Predicting the Health of Cutting Tools with Artificial Intelligence

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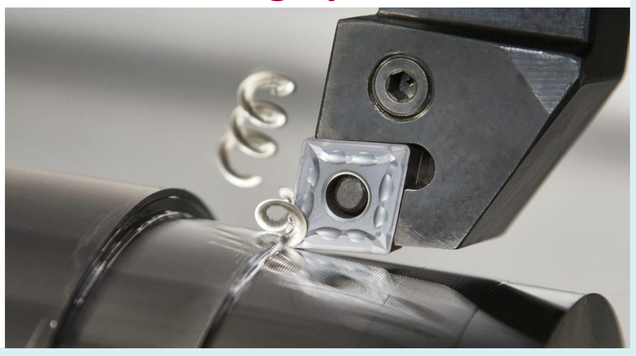
Context

- Machining operations are widely used to produce everyday products – Turning or Milling
- The cutting tool used deteriorates, resulting in poor quality surfaces
- Replacing the cutting tool at the optimal moment
  - Too early → Waste of the tool and replacement cost
  - Too late → Waste of the machined surface and associated costs

➔ **Need to track and predict the degradation of each tool for optimal remplacement**

Turning operation

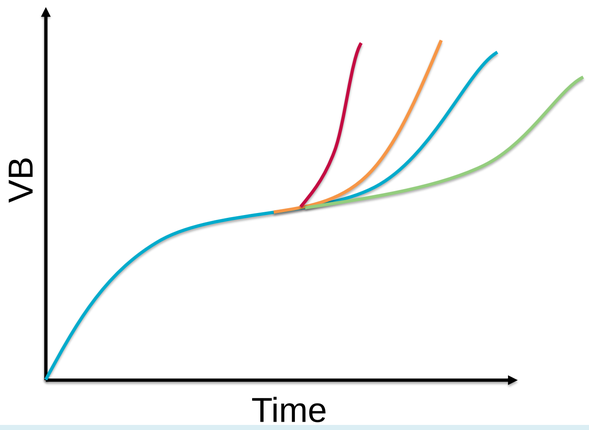


Degradation of the Tool & Technical Limitations

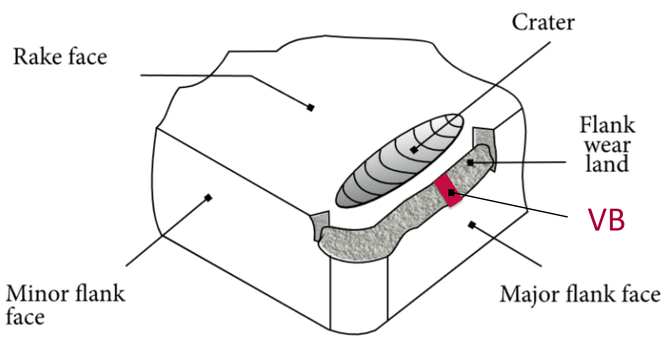
- Multiple degradation mechanisms occuring simultaneously → Impossible to predict beforehand
- A worn tool cannot produce a good surface quality
- Due to production constraints → not possible to stop the operation to check the state of the tool
- Indicator of wear : VB → wear land width on the flank face (worn if > 0.3 mm – ISO 3685)

➔ **Need to predict the state of the tool from indirect cutting signals**

Unpredictable degradation path



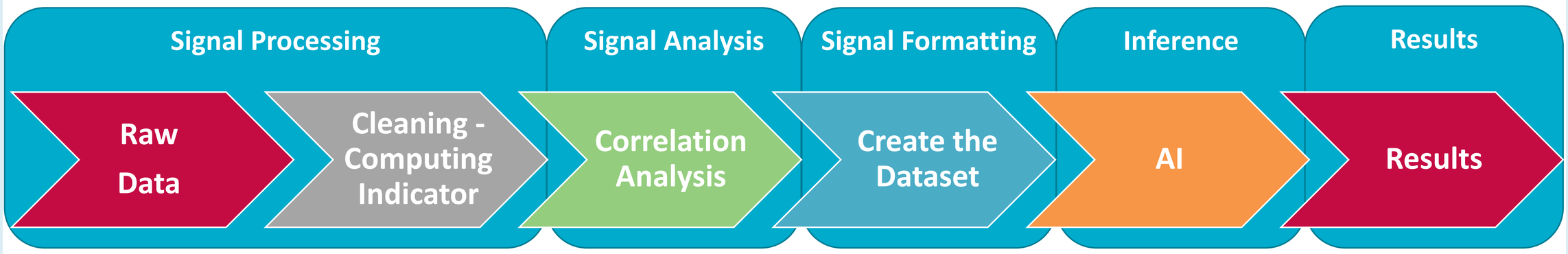
Degradation of the tool



Degradation of the workpiece

Our Approach

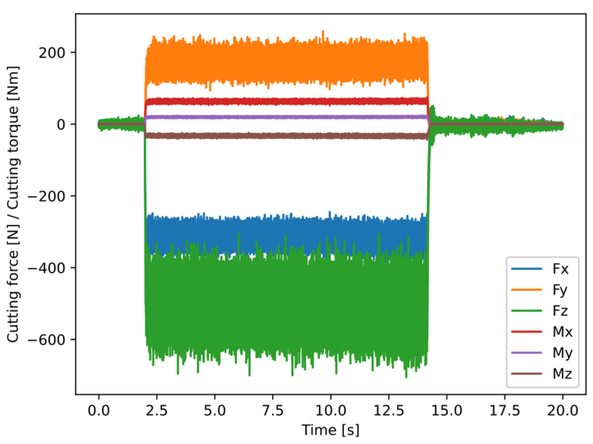
- Use the signal from **instrumented machine tool** to feed a « pipeline » of operations



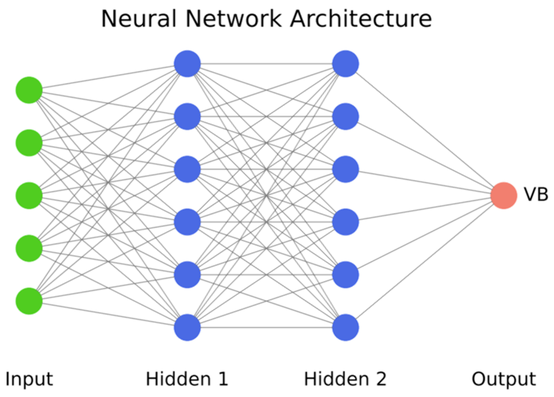
Results

- From the signal generated by the sensors, we are able to follow the evolution of the degradation accurately and in real time

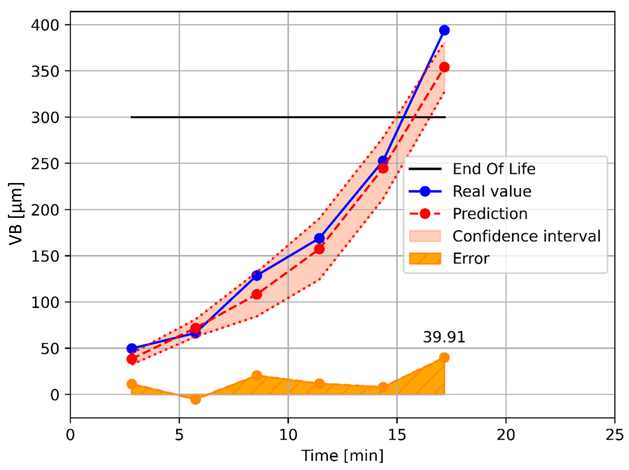
Processed Signal



Neural Network



Predicted Degradation



Conclusion & Perspective

- The proposed approach demonstrates the ability to monitor tool degradation with real time indirect monitoring
- High industrial interest
- Further work will focus on the predictive aspect of degradation