# Tool-wear prediction with deep learning models

## 1 Description

One of the most promising applications of machine learning algorithms is in the industry, where ML models can be used to decrease the production costs and increase the productivity of the companies. Tool-wear prediction [1, 2, 3] intends to determine whether a machining tool has been destroyed or has become defective during a machining process. Predicting tool-wear is important since it directly affects the properties of the manufactured parts. Algorithms that are able to automaticly detect tool-wear from the analysis of the parameters that describe the machining process are required for the new Industry-4.0 strategies [4] in the Basque country.

## 2 Objectives

The goal of this project is to implement a deep learning approach for tool-wear prediction. In this project, the dataset to be used is the CNC Mill Tool Wear[1]. It includes parameters of 18 different machining processes. The objective is, based on the information saved for each process, to determine whether the tool was unworn or worn. This is binary classification problem and, given the small number of examples (18), validation is expected to be done with leave-one-out cross-validation.

The student should: 1) Find a suitable data framing approach for this problem; 2) compare different neural network architectures for this sequence-based classification problem; 3) evaluate the approaches following a suitable methodology.

As in other projects, a report should describe the characteristics of the design, implementation, and results. A colab notebook should include calls to the implemented function that illustrate the way it works.

## 3 Suggestions

- Read the discussion on the site where the dataset is located.
- Decide on which parameters (e.g. velocity time series) are going to be modeled and chose an appropriate NN architecture.

## References


[1] Aldo Attanasio, Elisabetta Ceretti, and Claudio Giardini. Analytical models for tool wear prediction during AISI 1045 turning operations. *Procedia Cirp*, 8:218–223, 2013.

[2] N Ghosh, YB Ravi, A Patra, S Mukhopadhyay, S Paul, AR Mohanty, and AB Chattopadhyay. Estimation of tool wear during CNC milling using neural network-based sensor fusion. *Mechanical Systems and Signal Processing*, 21(1):466–479, 2007.

[3] M. Murua, A. Suárez, N. López de Lacalle, R. Santana, and A. Wretland. Feature extraction based prediction of tool wear of Inconel 718 in face turning. *Insight. Non-Destructive Testing and Condition Monitoring*, 60(8):1–8, 2018.


[1] Available from `https://www.kaggle.com/shasun/tool-wear-detection-in-cnc-mill`

[4] Andrea Ciffolilli and Alessandro Muscio. Industry 4.0: national and regional comparative advantages in key enabling technologies. *European Planning Studies*, 26(12):2323–2343, 2018.