

# From distance monitoring of instruments by a network for calibration of X-ray diffractometers



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## MONITORING OF DIFFRACTOMETER CALIBRATION AND MEASUREMENT TARE

THE MONITORING OF DIFFRACTOMETER PERFORMANCES BY USING DEVIATION CURVES (I.E. THE DEVIATION OF THE OBSERVED VALUES FROM THE EXPECTED ONES: SEE EN 13925-3).

THE DEVIATION CURVES ARE CALCULATED FOR EVALUATION OF:

- DIFFRACTION LINES POSITION
- NORMALISED INTENSITY
- FULL WIDTH AT HALF MAXIMUM (FWHM)
- ANGULAR DEVIATION CURVES
- LINE BREADTH
- INTENSITY
- SHAPE
- LATTICE PARAMETERS.

### APPLICATIONS:

- STRESS EVALUATION OF INDUSTRIAL COMPONENTS.
- VALUTAZIONE DELLA VITA RESIDUA IN VISTA DI CONTROLLI DOPO NUMEROSE ORE D'ESERCIZIO
- RESIDUAL STRESS EVALUATION,
- MICROSTRUCTURE DETERMINATION AND LATTICE TEXTURE,
- EVALUATION OF THE STATISTICAL DISTRIBUTION OF DEFECTS AND DAMAGES, EVALUATION OF TIME OF PROPAGATION BY PERIODIC CONTROLLI RIPETUTI,
- EVALUATION OF THICKNESS OF COVER MATERIALS (THIN AND THICK FILM),
- LATTICE DEFECTS DETERMINATION AND LATTICE MICROSTRUCTURE CALCULATION,
- EVALUATION OF RELATIONSHIP BETWEEN LATTICE DEFECTS AND MECHANICAL, THERMAL STRAINS AND OTHER PHYSICAL EFFECTS,
- EVALUATION OF CHEMICAL ELEMENTS CONCENTRATION THAT CAN BE CONSIDERED AS "WASTE" OR AS:
  - CATALYST OF CHEMICAL PROCESSES
  - RESPONSIBLE OF CRYSTALLISATION PROCESSES AND POLLUTANT CONDENSATION IN THERMAL PROCESS RESPONSIBLE FOR THE LOW PERFORMANCE OF WESSEL.

INTERESTED LABS BELONG TO THE FOLLOWING AREAS:

- METALLURGY
- NON DESTRUCTIVE TESTING FOR SAFETY IN INDUSTRIAL IMPLANTS
- PREVENTION FOR HEALTH AND ECOSYSTEM
- SURFACE CHARACTERISATION OF MATERIALS WHICH ARE USED IN MEDICAL IMPLANTOLOGY,
- QUALIFICATION AND FORMULATION OF PHARMACEUTICAL COMPOUNDS

### CALIBRATION AND TARE

CALIBRATION IS BASED ON "DIFFRACTION INSTRUMENTAL MONITORING" (DIM) WHICH DETERMINES THE CHARACTERISTIC OF AN EXPERIMENT IN TERMS OF SYSTEMATIC CONTRIBUTION (I.E. INSTRUMENT, PHYSICS AND OPERATIONS) AND GIVE THE EFFECTIVE VALUES OF PARAMETERS THAT CAN BE COMPARED WITH THE NOMINAL ONES PROVIDED BY MANUFACTURER. IT ALLOWS LATTICE PARAMETERS REFINEMENT FOR A BETTER IDENTIFICATION OF SAMPLE CHARACTERISTICS AND SOMETIMES MIXTURES. THIS METHOD GIVES EVALUATION OF THE PATTERN INTERNAL CONSISTENCY; IT INTRODUCES THE PRINCIPLE OF INVARIANCE OF CALIBRATION CURVES AND ALLOWS FOR THE VISUALISATION OF DEVIATION FROM EXPECTED VALUES AS REPORTED IN FIGURES REPORTING ON THE NETWORK PARTICIPATION COMPARISON.

The X-Ray Diffraction net links the participating diffraction labs in order to share data, diffractometers calibration, e-learning, information exchanging, collaboration in project of research, at distance conventions and meeting and other related factors. Commercial software are adopted for e-learning, tele-conferences and personal communication. Members can use text, chat, video and voice communication; they can also share programs (e.g. show a presentation, a graphic etc.) and can use a shared blackboard [2]. The implementation at the present state is based on programs (client and server) written in Visual Basic, where the winsock controls and the TCP protocol are used to transmit data. The calibration at distance is performed via dedicated software from the main lab of a network after having received the data from the members.

A direct link is established between the main lab and the member of the network where a diffractometer site exists. The experiment data can be sent in real time and enable the main lab to collect them and to start the calibration process. This lab linking system allows for performing distant instrument calibration and monitoring the diffractometer performances as well. Several advantages as time saved, and transcription of data are obvious. Other advantages stem from the immediate decision making processes when possible faults happen and not easily recognizable.

The characteristics curves of the instrument performances are filed and recovered when necessary in the network database. It is then possible to notify and to intervene when significant changes (but not directly visible by the unique diffractometer) are revealed.

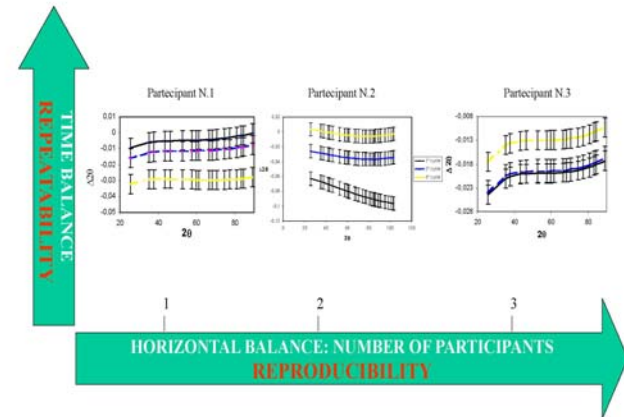
Diffraction data shall be stored in a shared database, where members of the X-Ray Diffraction Net compare and use the network data. The main lab uses a agreed protocol for the calibration and relays official characteristic curve for each individual diffractometer and the deviation from the average expected curve.

A cryptographic approach shall be used to prevent an unappropriate or unauthorised use of the stored and exchanged data.

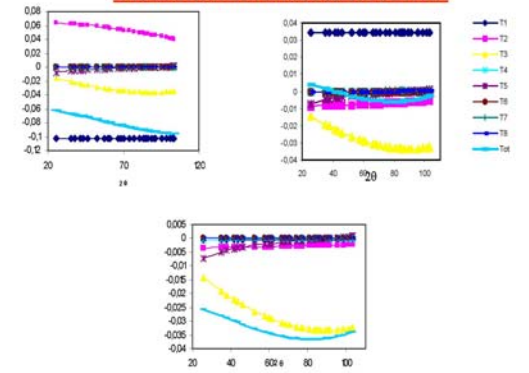
[1] G. Berti, "Calibration of Diffractometers: reports on experiments from 1997 to 2002", MTDC, 2002.

[2] Marco Pellizzon, (2004) "Studio di Fattibilità e sperimentazione di una rete per l'interconnessione di laboratori di diffrazione a raggi x", BD Engineering - University of Pisa (thesis degree).

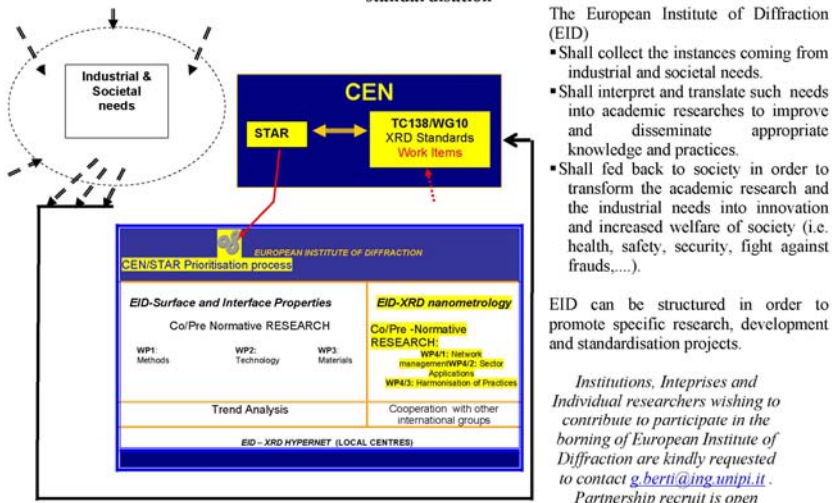
## Network participation comparison



## SINGLE PARAMETERS CONTRIBUTIONS



## A possible scheme to implement the European Institute of Diffraction stemming as a consequence of the standardisation



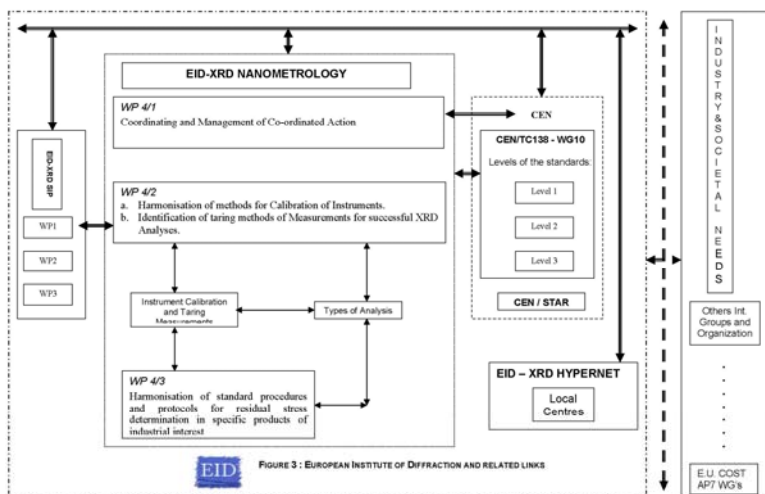
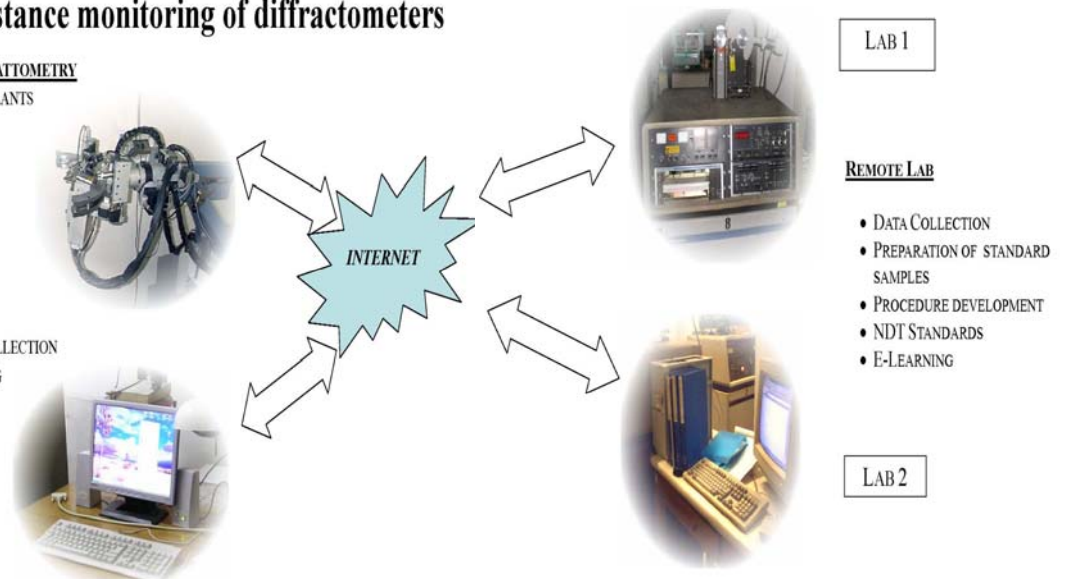
## From distance monitoring of diffractometers

### MOBILE DIFFRACTOMETRY

- NDT ON IMPLANTS

### MAIN LAB

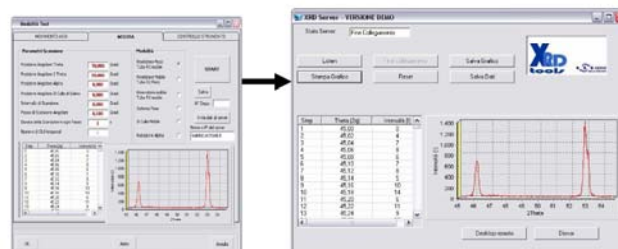
- REMOTE DATA COLLECTION
- DATA PROCESSING
- REPORT WRITING



### At-Distance calibration and monitoring of diffractometers

Diffractometer connects to main lab via internet.

- To calibrate the instrument
- To monitor the performance of the diffractometer



### E-Learning and Audio/video Conferences

