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SOFTWARE TOOLS FOR ISI - NEW APPROACH

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INTRODUCTION

The progress made in information technologies, with regard both to the ratio between performance and price and to the standardization of software development tools, has not occurred without reference to the problems involved in "ISI MANAGEMENT AND QUALIFICATION". The R&D groups using these technologies for the development of data analysis tools are devising new systems based on new concepts, such as complete ultrasonic signal treatment, signal processing, multi-window displays, etc., which until just a few years ago would have been impossible to develop at reasonable cost.

In this respect, TECNATOM is currently developing two types of data acquisition and processing systems incorporating the latest breakthroughs in both performance and operating philosophy. These two lines are, respectively, intermediate performance systems based on commercial, off-the-shelf architectures, such as personal computers, and high performance systems based on high profile work stations and specific processors running under real-time operating systems.

OUTLINE OF NEW DATA ACQUISITION SYSTEMS

We shall make a basic distinction between two sub-systems used for in-service inspections (ISI), to which computer-based techniques are widely applied:

* Data acquisition and monitoring sub-systems: These are in charge of capturing the information from sensors, filing this information and displaying it to the operator.

* Data evaluation and analysis sub-systems: These provide analysis tools for the detection, classification and dimensioning of indications.

Conceptually, both these sub-systems are the same today as they were in the past, although the tools on which they are based have undergone significant change. This evolution has been due to the following, among other things:

1. The need to improve test reliability and repeatability.
2. The need for objective evaluation.
3. The need to improve the accuracy of indication dimensioning.

4. The need to improve equipment operability.
5. Optimization of inspection and analysis times (competitivity and the market).
6. Stricter requirements in relation to personnel doses.
7. Stricter modifications of international codes.

Clearly, not only software tools have played a part in this positive evolution; the development of new NDT techniques, probes, etc. has also made a contribution, albeit to a much less spectacular extent.

The following table, which does not purport to be exhaustive, is a summary analysis of the development with time of user tools.

TABLE 1: Time-based comparison of different systems

	PAST	PRESENT	FUTURE
CONTROL	MANUAL/SEMI-AUTOMATIC	SEMI-AUTO./ AUTOMATIC	AUTO./ INTELLIGENT
ACQUISITION SYSTEM	VIDEO TAPES XY RECORDING	COMPUTERS	
INFORMATION TYPE	ANALOG	UT/AT DIGITAL-EC	UT-AT/RD EC-integr.
FILES	TAPES AND PAPER	COMP. DISK (Mby of data)	OPTICAL DISK (Gby of data)
MONITORING	ON UT EQUIPMENT	Computer-based B/C/D-scan	B/C/D+others PROC.TR
EVALUATION	VIDEO TAPES XY RECORDING	COMPUTER	COMPUTER
PROCESSING	NONE	B/C/D/TOP/(SAFT)	+E.S. AUTO.CLAS Geometry

UT: Ultrasonic EC: Eddy Currents RD: Raw Data AT: Amplitude-Time

TENDENCIES

We may appreciate from the above that the computer is the key factor in the evolution of the acquisition and processing systems used for ISI. This has led to a large number of tools which would have been unthinkable a few years ago possibly being available to the user in the near future. Let us now expand on the more important aspects of the previous table, underlining the following tendencies with respect to the systems in question:

1. Evolution towards simultaneous acquisition of the complete signal on several channels. This has important implications as regards computation, storage capacity and processing

possibilities.

2. Tendency to develop evaluation systems with new algorithms for software-based improvements to signal/noise ratio, image processing, automatic standards-based dimensioning, intelligent, automatic classification systems, etc.

3. Tendency towards greater integration of techniques, basically ultrasonic and eddy current techniques.

4. Development of geometric display systems, which will allow high degrees of realism to be obtained, both for displays and the actual calculations to be performed on them.

5. Introduction of new applications for test simulation.

6. Intelligent operating-aid systems: greater interactivity with the user in manual mode and with the controller in automatic mode.

7. Introduction of new displays (TOP, Histograms, etc.).

<u>CURRENT SUMIAD/MASERA TOOLS</u>

SUMIAD/MASERA is a PC-based acquisition and analysis system for ultrasonic NDT, incorporating many tools used in NDT and applicable to ISI. As regards the acquisition system, the following such tools may be underlined:

1. Test planning: This allows a database to be generated, including the structures of the probe-holding modules, offset, probe angles, mechanical controller parameters, etc.

2. System calibration: by fixing two echoes on the signal shown on the computer screen, or one echo and the sound velocity, using the mouse. The calibration system allows all parameters relating to the pulser/receiver, gain, attenuation, conversion, A/D, filters, gates, etc., to be handled from the computer.

3. Acquisition/reediting: The acquisition system allows multiple data displays to be accomplished, all on-line:

    * A-scan and projections (XY,XZ,YZ) + coordinates for various channels simultaneously and with different screen configurations. All the above is accomplished with actual coordinates (correction of angles, bounce, offset, etc.).
    * A-scan and TOF for various channels.

    * Three-dimensional views

    These displays are supported by tools such as ZOOM, measurement cursors, image processing, etc., which allow data to be evaluated up front.
    The system allows for different acquisition modes:
    * Acquisition of various echoes per gate and channel (number of gates user definable per channel).
    * Acquisition of complete signal (RF or Video).
    * Simultaneous RF and echo acquisition.

* The system stores up to 6 coordinates with the previous data.

As regards the Evaluation system (MASERA), graphic, signal processing and automatic analysis tools such as those described below have been incorporated:

* Application of actual geometries to the signal.
* Implementation of SAFT and LPC algorithms.
* Buttons for automatic code-based dimensioning of indications.
* Interaction tools:
* Zoom, measurement cursors, automatic positioning at maximum values, etc.
* Beam path simulations.
* Printing tools.
* Image processing.

CONCLUSIONS

The tendency as regards data acquisition and evaluation systems, especially those used for ultrasonic NDT, consists of developing instruments provided by the software with a view to increasing the reliability and objectiveness of the tests performed. The new approaches adopted by inspection systems with respect to operating environments in the field imply the use of increasingly sophisticated, computer-based graphic display systems, and increase signal processing capacities and automation of the evaluation process.