# *Echolyst*

Purpose

Echolyst is an advanced data acquisition and data analysis software for the impact-echo method. It is used along with the **Mirador** system (see datasheet) or other commercially available hardware for Impact-Echo. Besides the traditional use for interpretation of results of the impact-echo method, the **Echolyst** software incorporates innovative techniques to create 2-dimensional (2-D) and 3-dimensional (3-D) visual representations of measurements obtained from a grid test points. The key features of the software include:

- 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 a test location
- Report generation

Principle

The principle of the impact-echo method is described in the **Mirador** system's datasheet. To take full advantage of **Echolyst,** the user can generate a grid of test points at the inspection site. 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. 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 as shown, where 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 into the test object.

The essence of **Echolyst** is the technique for using the amplitudes of the different frequency components obtained at the grid points to construct a volumetric 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 and color coding is used to represent the relative amplitude of each
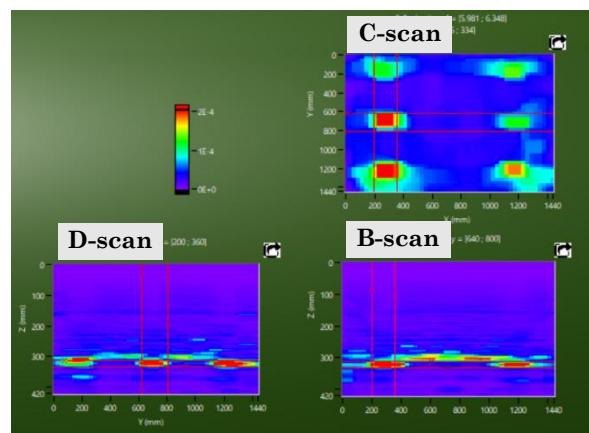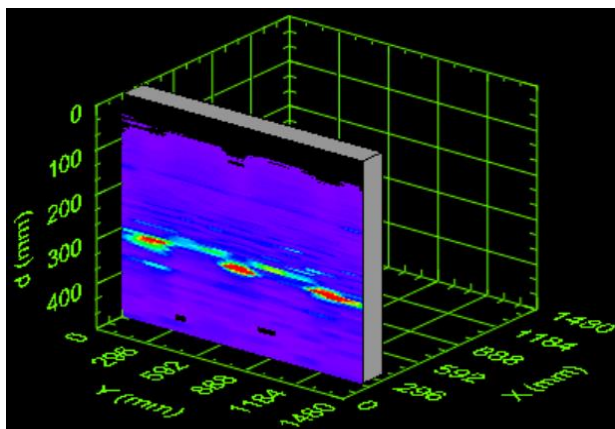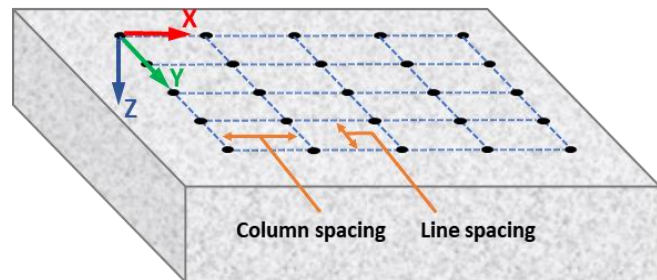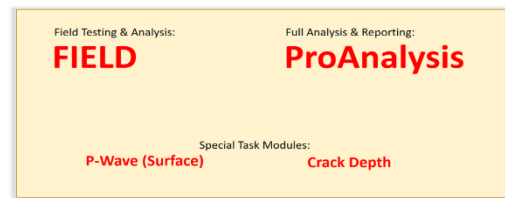
frequency. The strips are placed side-by-side, and the end result is a cross-section picture of the frequency peaks along a scan line. This image is called a **B-scan** (XZ-plane view) and all the B-scans obtained from all the scan lines are used to create a 3-D model of the test region, from which **D-scans** (YZ-plane view) and **C-scans** (XY-plane view) can also be generated. 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.
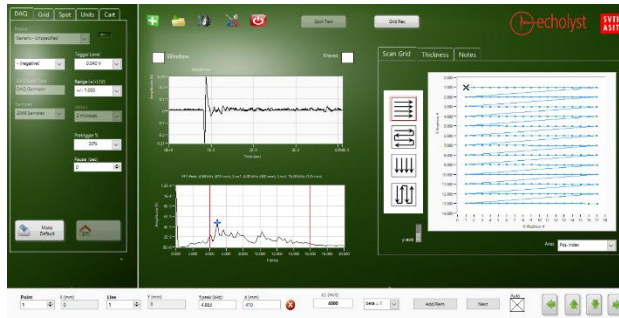
Since the measured frequency is related to an equivalent depth according to the basic equation of impact-echo, the measured depths can also be plotted along the scan grid to generate 2-D and 3-D representations (e.g. depth plot on the right) with depth values instead of frequency values representing the Z-axis.
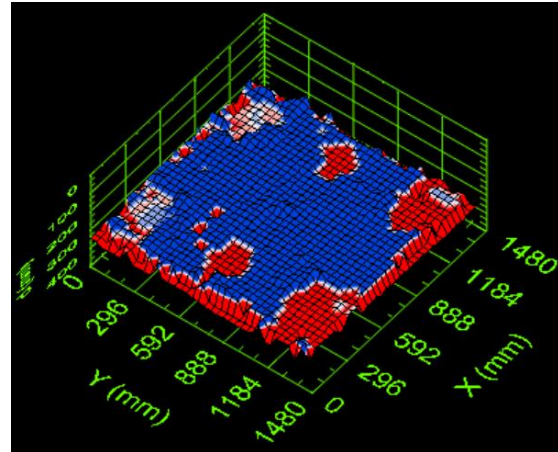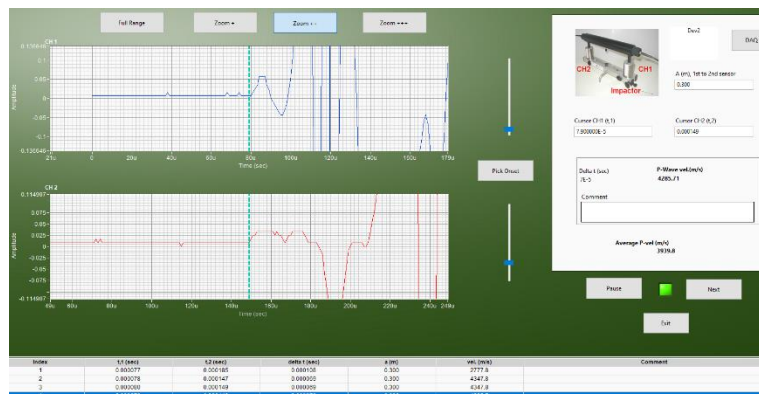

The Four Modules

FIELD Module
Acquisition and analysis of individual waveforms collected. It contains the tools for setting the acquisition parameters, calibration of wave speed and collecting data points.
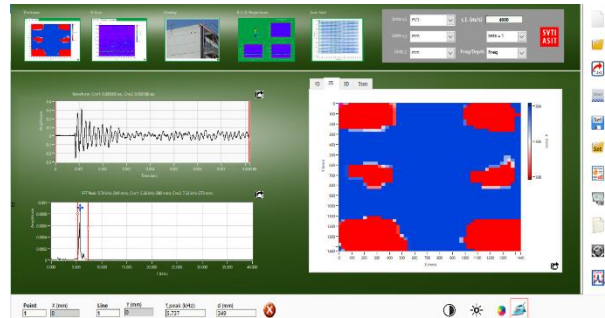
ProAnalysis Module
Full analysis of grid data and reporting. It contains the tools for statistical analysis, creating 2D and 3D thickness plots, 2D and 3D tomographic images and projections on imported photos or drawings.

P-Wave Module
For measuring wave velocity at the surface according to ASTM C1383.

Crack Depth Module
For the standard method to measure the depth of surface opening cracks.

Data Acquisition Parameters

A full menu of parameters to set up the data acquisition system is available: Number of samples, delta t between samples, trigger level, pre-trigger length, input signal voltage range, etc.

Sound Settings

To speed up data acquisition, a voice output provides full control for the user, who can focus on the measurement without having to watch the screen. The voice output can be configured according to the specific needs and preferences of the user.

Scans and Projections

Echolyst generates layer thickness profiles and displays them in various modes, in 1D, 2D and 3D. It also provides volumetric slicing capabilities for tomographic B-Scan, C-Scan and D-Scan imaging. The slicing is controlled intuitively, including options for color bar selection and customization, smoothing, contrast and threshold adjustment.

Overlay of Results

One of the unique features of **Echolyst** software for interpretation and reporting 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. Any volumetric slice or projection generated with an unlimited number of imported pictures (photos, drawings, CAD models, etc.) of the inspection object can be used.
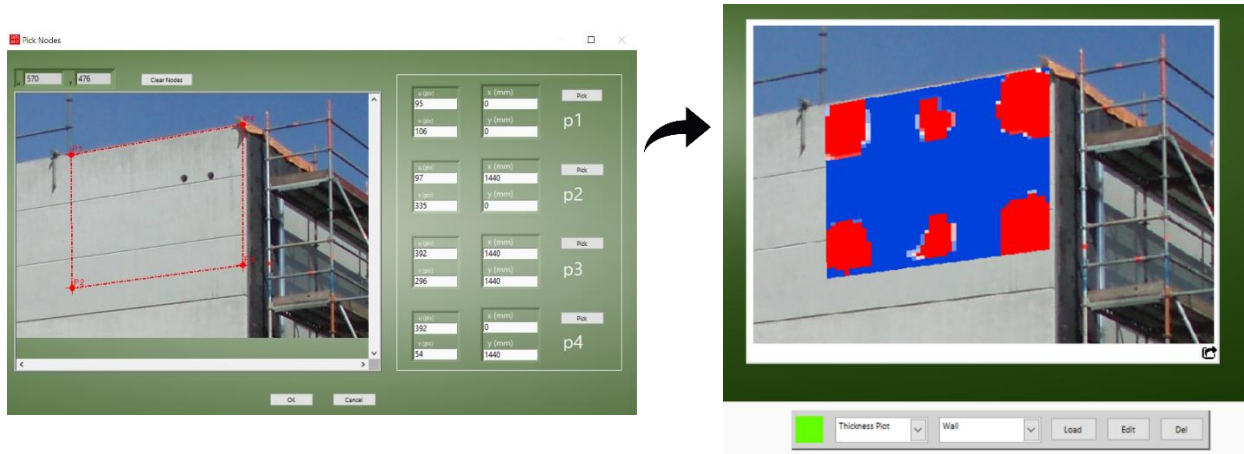
Report

During analysis, images and results can be exported, commented and compiled so the user can create a comprehensive analysis report. **Echolyst** is the only impact-echo software making the reporting flexible, easy and efficient.

Echolyst with Mirador-3000 being used

Echolyst with Mirador-5000 being used