Evaluation of the measurement uncertainty of 3D scanners

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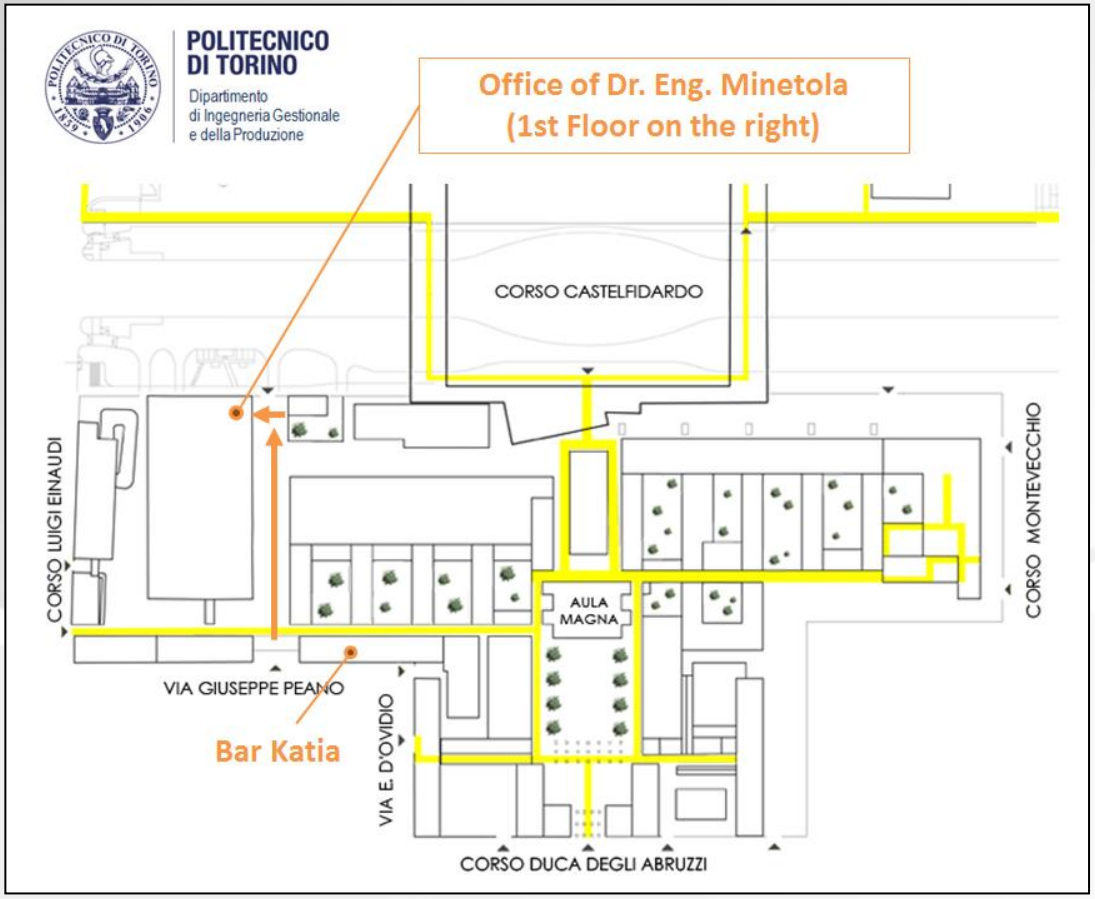

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Topic

Evaluation of the measurement uncertainty of 3D scanners

Optical 3D scanners are measuring devices that do not require contact with the object to be inspected. Industrial metrology and quality control sector is experiencing a revolution through the use of 3D scanner as a valid alternative to Coordinate Measuring Machines (CMMs).

Although the use of contactless inspection techniques is progressively increasing in industries, a standard guideline to qualify and evaluate the metrological characteristics of 3D scanners does not exist yet. The Italian guideline UNI ISO/TS 15530-3 outlines a procedure for the evaluation of the measurement uncertainty by measuring a reference workpiece. Even if the UNI ISO 15530-3 was defined for CMM machines, its use can be extended to 3D scanners for a preliminary study aimed at compensating the lack of a specific guideline.

The Advanced Manufacturing Technologies laboratory has recently bought a structured light 3D scanner based on fringe projection of blue LED light. This device is less sensitive to variations of the environmental lighting conditions and it allows the scanning of opaque/matt materials without the use of white powder spraying.

$$U = \sqrt{u_{cal}^2 + u_p^2 + u_w^2} + |b|$$

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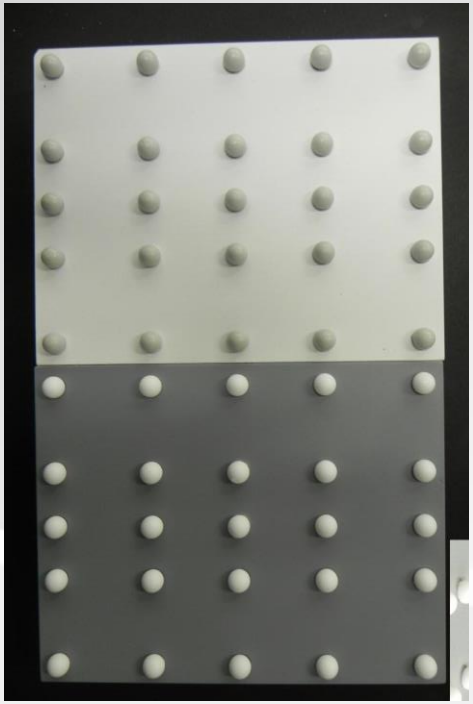
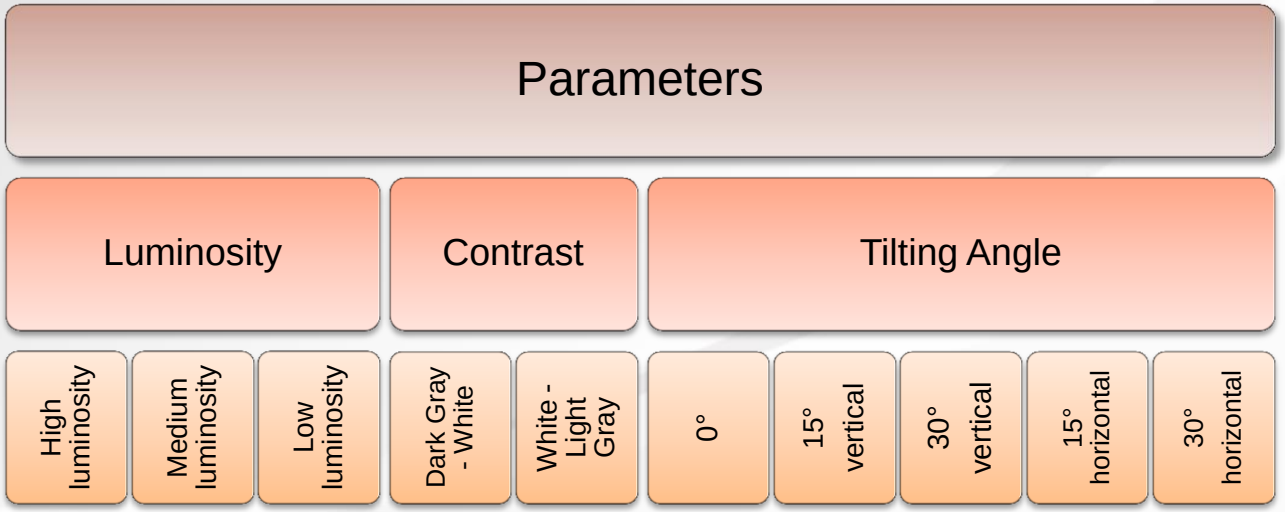
The experimental activity

The research activity aims at evaluating the measurement uncertainty of 3D scanners by referring to the UNI/ISO 15530-3 guideline. The experiments consist in repeated scans of two reference workpieces from different viewing angles under diverse environmental lighting conditions. The reference workpieces have a diverse contrast between the top plane and the reference spheres.

Using the above mentioned guideline, the measurement uncertainty of the tested 3D scanner can be evaluated through the measures of the diameters of the spheres and the relative distance among spheres centres under different working conditions.



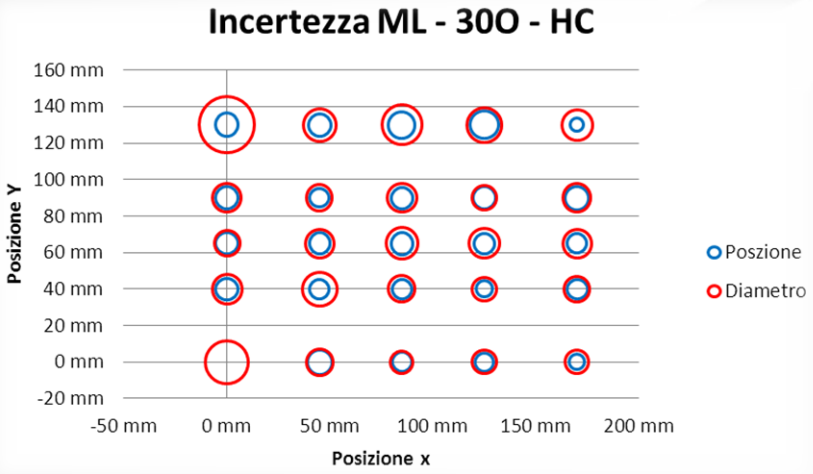


Results

The experimental activity aims at evaluating the measurement uncertainty of optical 3D scanner based on fringe projection (structured light) or laser triangulation:

The evaluation procedure consists of:

- Repeated scans of the reference workpieces from different viewing angle and under different environmental lighting conditions
- Analysis of the scan data and measures of the diameters of the spheres and of the relative distance among their centres
- Evaluation of measurement uncertainty on diameters and relative distances
- Evaluation of the influence of scan data filtering



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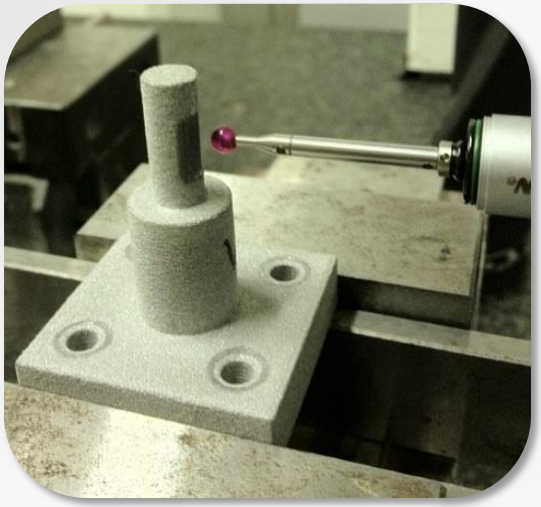
Requirements

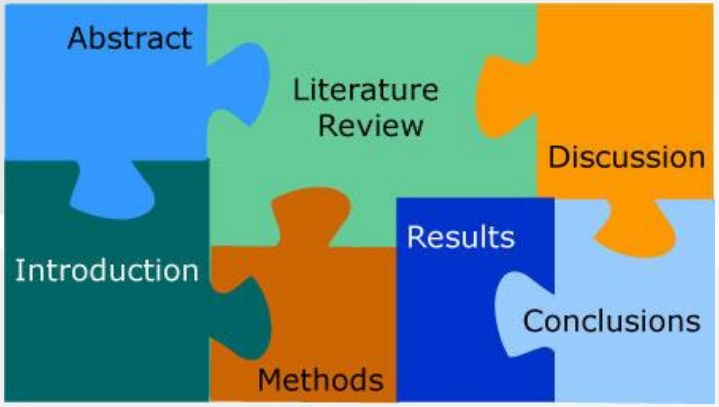
Good attitude for experimental tests.

Good attitude for numerical computing and mathematics is required.

During the project the student will get trained to use a Coordinate Measuring Machine (CMM) for inspection and measurements of built parts.



Committment for a minimum project period of 3 months (B.Sc.) or 6 months (M.Sc.).



Important notice

The early handing in of the thesis draft is a strict requirement. In order to graduate in the desired session the student should hand in the draft to the supervisor at least two weeks before the deadline of the students' office.

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