Delta-T Scan
Root Analysis System

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- **Fast, accurate root measurements**
- **High resolution over large area, no calibration needed**
- **Root length vs. diameter distribution analysis**
- **Soil particle size analysis**
- **Protected scanner, suitable for wet roots**
- **Root Washer option**

Delta-T Scan uses a customised flat-bed scanner to provide fast and easy analysis of roots, at high resolution

Powerful root analysis

Root measurements are of vital importance in plant science applications, but have often been neglected because of their difficulty. Using a specially splash protected flat-bed scanner, Delta-T Scan is optimised for high resolution root analyses, including:

- **root length, with a choice of three overlap correction methods**
- **root length, surface area and volume per unit volume of soil**
- **root length vs. diameter distributions**
- **root tip recognition, count and location**

Using Delta-T Scan

Prepared root samples are placed on the transparent trays supplied, using a special mesh panel to hold the roots flat against the base of the root tray. The sample is then scanned into an image file.

The scanner software includes a full range of functions for enhancing and thresholding the image of the sample. The image file is then passed to Delta-T Scan software, which provides a comprehensive range of analysis and measurement functions.

The analysis results are sent to output files which can be simply printed or listed on-screen, or may be exported to spreadsheets such as Excel, for further analysis and full graphical presentation of the data.
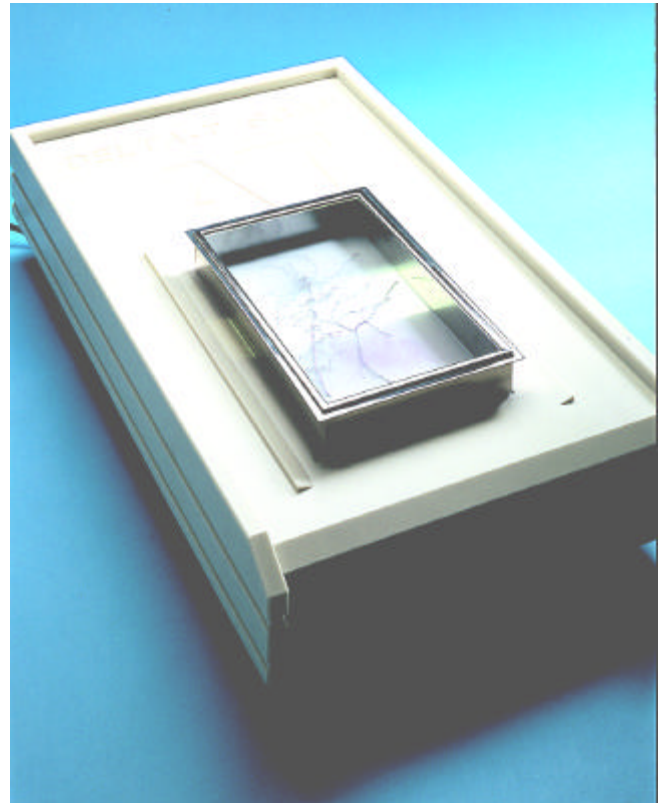
 Delta-T Scan offers superior resolution over a much larger area than is possible with systems based on a video camera, and because the scanner delivers digitised images with a precise number of dots per mm, no specific calibration is required.

Comprehensive manuals supplied with Delta-T Scan explain every step from optimising images to presenting the results; they also cover much of the theory.

Other applications include:
- shape and size analysis of objects
- direct measurements from maps and photographs of a known scale
- counting of overlapping seeds
- soil particle size distributions
- sort by standard sieve mesh sizes
- leaf area measurements

A self-running demonstration disk is available.

Delta-T Scan Software Functions

Length analysis Analyses long, thin objects such as roots. Calculates the area, length, average diameter (thickness), and density in terms of length per unit volume. There are four alternative algorithms to choose from: Delta-T SCAN generic, after Kirchhof (1992); Newman/Head (1966); Harris/Campbell (1989); or user-defined.

Thickness (diameter) distributions Based on length analysis, this calculates the length in each of a range of diameter intervals, defined automatically, or by the user. For each interval an analysis of surface area and volume is given, along with averages, deviations and percentage of the whole sample, assuming the objects are tubular.

Tip count Counts the number of ends or tips in the image. Tip co-ordinates are recorded, permitting checks to be made on the accuracy of the count.

Object size Measures, classifies and provides statistical analysis of the sizes of all objects in the image, within intervals defined by the user, e.g. to correspond with standard sieve mesh sizes.

Object count Delta-T Scan provides a method of correcting for touching and overlapping objects that does not require user intervention. This avoids the need for manual image editing.

Object scan Measures area, width and perimeter length for all objects within the image, ranking them by area. The results can be filtered to record only those objects falling within defined limits.

Area analysis Calculates total area (black on white or white on black), and percentage of the whole image covered by the objects). Estimates total biomass by extrapolating from sub-sample data.

Point-and-shoot Measurement of linear distance, or area, width and perimeter of any discrete object, may be made by pointing with the mouse cursor and clicking.

Batch processing Useful for processing long runs of images or several large image files. A batch processing file is created, including the chosen settings and the analysis required for each image. Delta-T Scan then works on this file, producing results files automatically.

Delta-T Scan Specifications

PROTECTED FLAT-BED SCANNER
HP Scanjet with splash protection cover, vertical screen and power safety trip switch
Max resolution: 0.042mm (600 d.p.i. optical)
Max sample size: 297 x 216mm
Scan speed: 22s at 600 dpi
Interface: USB or SCSI port (NB: most scanners will require Windows 95 or later, a CD drive and 16Mb RAM)
Image editing: software included
Power: 100 -127V AC or 220-240V AC, 50/60 Hz, auto switching, 100 W maximum
Size/weight: 860 x 500 x 190 mm (incl. cover). Wt.11.0 kg

IMAGE ANALYSIS SOFTWARE
Image size and resolution limited only by scanner and computer memory.
Accuracy:
Root length: (with the Delta-T root length standard target set) Root length accuracy is critically dependent on good sample preparation, presentation, contrast and resolution. A set of precision, artificial root targets type CTS is available for validating the root length algorithms and calibration coefficients.
Area: <1% for optimised image quality, <5% typical (depends on resolution, contrast, sample thickness, etc.)
Image file formats: MSP, BMP, TIF, PCX
Computer requirements: Delta-T Scan is a DOS program and will run on most PC compatibles. See also Scanner Interface information, above.

ACCESSORIES
See price list for details of Root Preparation and Handling Kit Root Tray Set, Reference Target Sets and other accessories.

Root Washer

• **Semi-automatic operation**
• **Optional pump and tank**

Root washing is essential preparation for measuring and analysing root samples. Washing by hand is time consuming and labour intensive, often resulting in the loss of finer material.

The Delta-T Root Washer helps automate the task, and retains fine root filaments. Based on a design from CSIRO Cunningham Lab in Australia, the Root Washer consists of four buckets each with a central overflow pipe and two water jets in the base. The water swirls around and up, teasing roots and soil apart. Fine roots in the outflow are collected in a 500 micron mesh filter; those remaining in the bucket are poured through the filter. Depending on the soil type and sample volume, about 10 samples per hour can be washed.

Water mains supplies are usually at a lower pressure than the 38 litres per minute at 3500 hPa required for optimum washing performance. An electric pump and recirculation tank are available to ensure adequate pressure, and to conserve water.

Ordering information

Delta-T Scan: Complete systems including the protected flat-bed scanner, Delta-T Scan software, a computer and accessories can be supplied. All main items, spares and accessories are available separately.
Basic Root Washer System type RWB Requires a water supply of 38 litre/minute at 3500 hPa. Includes 4 buckets, each with 2 jets, table, sieves, spray gun, hoses and connectors, 5 m of 12.5 mm input hose, and 4 plastic pots to hold washed samples.
Pumped Root Washer System type RWC Includes all items in Basic System, plus recirculation tank and 0.55 kW electric pump with pressure gauge and safety cut-out. The tank, and pump are available separately. (Please note that 110V pumped Root Washer Systems are <u>NOT</u> available).

For details of options, accessories, spares, consumables and electrical requirements please contact Delta-T Devices