MCCI Public dataset documentation

Contents

This dataset contains labelled data from vibration measurements during the milling process, in the context of the MCCi experiment that was funded under the AIRISE project. The data labelling concerns the existence of chatter in the machining process.

Equipment

The equipment that is used for generating the data is a Micromega-IAC-CM-U-03, triaxial, MEMS accelerometer. The data is acquired through a Labjack T8 data acquisition system. The sampling rate is consistent at 10kHz for all measurements. The vibration data that are logged are the data of the X and Y axis of the machine. The milling machines that are used for the data generation are a robotic machining cell, based on a Yaskawa GP225 robot and a Haas VF-2SS vertical machining center. In both cases, the accelerometer is installed on the spindle head.

Experiments

The experiments that were conducted were always side milling. In some cases, ramp coupons were machined (i.e. side milling with gradually increasing depth of cut has been performed), in order to be able to capture the onset of chatter and increase the accuracy of data labelling. In general, to label the data, the machined surface was evaluated, as well as the sound generated during the process. For the reader that is not familiar with machining processes, the following passage retrieved from ***Schmitz and Smith, Machining Dynamics, 2nd edition, page 243*** (https://doi.org/10.1007/978-3-319-93707-6) can help in understanding how the machining sound places a critical role in the assessment of chatter status (and also get a hint on the pathways to analyze the vibration data, since sound is a mechanical wave and thereby reflects very accurately the behavior of the machining system vibration in the time-frequency domain). *"Stable cuts sound different from those that chatter. Stable cuts generate sound at the tooth passing frequency, runout frequency and multiples of these. For that reason, stable cuts sound "clean"; they produce "pure" tones. Unstable cuts, however, also emit sound at the chatter frequency, which is generally not a multiple of the tooth passing or runout frequencies. For this reason, unstable cuts sound "harsh" or "raspy." They exhibit a mixture of frequencies that are not harmonically related. Machinists are familiar with this phenomenon and can usually tell if a cut sounds bad or good, not just*

loud or quiet." The experiments were carried out with varying process parameters and materials. For the Yaskawa robot, wrought Aluminum 7075-T6 coupons and coupons made from 316L Stainless Steel, prepared with Direct Energy Deposition technology were machined. For the Haas machining center, low-alloy steel coupons were machined. Climb milling was utilized in all cases and coolant was not used. Different process parameters were used for each experiment, which are reflected in the name of each file. Each experiment is saved into one or more files. Each experiment refers to a single machining pass. If the process was consistent throughout the whole pass, then a single file is generated. If the status of the process changes within the pass (i.e. transition from stable to chatter in a ramp coupon), then two files are assigned for a single experiment. This can be observed, since two files having the exact same process parameters, but different labels, might exist.

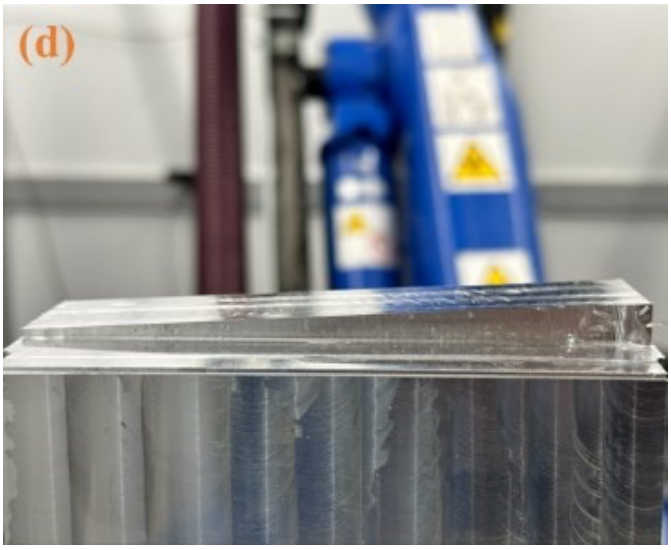

Figure 1 Example of a ramp coupon