University of Firenze

The MTTRF's state-of-the-art equipment has enabled us to boost research activities and provide students an outstanding equipment to learn the basics of machining. Our lab's research potential has greatly increased due to the possibility to carry out tests in demanding conditions and with hard-to-cut materials. Satisfaction of students that are entitled to use the machine during the classes on CAM is really high, and most of them are willing to remain in the lab as master student for their theses.

RESEARCH

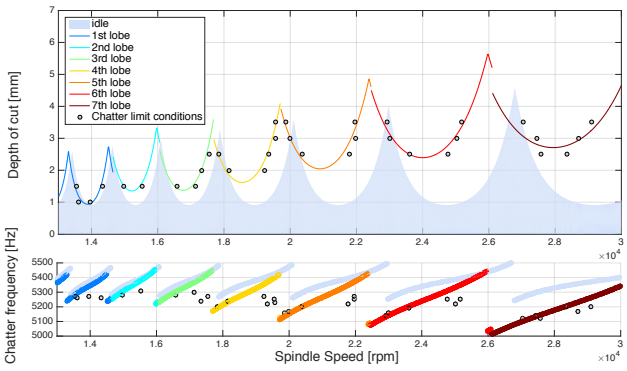
In-process assessment of machine dynamics

There are already many approaches to evaluate the chatter free zone using analytical models of the vibration phenomena. These models are often dependent from the machining strategy adopted and require many inputs to forecast the stable zone of the process. The required parameters are geometrical, material related and machine related (machine dynamics).

Among these data, the one that is more affected by errors is surely the machine dynamics. The reasons are many: the test is usually carried out manually and it introduces errors since the position of the tap often do not match exactly the cutting force application point; machine dynamics could be acquired only in static condition with the spindle is off; machine dynamics could change during the machining cycle due to a different position of the axes. Many researches have been carried out to overcome the first issue, while the second and third are hard to solve.

These are critical issues since the machine dynamics changes dramatically with the spindle speed, due especially to the gyroscopic effect, the change of stiffness due to the bearings' preload and thermal effects. Some test approaches have been developed to obtain the machine dynamics "on the go" while the spindle is rotating, but these require low rpm and an equipment that hardly could be used in a production environment.

The objective of 2016 is to create a method to assess the machine tool dynamics considering the effect of the rotating spindle.



The approach will be used to provide a more reliable estimation of the machining process stability.

Active fixture to reduce chatter occurrence

Auto regenerative vibrations, chatter, constitute a limit for the milling process productivity since they reduce the allowable material removal rate. The developed solution has been created in order to "break" the regenerative effect of the chatter vibrations. This result has been obtained thanks to the introduction of an actuation of the workpiece in order to reduce the regeneration of a vibrated surface at each pass of the tool tooth.

In order to be as not intrusive as possible, the actuation of the system using piezo has been integrated in a new design fixture. The advantage of this solution is that the manufacturer could machine the workpiece using its usual approach, avoiding to reduce the accessibility of the features and surfaces that must be machined. The developed fixture integrates not only the actuation but also some accelerometers, used to monitor the status of the process and control the actuation in order to have a positive result.

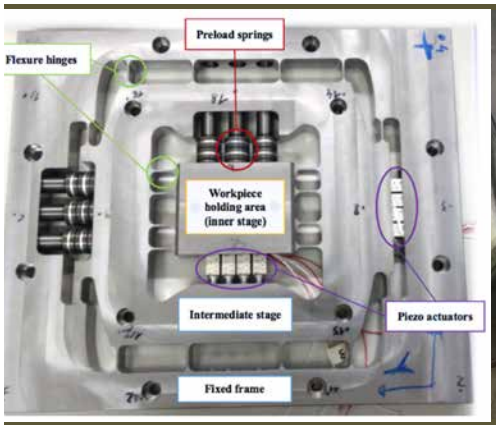
EDUCATION

Mechanical Production Planning & CAM (Undergraduate course)

The MTTRF equipment is used to show students how milling operation could be performed with a 5 axes machine and the different aspects compared to a traditional 3 axes machine. The teacher develops the manufacturing cycles to demonstrate the capability of the 5 axes machine with test machining process.

The machine is also used to show how a CAM system works and how process parameters could be set to obtain different machining time, surface finish, etc. also including the different results that could be obtained with the choice of different inserts.

During the final lab activities, students in groups receive the task to develop a whole manufacturing plan for an assigned mechanical product, using the ESPRIT CAM. After being revised by the assistants, the product is machined in order to verify if the required surface and dimensional specification have been really met and the related cycle time obtained.



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MTTRF Awardee since 2010