Application of Machine Learning on Side Channel Data streams from Advanced Machining Process

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Abstract:

Computer Numerical Control (CNC) machining is a crucial aspect of the modern industrial sphere, enabling the creation of complex parts with tight tolerances unable to be made any other way. Makerspaces provide manufacturing resources to non-professional users, and as such, greatly benefit from the inclusion of CNC mill among their tools. However, due to the number of machining parameters needed for a cut and their specificity to the material and project on which they are being used, the CNC can present a steep learning curve for novice users. Classifying the machine's use to provide feedback to the user would make this learning curve shallower. A previous method to accomplish this utilized Machine Learning (ML) models based on force data taken from built-in machine sensors. These models were evaluated using the area under the receiver operating characteristic curves (AUC), showing the strongest performance from Logistic Regression. Current research has investigated a similar method making use of acoustic data collected from a microphone mounted inside the machine's cabinet. This transition is motivated by an increase in scope; most CNCs lack the built-in sensors that allow for the previous method, and retrofits to include them are expensive. By using a microphone, more CNCs are available, and the cost of retrofit is significantly reduced. Comparison between the two methods shows that the acoustic-data-based models (ABM) performed at least as well, if not better than the force-data-based models (FBM). Further investigation seeks to determine the impact of tool wear, as well as test the acoustic methods sensitivity to changes in material or geometry.