21ST CENTURY MEASURING CHALLENGES

Summarized from a paper presented at the 2012 CMSC international conference, demonstrating the efficiency of dynamic referencing.

OVER THE PAST 30 YEARS, ONE OF THE MOST IMPORTANT CHANGES IN METROLOGY HAS BEEN THE DEVELOPMENT OF PORTABLE MEASURING DEVICES.

This has brought inspection right into the production line, as close to the part as possible. The change—sparked by the development of portable measuring arms in the early 1990s and the emergence of laser trackers shortly after—turned conventional industry inspection methods completely upside down. It also made it possible to take measurements more quickly and more often, fostering huge improvements in response time and quality. Far from the comfort of metrology labs where qualified inspectors operate digital CMMs with their heavy, stable granite table, portable measurement is still facing several major challenges.

Obstacles

TIn production environments, these are the daily obstacles faced by portable measurement solutions users: in production environments.

PERMANENT VIBRATIONS GENERATED BY PRODUCTION EQUIPMENT

REQUIREMENTS FOR RIGID EQUIPMENT SET-UPS

CHANGES IN TEMPERATURE AND HUMIDITY LEVELS

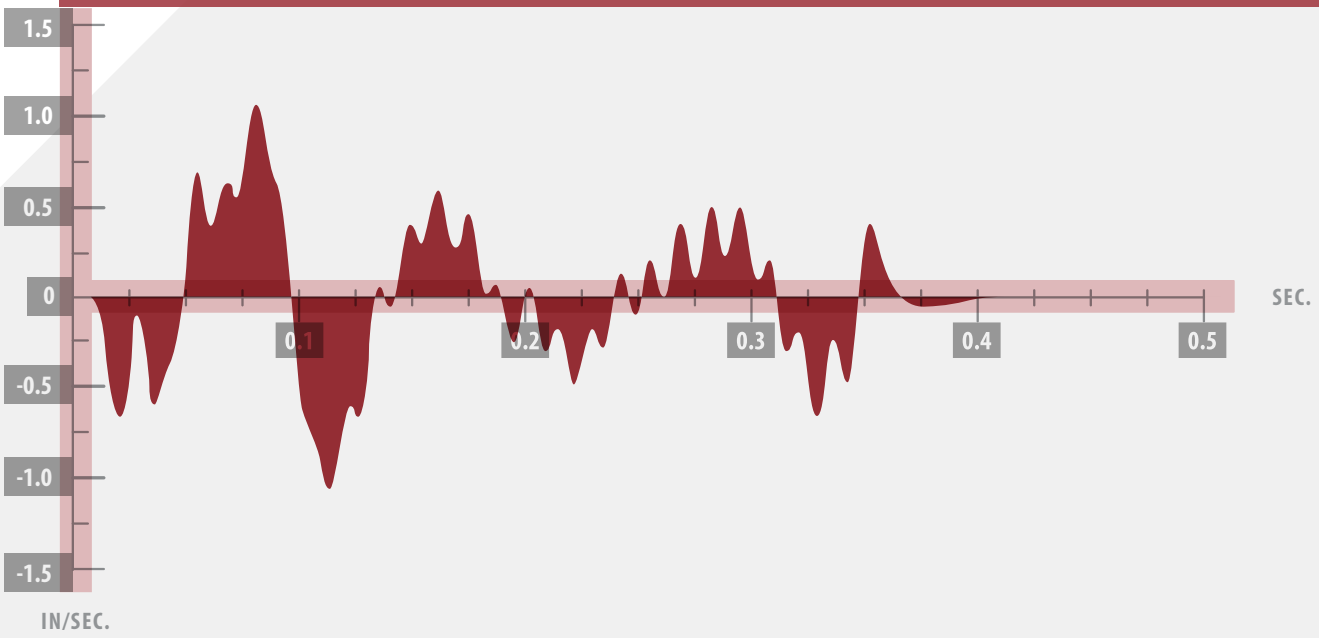
DIFFERENT OPERATORS' EXPERIENCE AND SKILLS LEVEL

Vibrations

There are several sources of vibration in a production or shop floor environment, including:

- NEARBY ROAD AND RAIL TRAFFIC
- PRODUCTION EQUIPMENT
- HANDLING EQUIPMENT
- OPERATORS

IF THE SHOP FLOOR IS INADEQUATELY INSULATED AGAINST VIBRATIONS, THESE VIBRATIONS ARE SUBSEQUENTLY TRANSMITTED TO THE MEASURING SYSTEM AS WELL AS TO THE OBJECT BEING MEASURED, AND MAY EVEN BE AMPLIFIED IF AN UNSTABLE TRIPOD OR NONRIGID BASE IS USED.



As an example, this graph presents press-induced soil vibrations (instant velocity as a function of time) at a projected CMM location. The vibrations have been recorded directly on site prior to the installation of a CMM in a factory that operates stamping presses with values up to 1.06 in./sec (26.9 mm/s) and a typical frequency of 17 Hz (soil resonance frequency) at a distance of 50 ft. from the press.

A lab-based experiment reproduced similar vibration levels.

VS

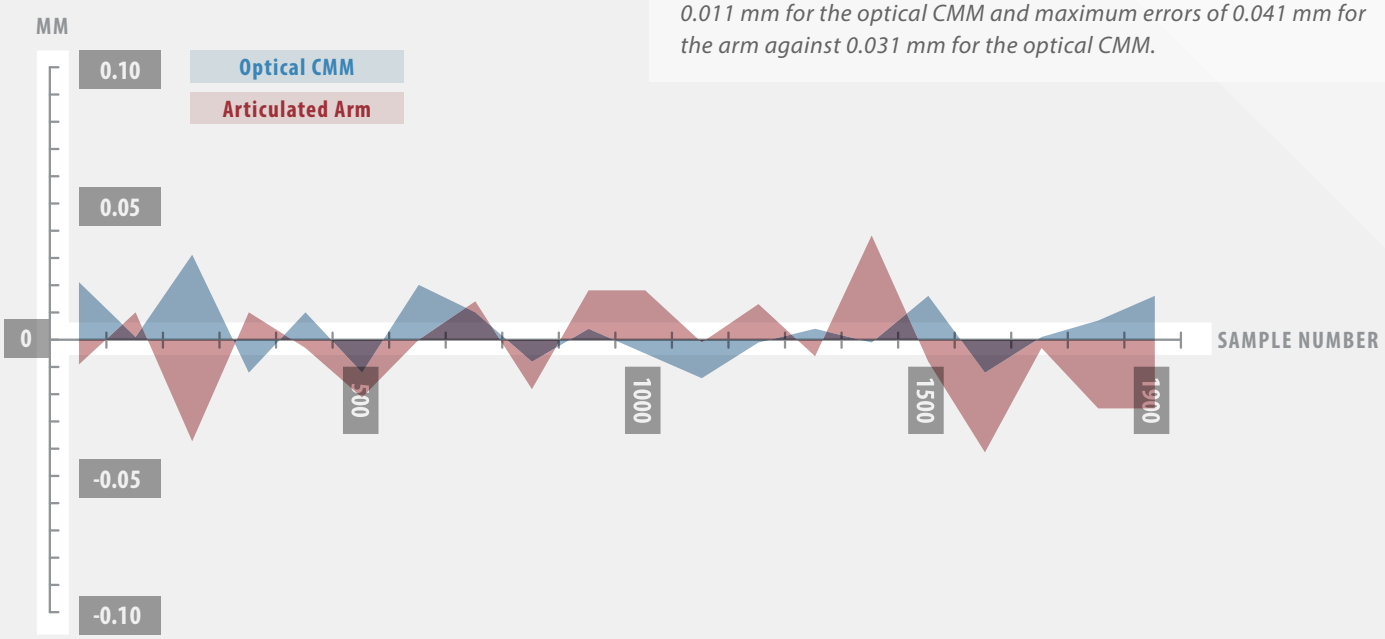
8 ft. Polyarticulated Arm

HandyPROBE Optical Portable CMM

A robot was used to evaluate the impact of such vibrations on portable CMMs. The machines tested (an 8 ft polyarticulated arm and a portable optical CMM HandyPROBE) have been mounted at the end of the robot arm. The robot was programmed to generate small and fast displacement, similar to the one observed in the previous example. Accuracy tests were made using a 2.5 m standard measurement gage fitted with cones, an artifact commonly used for accuracy testing under the VDI 2634 standard.

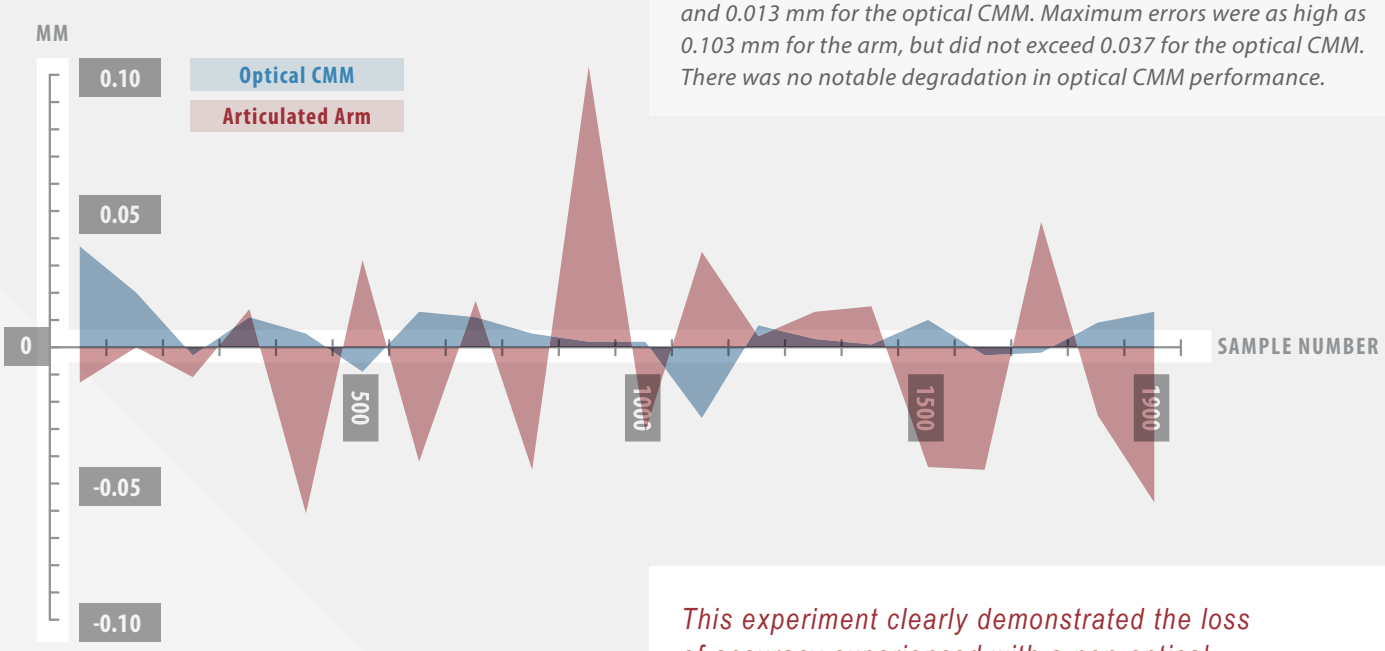
WITHOUT VIBRATIONS

Without vibrations, the results obtained for both devices were similar, with an average quadratic error (RMS) of 0.018 mm for the arm against 0.011 mm for the optical CMM and maximum errors of 0.041 mm for the arm against 0.031 mm for the optical CMM.



WITH VIBRATIONS

Test results with vibrations clearly show the advantage of dynamic referencing, with an average quadratic error of 0.039 mm for the arm and 0.013 mm for the optical CMM. Maximum errors were as high as 0.103 mm for the arm, but did not exceed 0.037 for the optical CMM. There was no notable degradation in optical CMM performance.



This experiment clearly demonstrated the loss of accuracy experienced with a non-optical portable solution in the absence of a granite table equipped with anti-vibration pads.

Operator-related errors

Another advantage identified through this study is the impact on the reduction of operator-related errors. CMSC's 2011 Measurement Study Report entitled "How Behavior Impacts Your Measurement" includes a compelling and detailed analysis of operator behavior in the metrology process. This analysis was using some predefined metrology setup to test participants in real conditions. No instructions or procedures were given.

HUMAN ERROR IS A MAJOR FACTOR IN POOR QUALITY MEASUREMENTS.

One of the study conclusions is that human error is a major factor in poor quality measurements. **Dynamic referencing actively contributes to reducing some of the human errors identified in the CMSC study, i.e. inadequate operator assessment of the risks deriving from an unstable environment, heavy traffic, or an unstable part.**

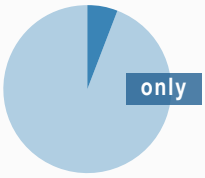
MORE THAN

40% of participants worked in the quality control or inspection fields.

OVER **60%**

HAD AT LEAST 7 YEARS OF EXPERIENCE AND/OR PERFORMED MEASUREMENTS ON A DAILY/WEEKLY BASIS.

IN THE "ARTICULATED ARM/ENGINE COMPARTMENT" TEST



6% OF PARTICIPANTS NOTED THAT THE MEASUREMENT DEVICE WAS ON A CARPET.

IN THE "LASER TRACKER/DOOR" TEST

6% PAID ATTENTION TO THE STABILITY OF THE PART.

7% OF PARTICIPANTS MOVED THE PART AFTER ALIGNING.

7% CHECKED DRIFT ON ONE ALIGNMENT POINT AT THE END OF MEASUREMENT.

It is impossible to assess errors related to the instability of the measurement setup, but they probably significantly contributed to the errors observed: up to 3.81 mm on engine compartment, up to 43.18 mm on door and up to 8.198 mm on the full vehicle test!

IN THE "LASER TRACKER/VEHICLE" TEST

20% EXPRESSED CONCERNS ABOUT THE PRESENCE OF THE CARPET.

15% QUESTIONED PART STABILITY.

25% MENTIONED THE NEED TO OBTAIN A GOOD ALIGNMENT.

Dynamic referencing ensures high accuracy measurements in shop floor conditions and actively contributes to reducing operator-related errors

Users should no longer to compare benefits between two solutions, but rather choose between a solution that will deliver results, and one that will not.

REFERENCES

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www.creaform3d.com/en/resource-center/technological-fundamentals/truaccurracy-accurate-measurement-solutions-real-life

5825, rue Saint-Georges
Lévis (Québec) G6V 4L2 Canada

T. 1 418 833.4446 F. 1 418 833.9588
info@creaform3d.com | www.creaform3d.com

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