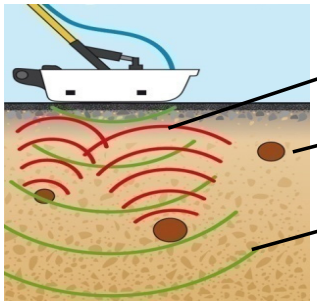
Tree Root Morphology Mapping
by
Non-Invasive Ground-Penetrating Radar

Root Inspection Procedure

Scan over either Bare Surface (soil, grass) or Covered Surface (brick, concrete, paving, asphalt). Choose an antenna with the right resolution/depth characteristic.

Smallest Detectable Root Diameter:
1cm (0.4in) with 900MHz antenna
2cm (0.8in) with 400MHz antenna

Scan depths to:
1m (3ft) using 900MHz antenna
3m (9ft) using 400MHz antenna



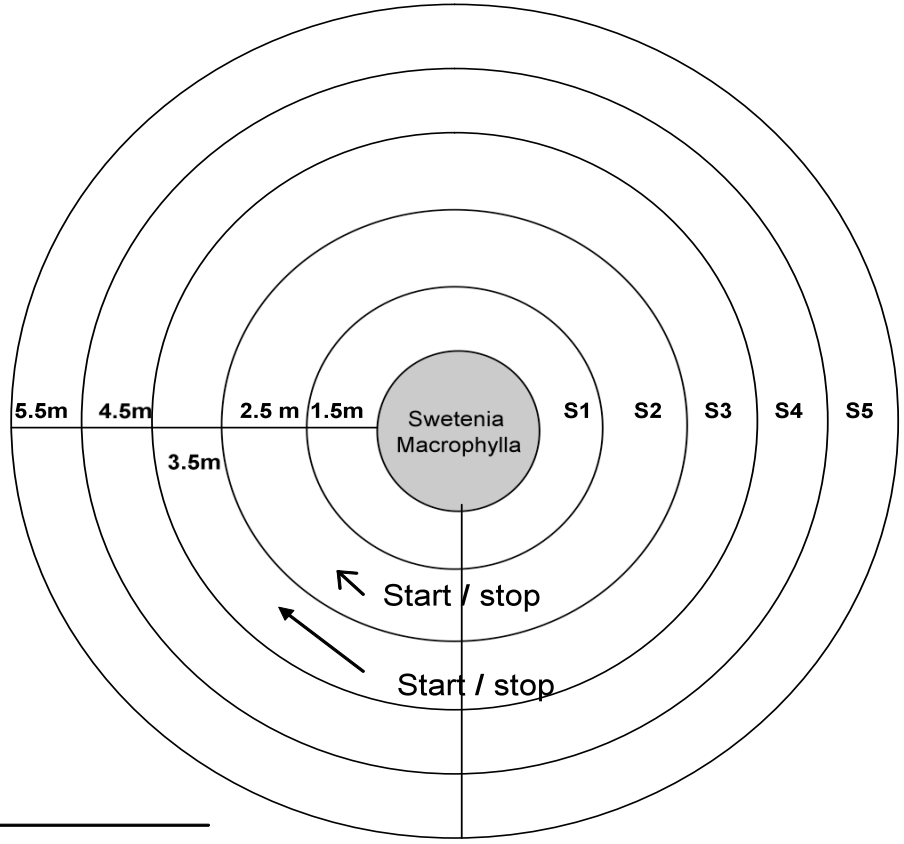
Objectives …

- Set GPR scan lines in the area around a tree
- Scan with GPR system – either covered (concrete, asphalt, brick, pavers) or bare surfaces – to detect root reflections
- Connect the reflections (“hits”) found on each scan line with succeeding scan lines to create a 3D Root Morphology Map
- Create a Root Surface Density Map to show Root layout and density

Here are the steps …

Step 1: Prepare a Root Scan Layout

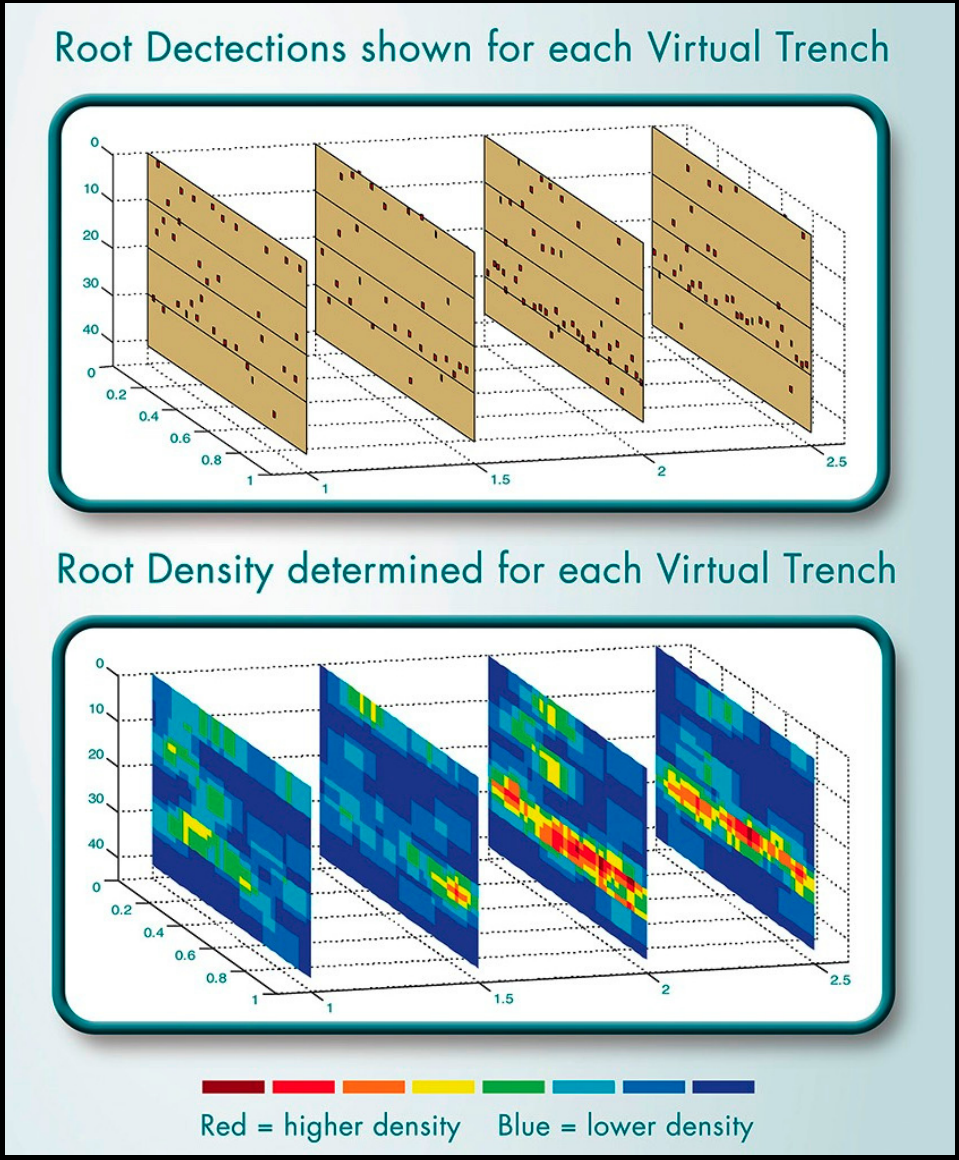
S1 : Scan 1
S2 : Scan 2
S3 : Scan 3
S4 : Scan 4
S5 : Scan 5



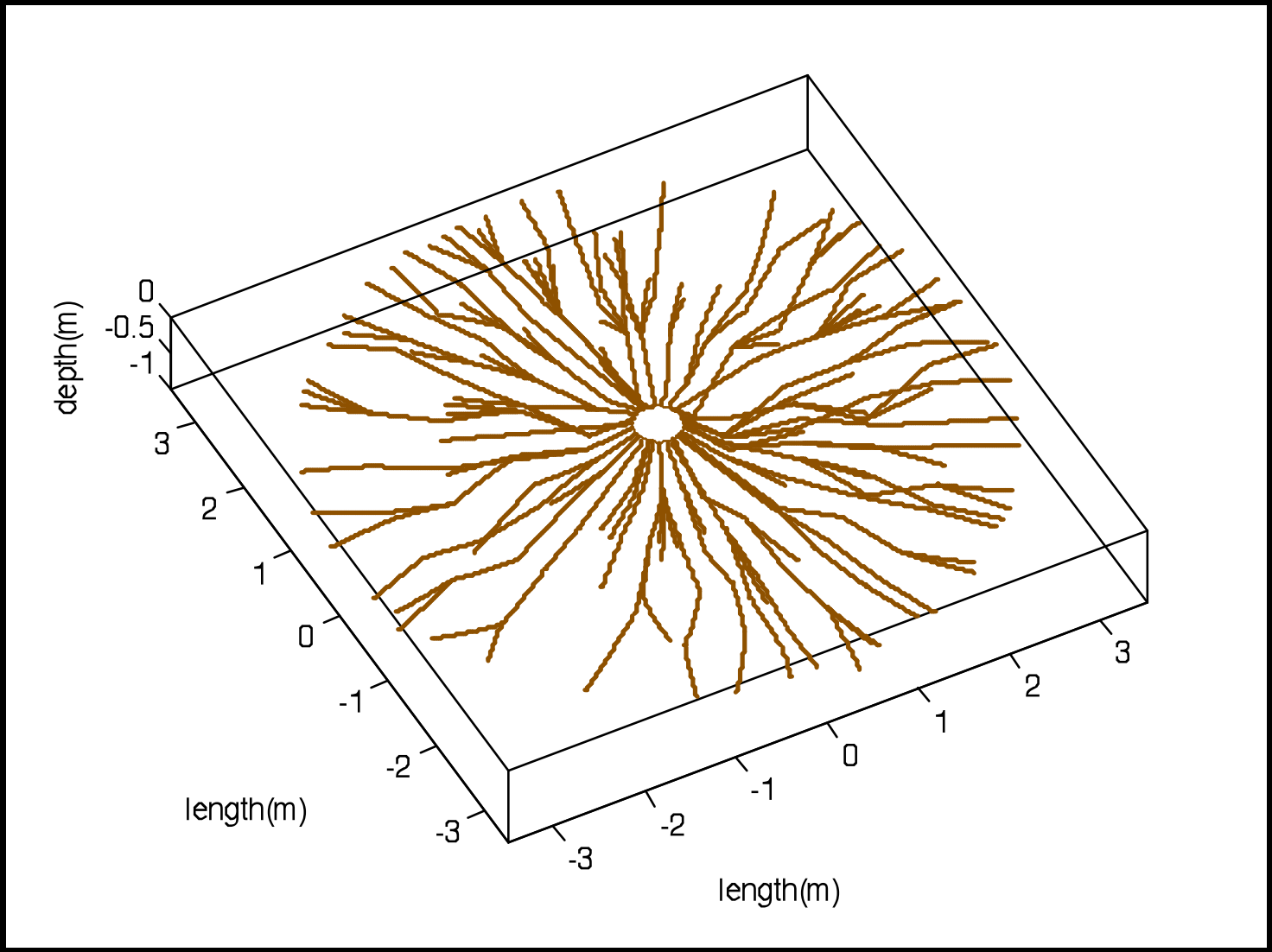
Step 2: Create a Rough Grid to Implement the Root Scan Layout

Step 3: Scan each Grid Line using Ground-Penetrating Radar (GPR) with Data Acquisition Triggered by a Distance-Encoding Wheel

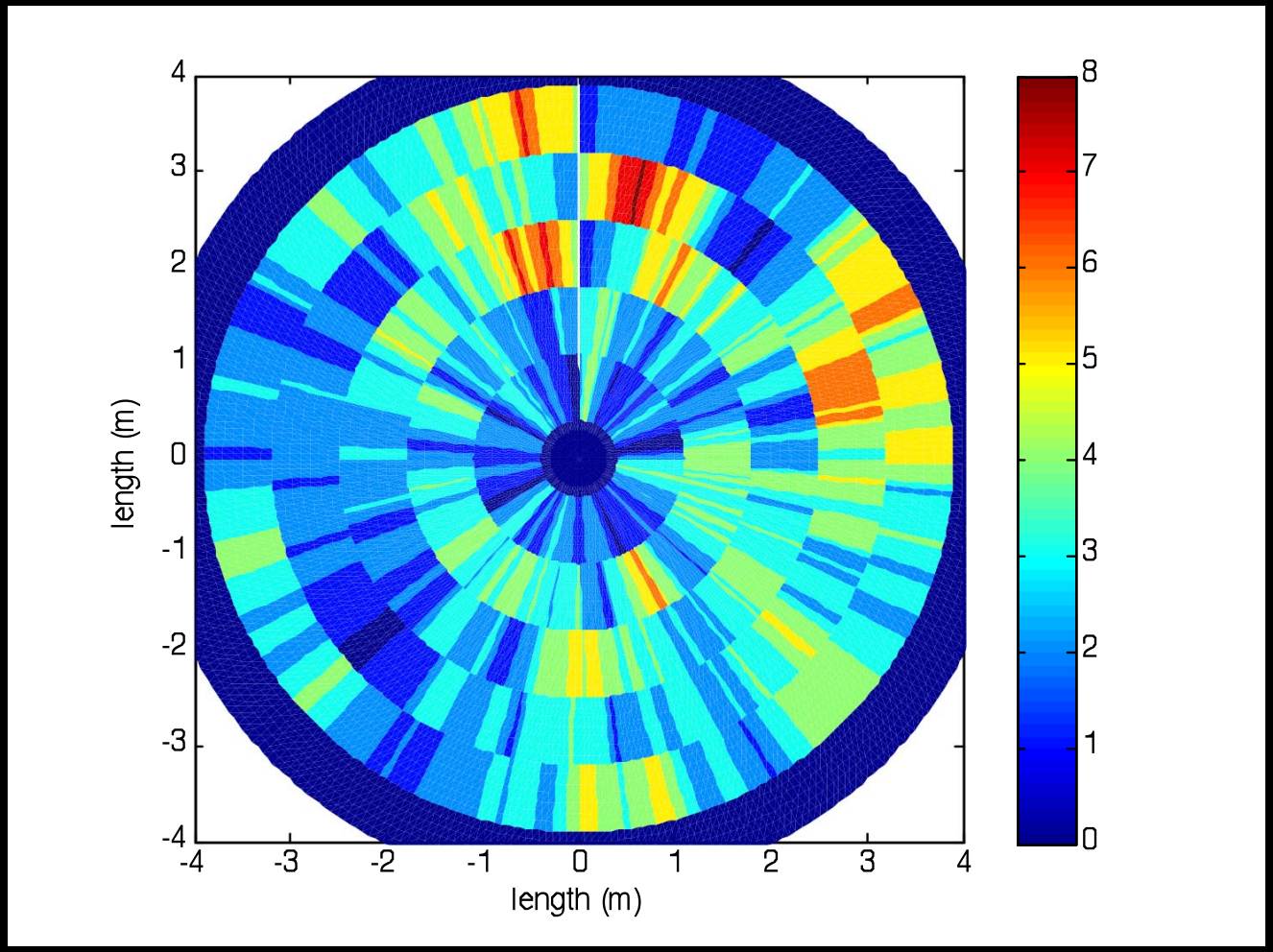
Step 4: Process each Scan Line to create a 2D "Virtual Trench" map showing X (distance along scan line) & Y (depth) coordinates of each Root Detection (dots)



Step 5: Create a 3D Root Morphology map ("Virtual Excavation") by algorithmically connecting the detected roots found on each Scan Line



Step 6: Process the 3D Root Morphology map to create a Surface Density map



Summary

- Tree Roots can be Detected and Mapped accurately, as confirmed by test excavations, using Non-Invasive Ground Penetrating Radar

- Soils that are generally considered hostile to GPR – such as clay – can be inspected successfully by appropriate Signal Processing

- Soil "clutter" can be significantly minimized by a Data Preprocessing step using a Combination of Signal Processing algorithms to enhance the Signal/ Noise Ratio

- 2D "Virtual Trench" maps can be created from the detected roots along each line scanned

- Connectivity Algorithm has been developed to automatically connect detected roots on multiple scan lines to create a 3D Root Morphology Map ("Virtual Excavation")

- Root Surface Density map shows the overall layout and density