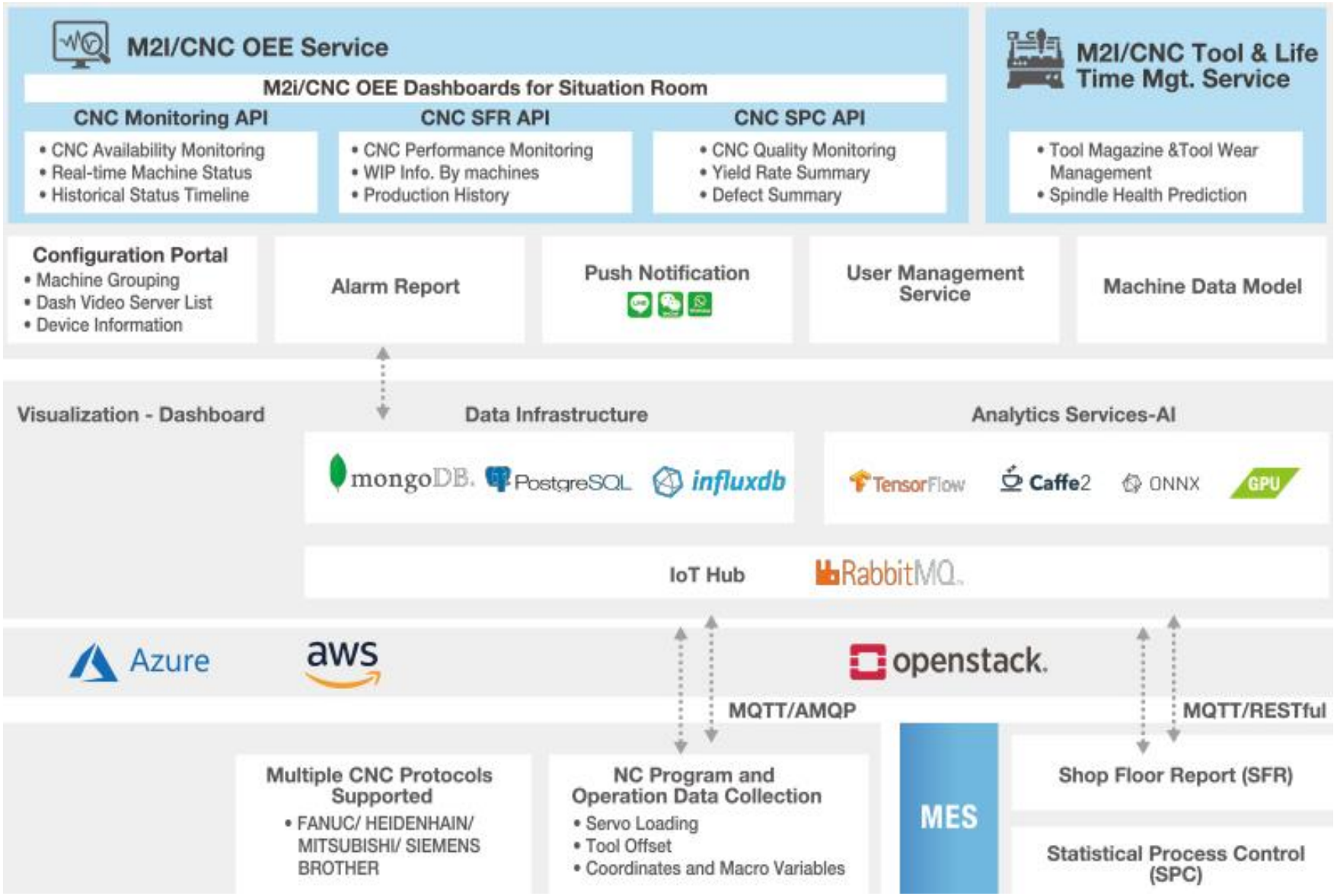
COMBINE

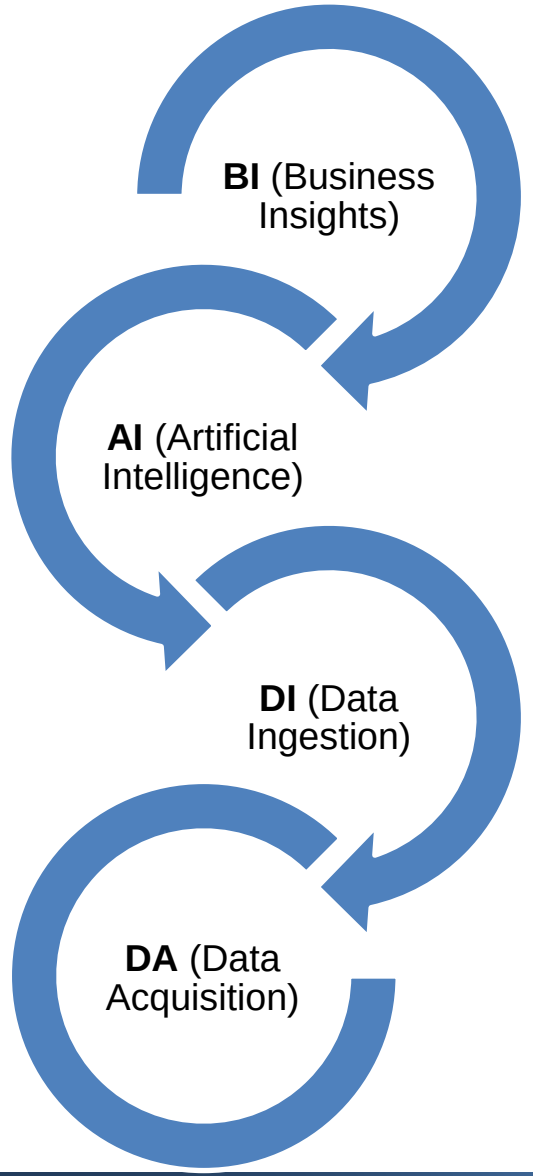
Perform any aggregation of data from multiple sources or from re-injected system data

CONVEY

Derive insights that shows perspectives of metrics; OEE, Predictive Analysis, Cause and Effect Analysis, etc.

CNC DATA INSIGHTS AS A SERVICE





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CNC MACHINES DATA ANALYTICS

1. SPINDLE DATA ANALYTICS
2. TOOL CONDITION PREDICTION
3. MACHINE PERFORMANCE ANALYSIS

CNC DATA MODEL

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X-axis

- X1_ActualPosition: actual x position of part (mm)
- X1_ActualVelocity: actual x velocity of part (mm/s)
- X1_ActualAcceleration: actual x acceleration of part (mm/s/s)
- X1_CommandPosition: reference x position of part (mm)
- X1_CommandVelocity: reference x velocity of part (mm/s)
- X1_CommandAcceleration: reference x acceleration of part (mm/s/s)
- X1_CurrentFeedback: current (A)
- X1_DCBusVoltage: voltage (V)
- X1_OutputCurrent: current (A)
- X1_OutputVoltage: voltage (V)
- X1_OutputPower: power (kW)

Y-axis

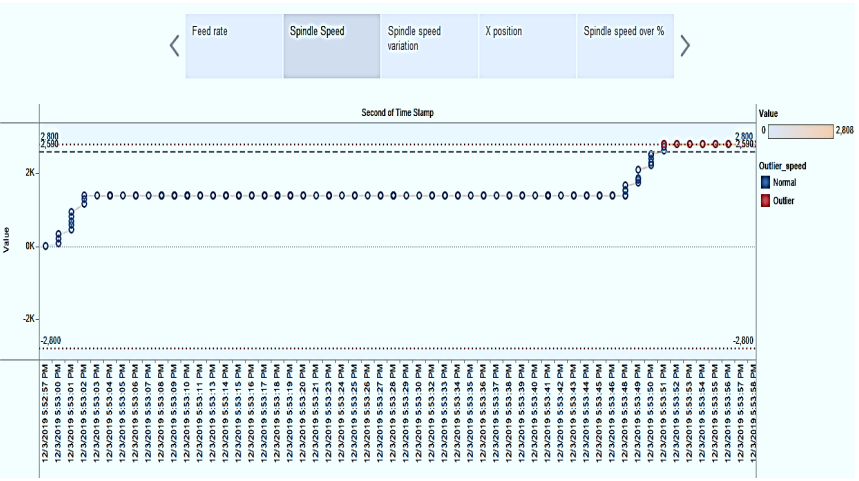
- Y1_ActualPosition: actual y position of part (mm)
- Y1_ActualVelocity: actual y velocity of part (mm/s)
- Y1_ActualAcceleration: actual y acceleration of part (mm/s/s)
- Y1_CommandPosition: reference y position of part (mm)
- Y1_CommandVelocity: reference y velocity of part (mm/s)
- Y1_CommandAcceleration: reference y acceleration of part (mm/s/s)
- Y1_CurrentFeedback: current (A)
- Y1_DCBusVoltage: voltage (V)
- Y1_OutputCurrent: current (A)
- Y1_OutputVoltage: voltage (V)
- Y1_OutputPower: power (kW)

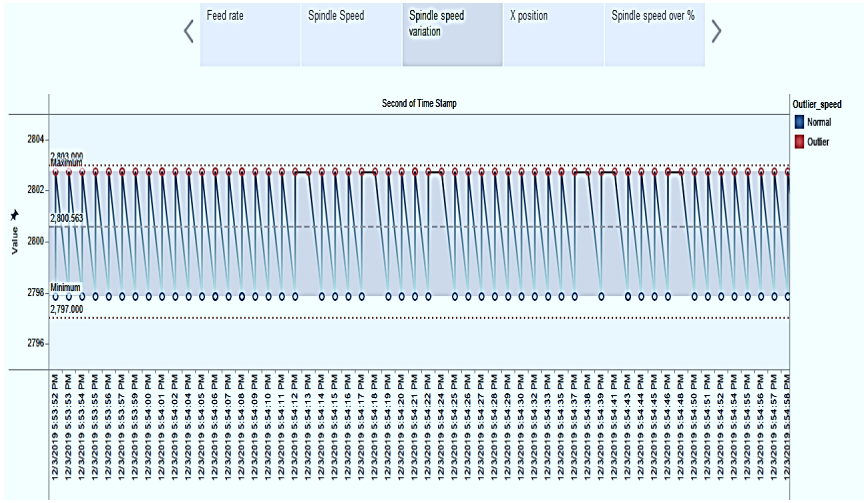
Z-axis

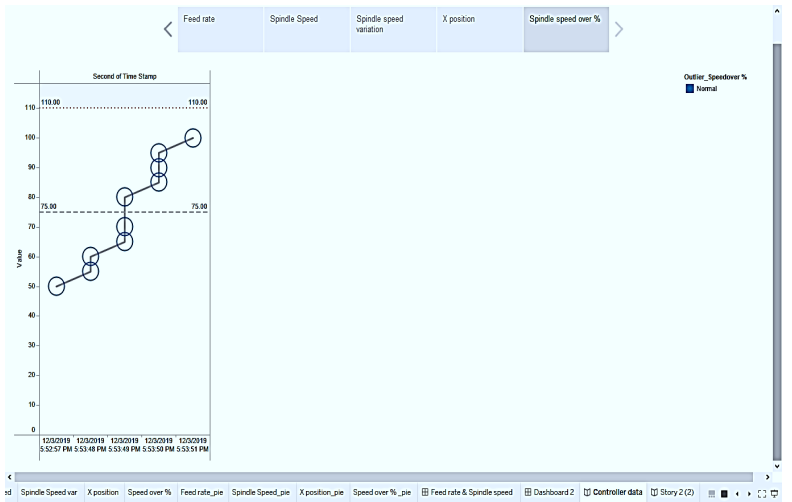
- Z1_ActualPosition: actual z position of part (mm)
- Z1_ActualVelocity: actual z velocity of part (mm/s)
- Z1_ActualAcceleration: actual z acceleration of part (mm/s/s)
- Z1_CommandPosition: reference z position of part (mm)
- Z1_CommandVelocity: reference z velocity of part (mm/s)
- Z1_CommandAcceleration: reference z acceleration of part (mm/s/s)
- Z1_CurrentFeedback: current (A)
- Z1_DCBusVoltage: voltage (V)
- Z1_OutputCurrent: current (A)
- Z1_OutputVoltage: voltage (V)

Spindle

- S1_ActualPosition: actual position of spindle (mm)
- S1_ActualVelocity: actual velocity of spindle (mm/s)
- S1_ActualAcceleration: actual acceleration of spindle (mm/s/s)
- S1_CommandPosition: reference position of spindle (mm)
- S1_CommandVelocity: reference velocity of spindle (mm/s)
- S1_CommandAcceleration: reference acceleration of spindle (mm/s/s)
- S1_CurrentFeedback: current (A)
- S1_DCBusVoltage: voltage (V)
- S1_OutputCurrent: current (A)
- S1_OutputVoltage: voltage (V)
- S1_OutputPower: current (A)
- S1_SystemInertia: torque inertia (kg*m^2)







PRODUCTIVITY - CNC MACHINE'S PERFORMANCE METRICS

- Spindle, Hydraulic, and Lubrication Analysis are showcased as part of the machine performance monitoring dashboard
- CNC Machine Failure Prediction with What-If Models; A&Es (Alerts & Events) Analysis for shutdowns
- Solution supports for Energy losses analytics

SPINDLE SPEED ANALYSIS

1

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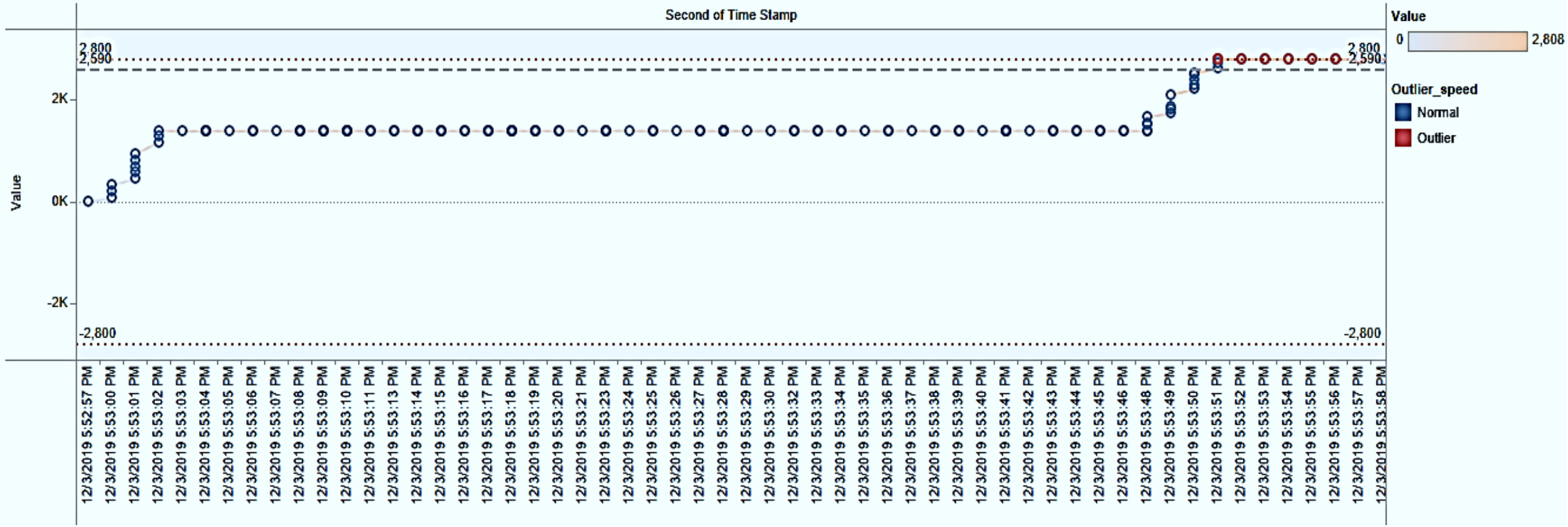
Feed rate | Spindle Speed | Spindle speed variation | X position | Spindle speed over %



SPINDLE SPEED VARIATION ANALYSIS 1

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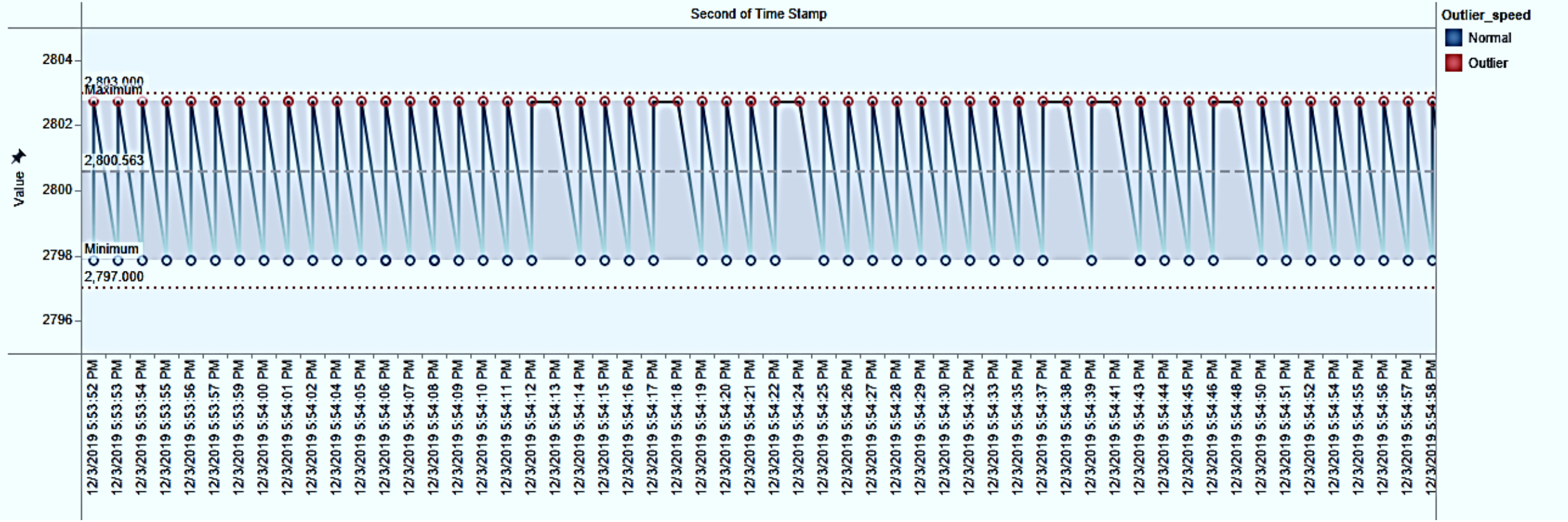
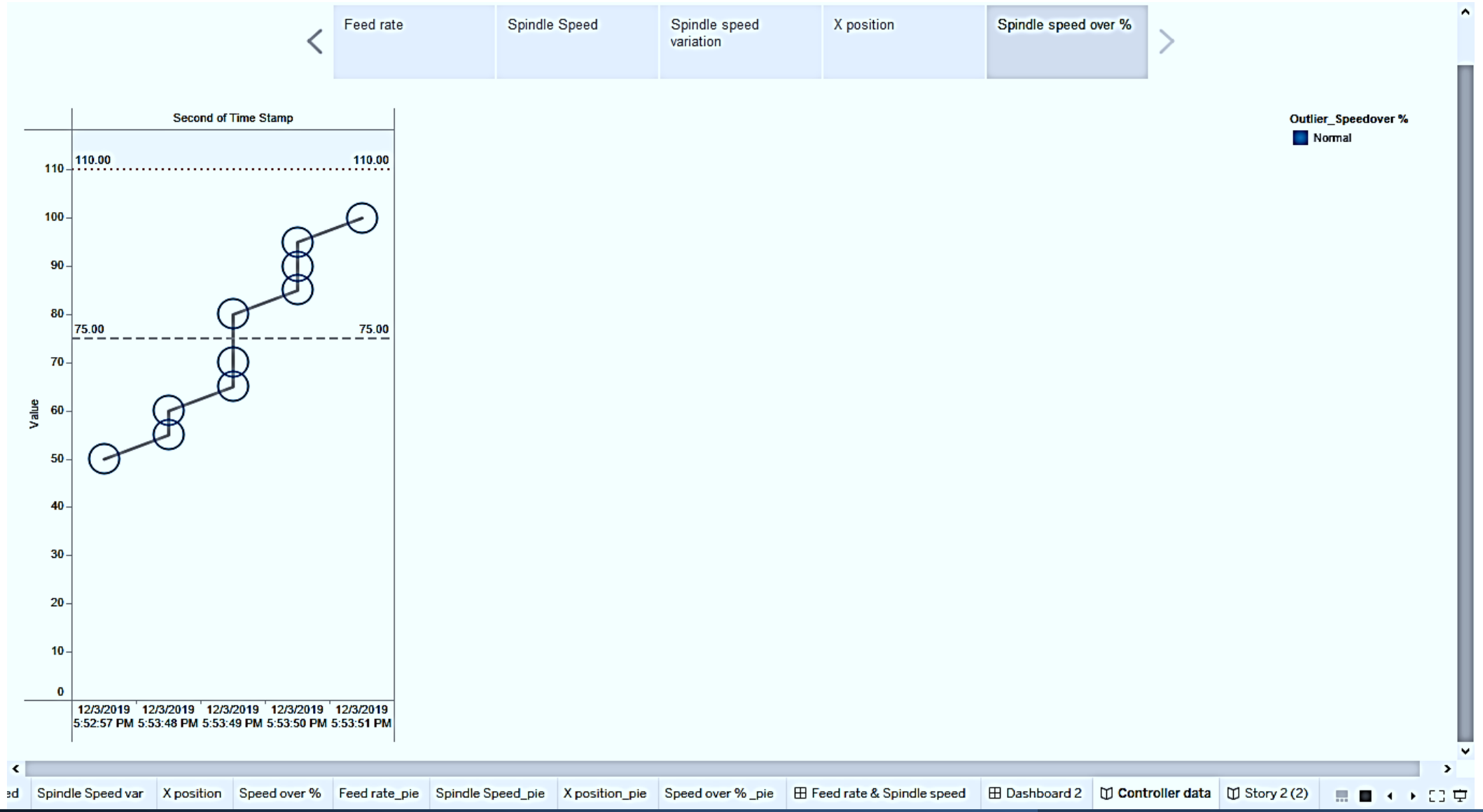
Feed rate | Spindle Speed | Spindle speed variation | X position | Spindle speed over %

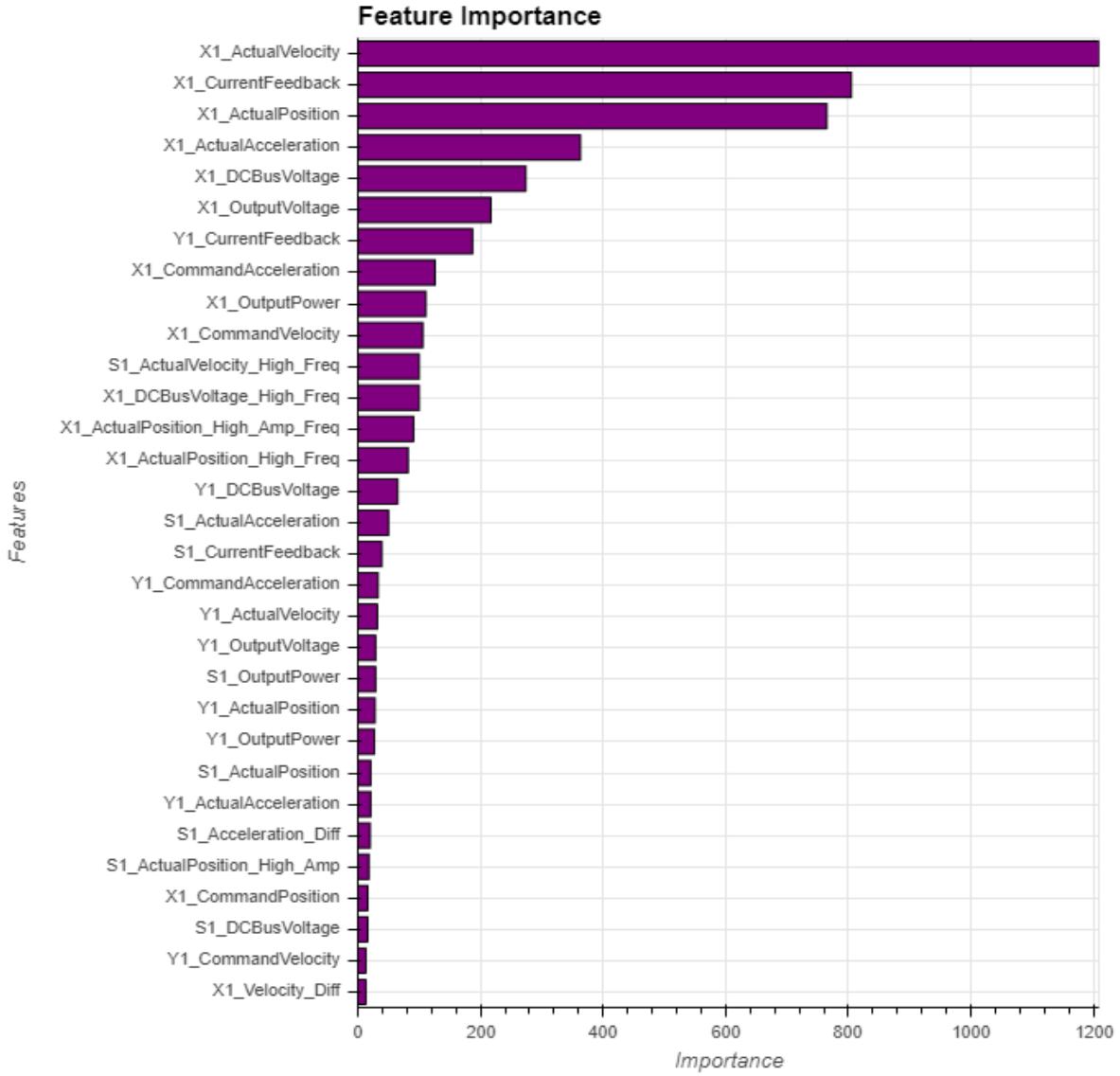


SPINDLE SPEED OVER % ANALYSIS 1



FEATURES FOR TOOL CONDITION 2

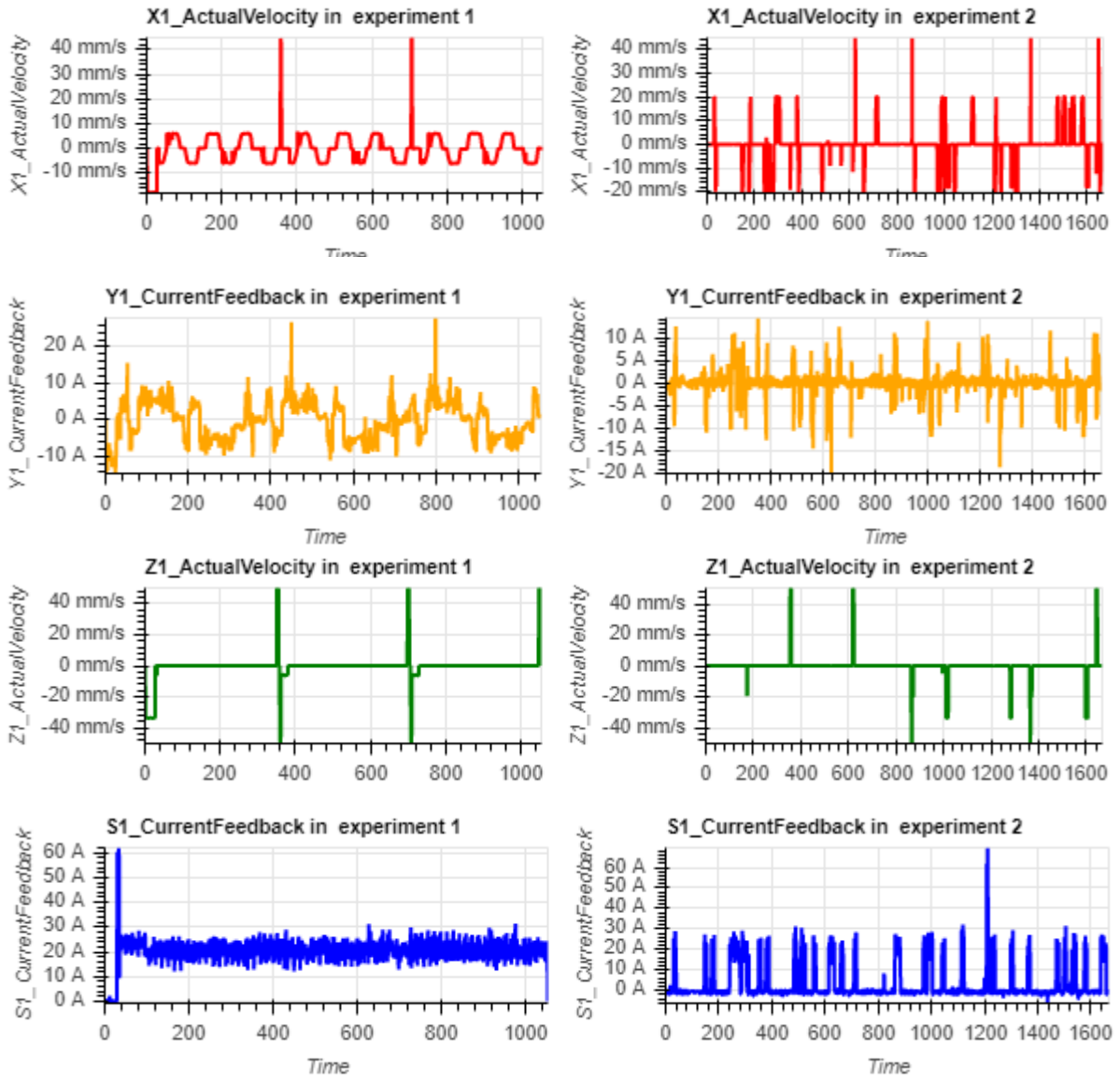
1. Speeds (RPMs, rotary velocity, spindle speed)
2. Feed rate
3. Loads & positions of tools on each individual axis
4. Machine status (active, inactive) and part count increments
5. Other control metrics that come off a machine that must be there anyway for the machine to run



PREDICT TOOL CONDITION 2

Features

- X-Axis
- Y-Axis
- Z-Axis
- Spindle



PREDICT TOOL WEAR 2

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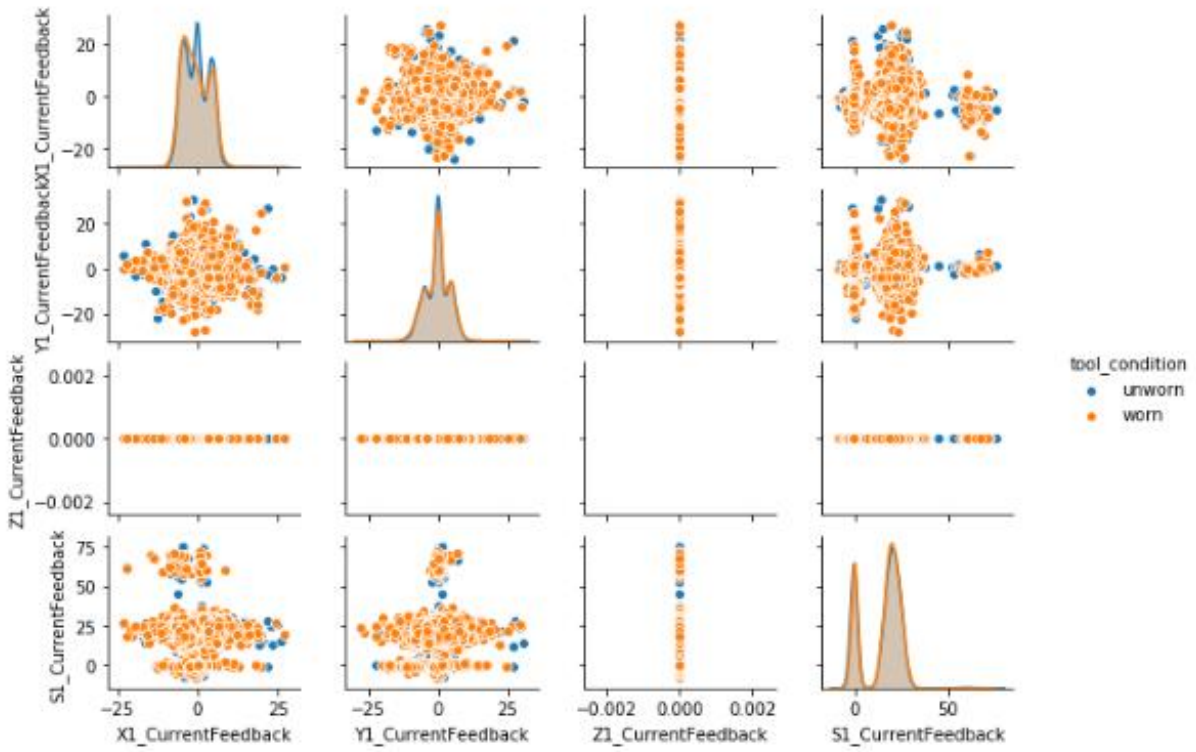
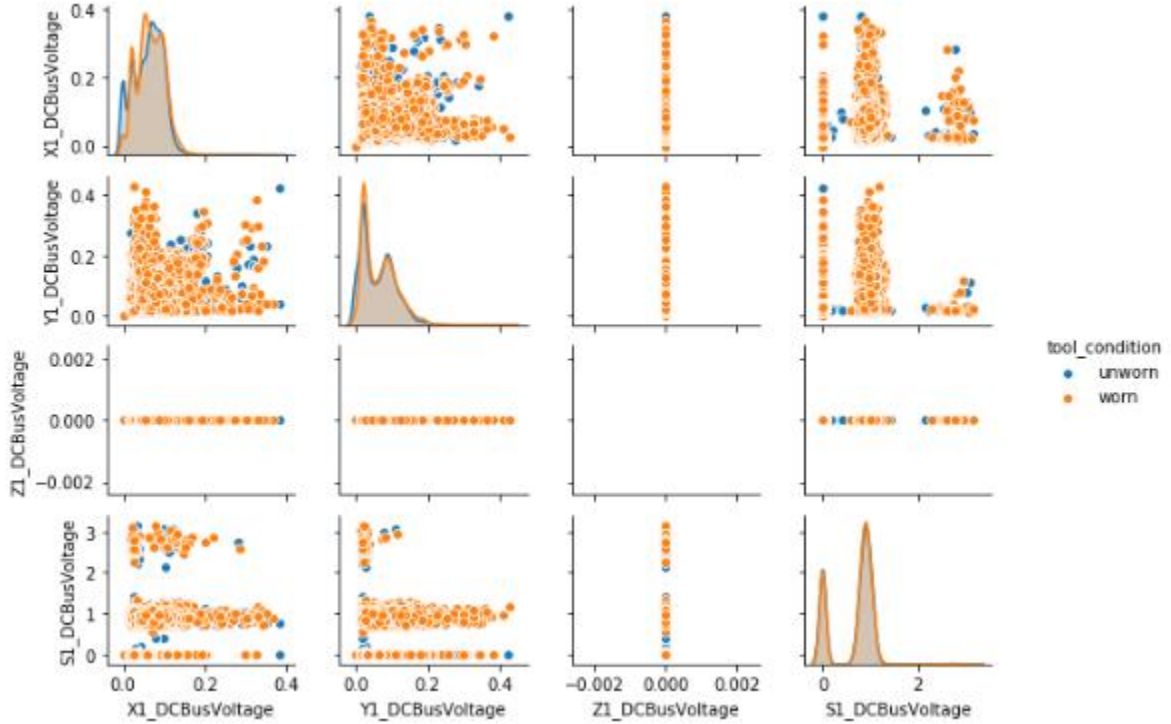
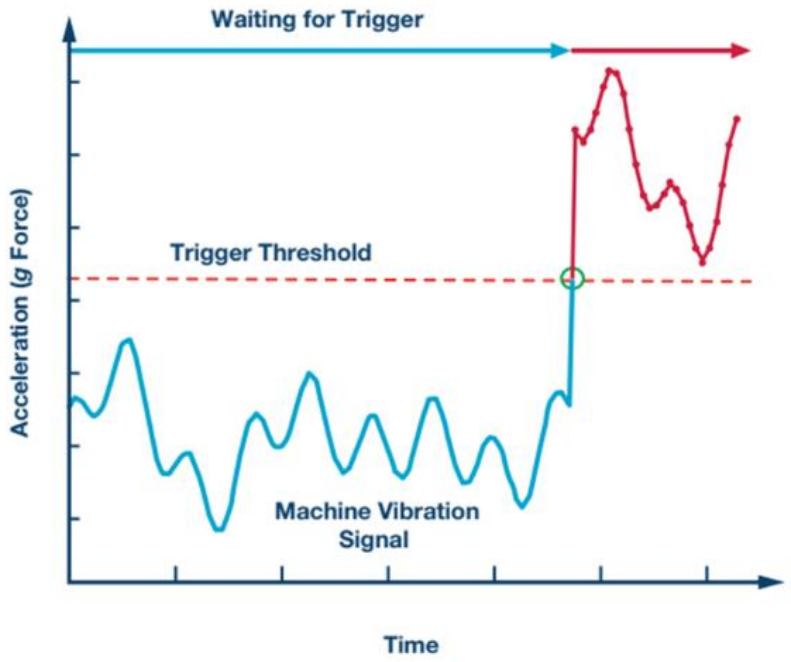
TOOL CONDITION - CURRENT

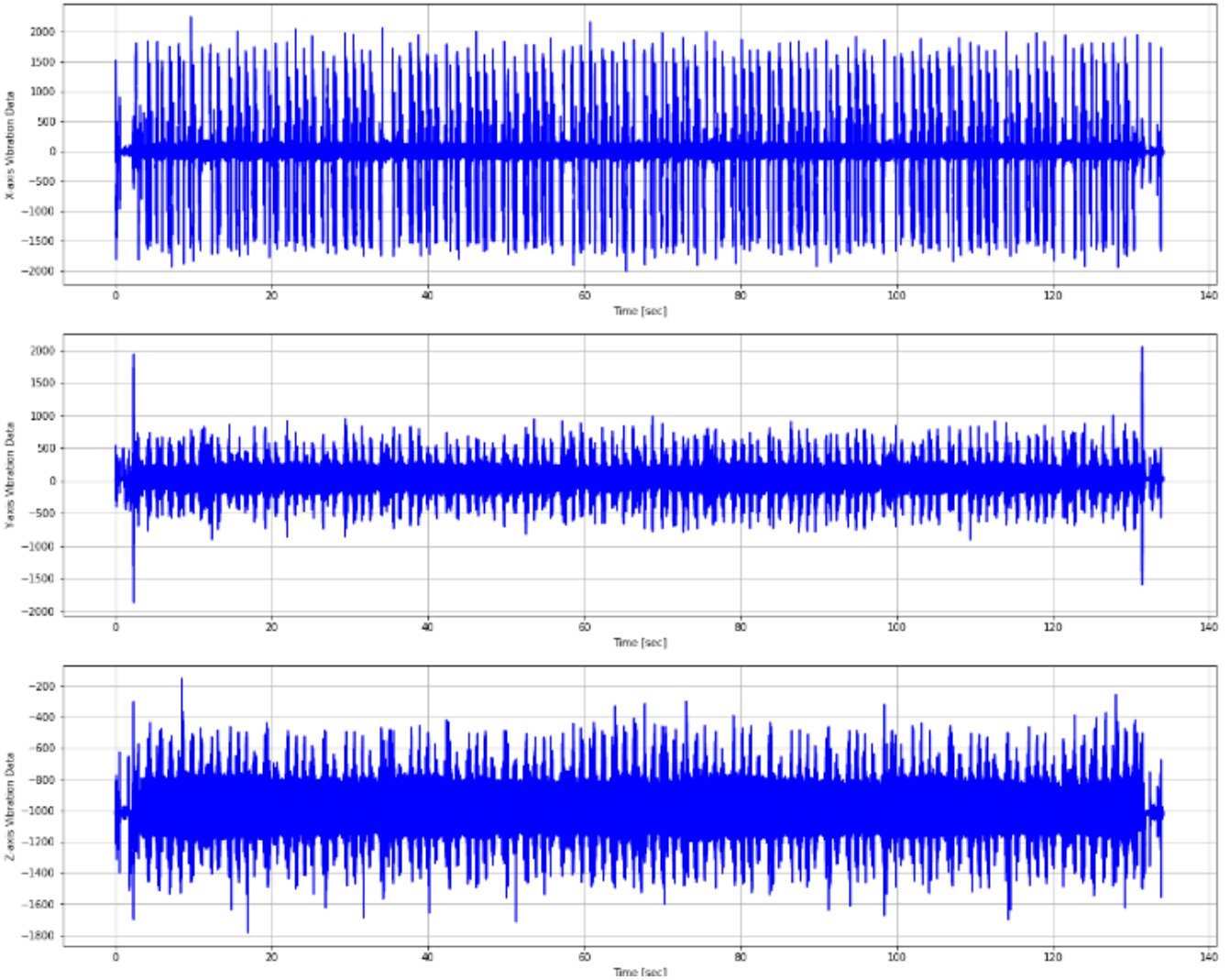


TOOL CONDITION - VOLTAGE

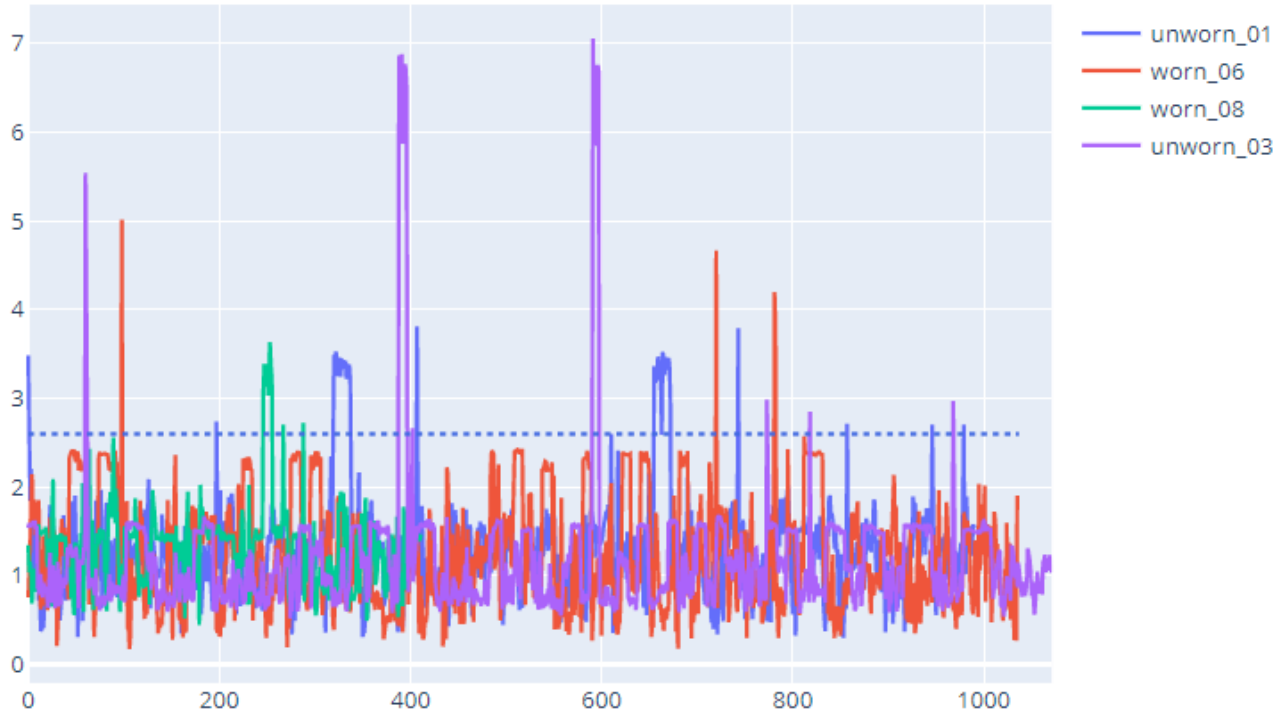


PERFORMANCE - VIBRATION ANALYSIS 3





PERFORMANCE - OUTLIER DETECTION 3



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THANK YOU