PhD thesis at LaBoMaP
2021-2024 Academic years

PhD thesis subject in Mechanical Engineering

# 5 Axis CNC Machine-Tools: Designing a Measuring Architecture and Instrumented Trials for High Precision Machining

Machine-tools (MOs) are frequently used production means in the manufacturing industry. Their international market (production and exploitation) has been highly expanding over the last two decades. Due to the highly competitive environment, new structures, called "multi-functional", have emerged: they guarantee many possible operations on the same production mean, combining productivity and quality of the manufactured geometric surfaces. As a consequence, parts that are produced by this kind of means are even more complex, leading in the meantime to cost and manufacturing time savings, and to a better quality.

In spite of a clearly expressed international industrial need, this range of available machine-tools on the market has not until then the ability to reach the desired accuracy levels (<10µm) on the whole workspace. According to the machine kinematic and the machine setting-up, the maximal deviation in the volume – called volumetric accuracy – currently amounts to several tenths of millimeters, or millimeters in some extreme cases.

Inducting traceable dimensional metrology directly on machine-tools (i. e. adjusted with the SI metre) is a requirement to significantly improve manufacturing processes. The project aims at improving the quality of manufacturing parts, directly in the workshop with intermediate metrological inspection of the *in situ* piece (i.e. directly on the manufacturing mean), without having to wait until the piece is fully manufactured before being controlled on a dedicated mean (artefact or tridimensional measuring machine). As a consequence, the number of scrapped parts is reduced, costs are saved and competitiveness of companies increases.

This PhD work aims at developing, designing and manufacturing an experimental system for characterizing geometry of rotary axis. It also aims at developing associated measurement procedures to qualify and quantify the geometrical accuracy of rotary axes from of structural loops by *in situ* traceable measurements (i.e. in the machine with a momentary production stop).

**Keywords:** Modeling, identification, *in-situ* measurement, conception, instrumentation, geometric error

**Required profile:**

The future PhD student holds a Research Master's degree or a Master's of Science including an internship experience in research. The chosen applicant needs to have studied mechanical engineering. He (she) has good knowledge and skills in geometric modelling and measurement (digital models development). He (she) has a strong interest for testing and acquisition.
Reference letters are highly recommended.

Important note: the PhD student will have the possibility to carry out a teaching mission (64 hours a year) within the educational team at ENSAM Cluny.

**Duration:** three years from September 2021

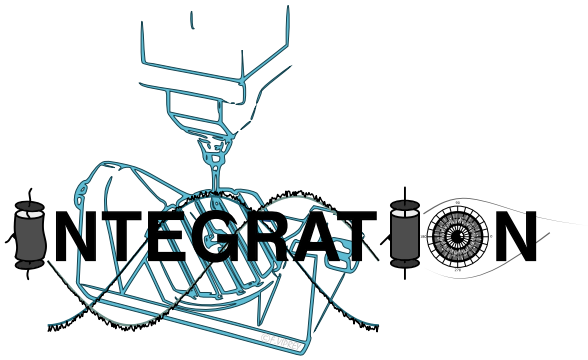
**Hosting lab:** LaBoMaP, ENSAM in Cluny

**Financing:** Agence Nationale de la Recherche (French National Agency for Research)

**Salary:** 1900€/month net during 3 years

This thesis has been developed within the framework of the ANR JCJC INTEGRATION project in collaboration with several academic partners: LaBoMaP, LURPA, LNE.

**Traceable Identification of Geometric Accuracy on Rotary Axes – Development of Novel Contactless Material Standard**

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