FOR APPLICATION, PLEASE CONTACT ADVISOR(S) BY EMAIL WITH COPY TO: ali.siadat@ensam.eu AND yvon.velot@ensam.eu

Research Topic for the ParisTech/CSC PhD Program

Field (cf. List of fields below): Design, Industrialization
Subfield: (Applied Physics, Chemistry, Mathematics, Mech. Eng. etc…) : Inspection, Metrology, Mathematics

Title: Influence of stereovision scanning strategies on the accuracy of geometrical and dimensional measurement evaluations

ParisTech School: Arts et Métiers ParisTech

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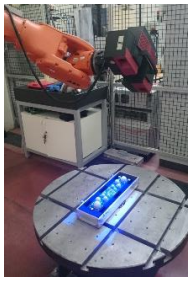
Short description of possible research topics for a PhD:
Stereovision allows to scan workpieces in 3 dimensions and to export an image with a large number of points. Used for reverse engineering applications for a long time, stereovision is increasingly used for shape, dimensions or geometric constraints inspection. On the one hand, this technology is much faster than contact measurement techniques such as dynamic probes associated with a coordinates measuring machine (CMM). On the other hand, measurement uncertainties are up today far below those obtained with a CMM. But it was found that the quality of the measurement information could be variable depending on the strategy of workpiece 3D-scanning with the stereovision device. Therefore, we could imagine that it is possible to establish good practices protocols for the number and the orientation of the different scanning points of view according to the defect which we want to evaluate.
The PhD proposal deals with the research of best measurement strategies by stereovision to evaluate dimensions (*diameters, distances, ...*), form deviations (*straightness, flatness, circularity, cylindricity, or any profile or surface form*), orientation deviations (*parallelism, perpendicularity, inclination*), and positional deviations (*concentricity, symmetry, localization*). For this purpose, an artefact must be designed and machined. It must be long enough to also evaluate the impact of the propagation of successive views association on the reconstruction of the whole workpiece. Then, this artefact will be rigorously inspected on CMM following an inter-comparison protocol which will allow to know the exact geometry of the artefact with the least possible uncertainties. Therefore, several stereovision measurement strategies will be tested and compared against the reference measurements to estimate differences in accuracy for trueness and repeatability. The strategy of positioning reference points for the combination of different views, such as the impact of the number of reference points and their positioning (*on the part, or on a frame*) will also be evaluated. The use of photogrammetry to accurately determine position of reference points may also be considered to evaluate the improvement it brings to the results.
All of these experiments should lead to good practices recommendations in order to improve accuracy on 3D-scanning by stereovision.

Scan of a valve body



Scan of calibrated balls

Required background of the student: (Which should be the main field of study of the applicant before applying)

- Knowledge in inspection, in contactless metrology (3D-scanning by stereovision) if possible
- Applied mathematics

A list of 5(max.) representative publications of the group: (Related to the research topic)
Until today, we used 3D-scanning as a tool to inspect and to investigate parts to better understand interactions between workpiece and process. Although stereovision systems are famous to be flexible systems, we noticed an influence of acquisition strategies on accuracy so we want to develop this new activity.
C. Gutierrez, L. Langlois, C. Baudouin, R. Bigot, E. Frémeaux ; “Impact of tool wear on Cross wedge rolling process stability and on product quality”. AIP Conference Proceedings, vol. 1896, October 2017. doi: 10.1063/1.5008221