Iniciativa catim

CIMi2010 metrology and the new challenges for a sustainable growth

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Challenges to Prove the Quality of Measurements in High-Accuracy 3D Coordinates Machines

Desafios para Provar a Qualidade das Medições em Máquinas de Coordenadas 3D de Alta Exactidão

Fernando Ferreira
CATIM
Technological Centre for Metal Working Industry
Porto - Portugal

Summary

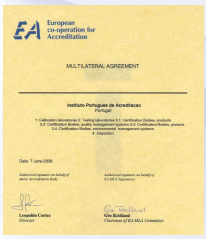
CATIM is a non profit private institution of public utility, created in 1986, *and is a result of the interests association, industrial companies and respective associations with public organisms.*

Mission is to contribute for the innovation and competitiveness of the metal national industries and similars.

Vocation is to give technical and technological support to the metallurgic and metal industries and similars.

Some of the CATIM Services

Metrology	Quality	Products Testing	Materials Testing
CE Marking	Health and Safety	Safety Machinery	Safety Verification
Environment	Masses	Trainning Courses	Consulting



IPAC acreditação

Portuguese Institute for Accreditation

The CATIM was the first institution in Portugal, to obtain the accreditation of laboratories for calibrations and tests, according to the normative reference NP EN ISO/IEC 17025.

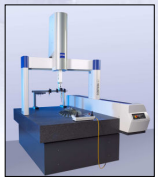
Coordinate Measuring Machines - Laboratory

Accredited Laboratory according to the normative reference NP EN ISO / IEC 17025:2005 ***For Calibration and Testing***

IPAC acreditação M0003 Calibração

IPAC acreditação L0269 Ensaios

Portable Arm, CIMCORE with **Laserscanner V5,** Perceptron



Coordinate Measuring Machine **Contura G2,** ZEISS

Coordinate Measuring Machine **UPMC Ultra,** ZEISS

WE COLABORATTE WITH OUR CLIENTS IN

Inspection and Measurement Parts			News Products Development
Verification Tools			Suppliers Approval
Prototypes Measurement	Process Production Validation	Calibrations Standards	Reverse Engineering Digitalization

WITH THESE CMM'S WE CAN GARANTEE

Good Repeatibility	Good Accuracy	Versatility	Measure Complex Geometries

WE PROVIDE SERVICE TO

- Automotive Industry
- Aerospace Industry
- Navy Industry
- Railway Industry

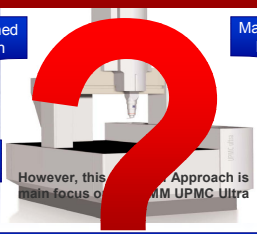
COMPANIES

Força Aérea Portuguesa	SILAMPOS	EFACEC	BOSCH	OPEL	RENAULT
VOLVO	AUDI	Volkswagen	SKODA	FIAT	TATA
SAAB	LISNAVE	MARTIFER	TECNOVIA	AMORIM	FAURECIA
EMEF	Swedwood	SODECIA	… And more about 2500 Companies!		

With all these capabilities, How can we guarantee the quality of the measurements to our clients?

Machine Designed For Calibration

Machine Designed For Research



Measuring Range X850 Y1150 Z600

However, this … Approach is main focus o… MM UPMC Ultra

Vmax ~80 mm/s

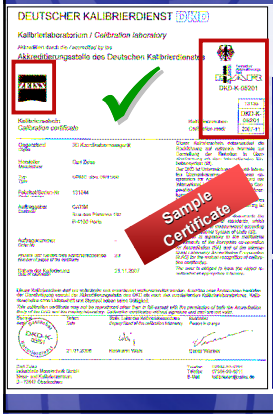
- MPE(1/2D) = 0,… µm, (with L in mm)
- MPE(3D) = 0,4-… µm, (with L in mm)

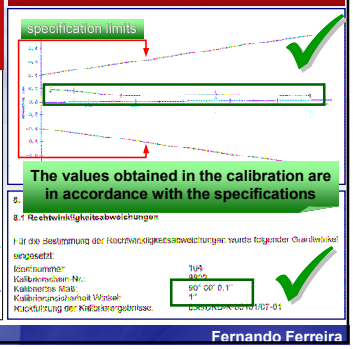
1. Validated Software

The software manages all the information obtained when we operate with a CMM.
So, we must have confidence in software.

We use "CALYPSO" software and it was validated by PTB (Germany)

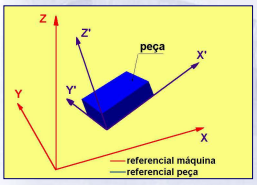
2. CMM UPMC Ultra Calibrated by ZEISS Accordance with ISO 10360





The values obtained in the calibration are in accordance with the specifications

3. THE ALIGNMENT AND THE MEASUREMENT STRATEGY



The CATIM response to the needs of Industry is to promote training courses in Metrology Coordinate with special focus on this subject.

In a measurement, in addition to the choice of measurement strategy, another important aspect is the choice of alignment to be taken (adjustment of the reference machine to the reference part, for 3 axes).

Selection of references, we can eliminate, *or not*, the errors made by traditional alignment (commit themselves often unintentionally).

4. THE INTERLABORATORY COMPARISON TEST

The Interlaboratory Comparison test is an important tool for:

- Performance evaluation of laboratories;
- Validation of Methods;
- Detection of systematic errors.

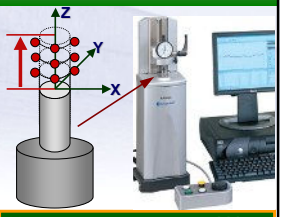
Measurement of a Engine Block for an ECI International, promoted by the company SIL Ingeniería (Reference Laboratory: CATIM).

5. INTERNAL VERIFICATION TEST (CATIM)

Ponto nº	UPMC Ultra	Laser (INTF)	Erro (µm)
Ponto1	14.99992	14.99991	0.01
Ponto2	24.98999	24.98993	0.06
Ponto3	34.98002	34.97996	0.06
Ponto4	44.97002	44.96999	0.03
Ponto5	49.96000	49.96001	-0.01
Ponto6	54.95003	54.94994	0.09
Ponto7	59.93997	59.93996	0.01
Ponto8	64.92997	64.92996	0.01
Ponto9	69.91998	69.91999	-0.01
Ponto10	74.90999	74.90998	0.01
Ponto11	76.89995	76.89999	-0.04
Ponto12	78.89002	78.89000	0.02
Ponto13	80.88002	80.88001	0.01
Ponto14	82.87009	82.87002	0.07
Ponto15	84.86005	84.86003	0.02
Ponto16	86.85005	86.85002	0.03
Ponto17	88.84003	88.84003	0.00

Average of 5pts in each position

The test was control the displacement of the cylinder in a I-Checker with the UPMC Ultra and by Interferometry



90 nanometers seems an ambitious value, but was the largest deviation obtained during the test

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6. EXTERNAL VERIFICATION TEST (CATIM-LOMG)

The test was measure angle blocks with CMM's:
- UPMC Ultra (CATIM)
- UMC 550 (LOMG)

Angulo	UPMC Ultra	Lab. Externo	Erro (graus)
Ang 0.5º	0.49997º	0.49994º	0.00002º
Ang 9º	8.99983º	8.99986º	-0.00003º
Ang 30º	30.00001º	30.00006º	-0.00004º
Ang 60º	60.00011º	60.00033º	-0.00022º
Ang 90º	89.99986º	89.99978º	0.00008º

Average of 3 measures in each angle

The largest deviation obtained in this test is less than 1 second.

-0,79''

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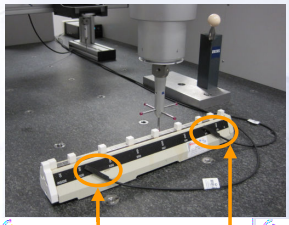
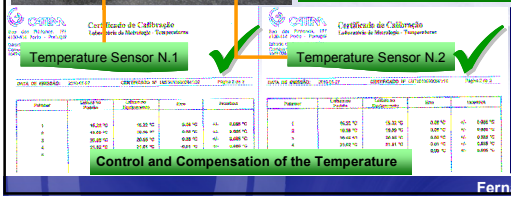
7. EXTERNAL VERIFICATION TEST (CATIM-MITUTOYO)



The test was calibrate a Calliper Checker, measuring the distance between blocks with:
- CMM UPMC Ultra (CATIM)
- Interferometry (MITUTOYO)



Temperature Sensor N.1

Temperature Sensor N.2

Control and Compensation of the Temperature

Note: The thermal expansion coefficient used for the 515-555 is 10,4 ppm/C.

MPE_{MIT} = 5 micrometers

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8. EXTERNAL VERIFICATION TEST (CATIM CMM - MITUTOYO INTERROMETRY)

STEP Refª.: 820406

(mm)	$CATIM_{UPMC}$ (mm)	U_{UPMC} (µm)	Mitutoyo Laser (mm)	U (µm)	Erro (CATIM-MIT)	En
20	20.0005	± 0.35	20.00059	± 0.17	-0.09	0.23
50	50.0004	± 0.40	50.00073	± 0.18	-0.33	0.75
100	100.0002	± 0.48	100.00061	± 0.19	-0.41	0.79
150	150.0000	± 0.56	150.00038	± 0.21	-0.38	0.63
200	199.9996	± 0.64	200.00012	± 0.23	-0.52	0.77
250	249.9994	± 0.72	249.99990	± 0.24	-0.50	0.66
300	299.9991	± 0.80	299.99960	± 0.26	-0.50	0.59
330	329.9993	± 0.85	329.99971	± 0.27	-0.41	0.46
360	360.0004	± 0.90	360.00086	± 0.28	-0.46	0.49

The largest deviation between CATIM and MITUTOYO is 0,52 Micrometers *(in 200 mm step)*

Average of 5 values CATIM

Average of 5 values MITUTOYO

$$En = \frac{V_{Catim} - V_{Mitutoyo}}{\sqrt{U^2_{Catim} + U^2_{Mitutoyo}}}$$

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MAIN CONCLUSIONS

The need to ensure good quality of measurements leads us to seek the good ways to obtained good results in the CMM's.
The most relevant are:

- **The Comparison Test Laboratory;**
- **The Verification Tests** *(Internal and External)*;
- **The Calibration of the CMM according to ISO 10360;**
- **The Use of Validated Software;**
- **The Alignment and the Measurement Strategy;**
- **The Control of the Temperature** *(the parameter more difficult to control)*;
- **The Academic Training of the Metrologist.**

These are some keys to prove the quality of measurements in CMM's and should be considered by all metrological community.

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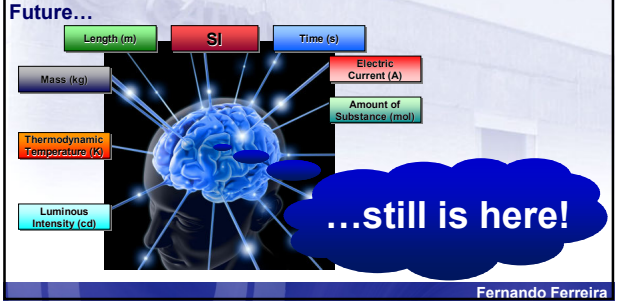
However, we can project new Coordinate Measuring Machines, the most sophisticated, more accurate, but the most important and powerful resource, for the Metrology, for the Academy, for the Industry, for Sustainability and for the Future…



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Thank you for your kind attention!
Muito Obrigado!
A Special Thank for CATIM CMM's Team Work
Fernando Ferreira
CATIM
Technological Centre for Metal Working Industry
Porto - Portugal
fernando.ferreira@catim.pt
www.catim.pt