

Proposal: Machining Result Prediction and Tool Wear Detection of milling machine

Overview

For a real-life milling process, there is a problem that it's difficult to determine an appropriate set of inputs of the milling machine for a better machining result and maintain a low wear on the tool at the same time. Therefore, it can be proposed as 'Machining Result Prediction and Tool Wear Detection of milling machine' and it can be solved by the six modules of mechanistic data science below,

Module 1: Gathering and generating the needed data

In this module, it is unknown that which parameters would affect the results, so gathering as much as possible data related to the parameters of the machine, results and any other things involved in the experiments is crucial. (For example, the material of the workpiece, feed rate, color, weight, dimension of the workpiece, temperature, humidity, etc.)

Module 2: Extracting the mechanistic features

In this module, because of the importance of mechanistic features in the further data science analysis, some parameters should be extracted from the database or computed to generate a new parameter for analyzing. For this proposal, it could be the material of the workpiece, feed rate, and clamp pressure, tool condition (unworn and worn tools).

Module 3: Reducing the dimensions based on the knowledge and experience

After the extraction module, there would be a relatively large number of features need to be taken into account, so reducing the dimensions of the attributes can get more accurate results.

Module 4: Reducing order surrogate models

For such this proposal, computing is a very time-consuming part, and reducing order surrogate models of this proposal can reduce the load and complexity of the mathematical models in numerical simulations.

Module 5: Using Neural networks for regression and classification

In this module, it is focused on the relationships between a dependent variable (in this proposal, it would be the tool wear and the machining result) and one or more independent variables (In this proposal, it might be the material of the workpiece, feed rate, and clamp pressure, tool condition (unworn and worn tools)).

Module 6: System and Design

The last module for this proposal is to tie the other modules together and gain a procedure for predicting the machining results and tool wear. Once the inputs are added to the procedure, it can be known the results and tool wear for making a better decision.