

MIRA d'Or

Purpose

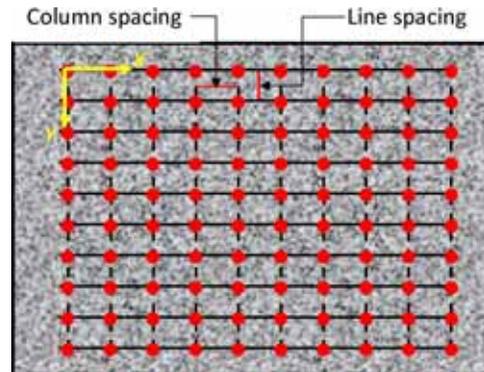
MIRA d'Or is an advanced data acquisition and data analysis system for the impact-echo method. It is intended for use with the **MIRA d'Or** scanner system or it can be used with a **DOCTer** Mark IV transducer as an alternative to the **Viking** software. **MIRA d'Or** incorporates innovative techniques to create 2-dimensional (2-D) and 3-dimensional (3-D) visual representations of the results of impact-echo tests obtained from a grid of closely-spaced test points. The key features of the software include the following:



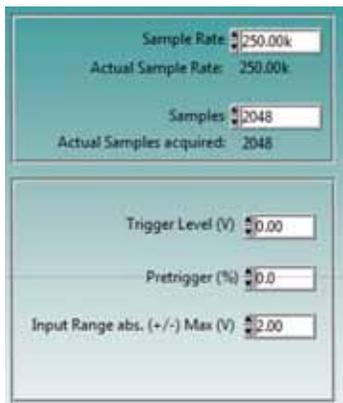
- Simple interfaces for setting up data acquisition parameters and defining the testing grid
- Audio assisted prompts during testing to speed up data acquisition
- Visualization of impact-echo tests results by creating a 3-D volume model of the test region
- Ability to look at reflecting interface on different cutting planes
- Ability to superimpose test results on real world image of test location
- Menu driven report generation in a format that can be edited with a word processor

Principle

The principle of the impact-echo method is discussed on page 50 and is not repeated here. **MIRA d'Or** assumes that impact-echo tests will be performed using a predefined grid of test points. If a **DOCTer** Mark IV transducer is used, a series of equally-spaced scan lines of equal length are marked on the test surface, and equally spaced test points are marked along each line. These points line up to create "columns" of test points. The distance between test points on a scan line defines the column spacing. The combination of "lines" and "columns" defines the 2-D grid that is the basis for subsequent displays. An X-Y-Z coordinate system is defined with the origin as shown. The X-axis is parallel to the scan lines, and the Y-axis is parallel to the columns. The Z-axis is the depth axis and it points into the test object. The grid spacing and the frequency steps in the amplitude spectrum define the size of the "voxel" (or the resolution) for developing the volume model of the test region. If the **MIRA d'Or** scanner system is used, the scan line locations and the line corresponding to the first column are marked on the test surface. The distance between test points along a scan line is selected through the software. The test frame is moved manually from one scan line to another, and the software takes care of data acquisition along each scan line.



Data Acquisition Parameters



The figure to the left shows the input window to define the five parameters required to set up the data acquisition system:

- Sampling frequency
- Number of samples
- The trigger level
- The length of the pre-trigger waveform to be captured
- The maximum signal voltage expected

Sound Settings

To speed up data acquisition, two sound options are provided:

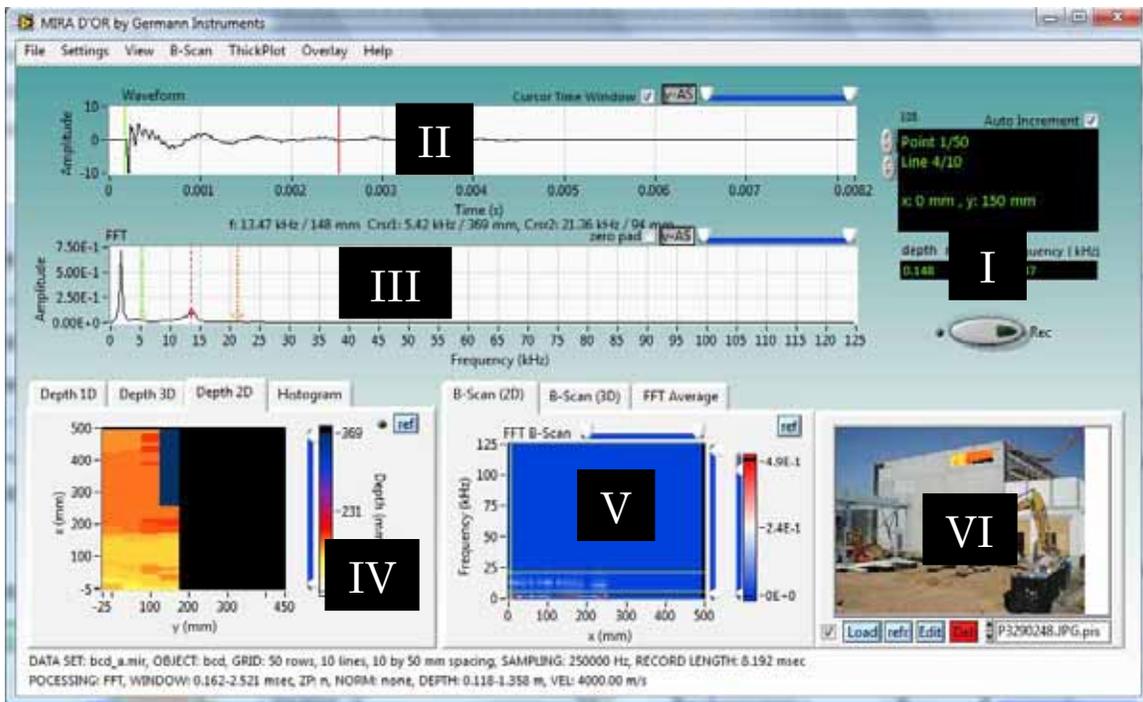
- Voice output that gives the peak frequency, calculated flaw depth, and test position upon completion of the test at a grid point
- Audible sounds indicate a signal was acquired and the relative magnitude of the peak frequency in the waveform

The intent of these audible prompts is to eliminate having to look at the captured waveform and amplitude spectrum before moving on to the next point. If the audible prompts are as expected, the operator can move to the next point without having to review the results. If the audible prompts are unexpected, the operator can stop data acquisition, review the results, and decide whether to re-test before moving to the next point.

Main Window

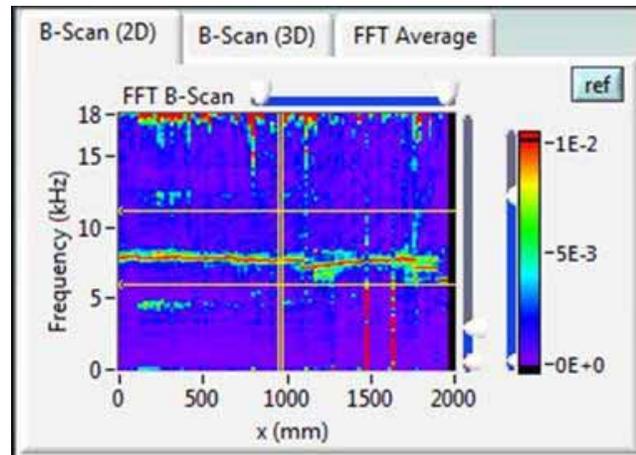
The following figure shows the main window during testing. The different parts of the display are as follows:

- I – Button to activate data acquisition; navigation panel to move to different grid points
- II – Recorded waveform
- III – The amplitude spectrum of the waveform
- IV – Depth plots
- V – B-scan plots
- VI – Test results overlaid on photo of test site



Scans and Projections

The essence of **MIRA d'Or** is the technique for using the amplitude spectra (see pg. 50) obtained at the grid points to construct a volume model of the test region from which locations of reflecting interfaces can be presented as images. Each spectrum along a scan line is represented as a vertical strip, with a width equal to the test point spacing. The vertical axis of the strip corresponds to frequency. Color coding is used to represent the relative amplitude of each frequency. The strips are placed side-by-side, and the end result is a cross-section picture of the frequency peaks along a scan line. This image is called a **B-scan** and is analogous to the B-



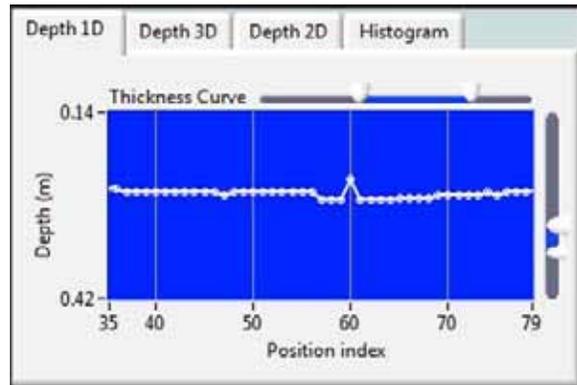
MIRA d'Or

scan obtained using the **MIRA** system (pg. 99). The B-scans obtained from all the scan lines are used to create a volume model of the test region, from which **D-scans** and **C-scans** can be generated. A D-scan shows frequency information on a plane passing through a column line (side view), and a C-scan shows frequency information on a plane parallel to the surface at a given depth (plan view). In addition to views on individual planes, there is the option to create **B-, C-, and D-projections** which are based on averaging the amplitude spectra from two or more adjacent planes.

Depth Plots

If the P-wave speed is known, the frequency axis in a B-scan can be converted to depth using the approximate equation on page 50. The result is called a **depth plot**, and four types of depth plots are available:

- **1-D plot:** shows the depths of reflecting interface along a scan line (as shown on right)
- **2-D plot:** provides a plan view of the depth at each grid point using a color scale to represent different depths
- **3-D plot:** the same information as in the 2-D plot is shown in 3-D by plotting the depth at each grid point along with color
- **Histogram:** shows the distribution of the calculated depths at the grid points

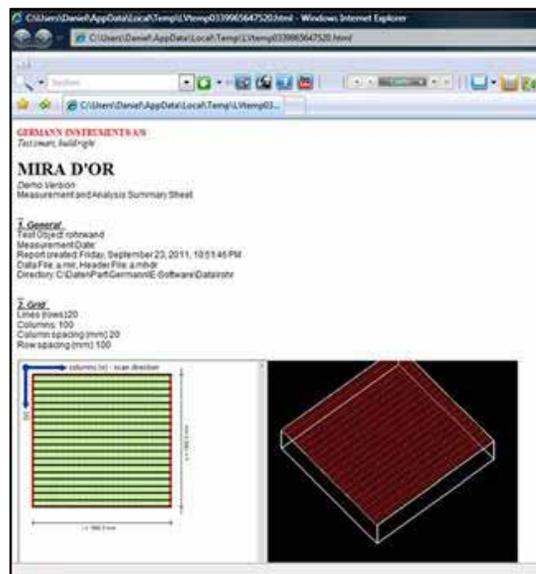


Overlay of Results on Photo

One of the unique features of **MIRA d'Or** software is the ability to superimpose an image created during data analysis onto a photograph of the test site. This provides an effective way to present test results to the client. First, a photo of the test site is imported. Four points are selected on the photo and their coordinates relative to the origin of the test grid are entered. It is best to take the photo after the test grid has been marked on the structure and to use the corners of the test grid the four reference points. An image of the test results is superimposed on the photo (as shown to the left). The superimposed image can be a C-scan, a C-projection, or a 2-D depth plot.

Report Preparation

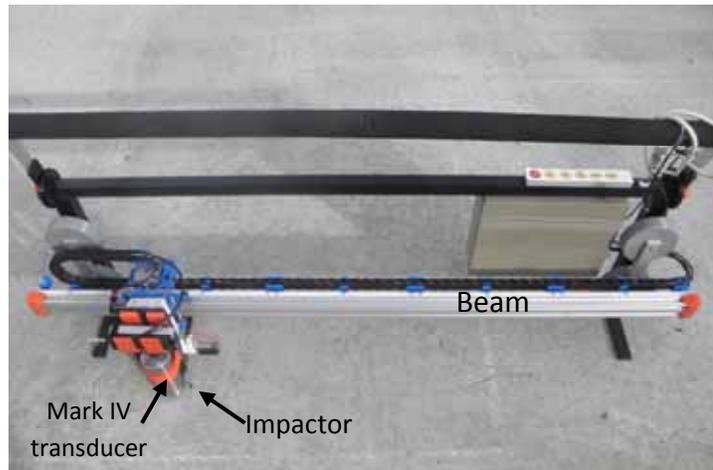
Images created during data analysis can be saved as JPEG files by clicking on check boxes next to the names of the corresponding images. When a test report is to be created, the user selects the images to be included in the report by clicking on their file names. After the desired files are selected, **MIRA d'Or** generates a draft test report, which will be displayed in a browser window and also saved as an HTML file. In addition to the selected images, the report will include automatically the testing parameters entered during set up. The file can be opened and edited with a word processor such as MS WORD®.



MIRA D'Or Scanner System

The resolution of the images generated by **MIRA d'Or** is related directly to the distances between points defined by the test grid. Manual testing with the **DOCTer** Mark IV transducer can take a long time if a large surface has to be tested. The **MIRA d'Or** scanner system has been developed to reduce the time required to obtain impact-echo data at closely-spaced test points, and thereby improve image resolution. The scanner system includes the following key components:

- Tracking beam (1 m long)
- Mark IV transducer
- Spring driven spherical impactor
- Data acquisition card connected to computer



To use the scanner system, the user first defines the test grid by marking the first column line and all the scan lines. The beam is positioned so that it is parallel to the scan lines and the transducer lines up with the first test point. The distance between test points is entered into the **MIRA d'Or** program, and testing is initiated. The scanner system lowers the transducer onto the surface, lifts the impactor spring, and releases the impactor. The software stores the data and sends a signal to the scanner system that causes the transducer to be lifted and moved to the next point. The process is repeated until all points along the first scan line are tested. The frame is moved manually to the next scan line and the sequence of steps is repeated until the entire surface is scanned. The time between successive tests is 2 to 3 seconds. Multiple tracking beams can be joined together to increase the length of the scan lines as desired.

The system comes with a 7-mm spherical impactor as the recommended size, which corresponds to a maximum usable frequency of about 40 kHz. Other sizes ranging from 4 mm to 10 mm are available.

MIRA d'Or Ordering Information

MIRA d'Or can be used with a manual system incorporating the **DOCTer** Mark IV transducer and spherical impactors:

| Item | Order No. |
|--|-----------|
| MIRA d'Or software with USB license key | MDOR-100 |
| Laptop computer with D/A card | MDOR-110 |
| Mark IV transducer | DOC 40 |
| Star support with 5, 8 and 12 mm impactors | DOC 60 |

Alternatively, to reduce testing time, **MIRA d'Or** can be ordered with the scanner system:

| Item | Order No. |
|--|-----------|
| MIRA d'Or software with USB license key | MDOR-100 |
| Laptop computer | MDOR-115 |
| Scanner frame with Mark IV transducer, 7-mm impactor, D/A card | MDOR-120 |
| Additional 1-m lengths of tracking beam with connection hardware | MDOR-130 |
| 4-mm impactor | MDOR-140 |
| 10-mm impactor | MDOR-150 |

