

## Practical Use of Tomography as a part of Tree Risk Evaluation

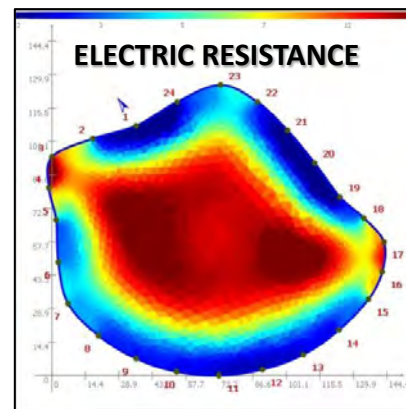
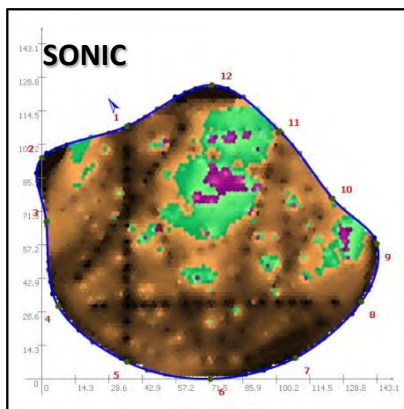
### For the 2014 Annual California Tree Failure Report Program

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#### Key Points on Tree Tomography:

**Tomography:** a technology that produces a cross sectional image (*tomogram*) of a 3-dimensional object. Examples, x-ray, MRI, CAT scan, ultrasound, PET scan.

**Tree Tomography:** two types – **sonic** (acoustic) measures relative density, and **electric resistance** which measures moisture gradient and ion concentration.



#### Why is Tomography used in Arboriculture?

- To better understand the interior structural condition of trees.
- To provide a more accurate estimate of Tree Risk
- To facilitate management decisions about trees.
- To graphically document a representation of the cross-section of the scanned area of the tree.

#### How is Tomography best used in Arboriculture?

- Trees that are good candidates for tomography are identified during a basic tree evaluation.
- Tree owners/managers are informed about tree tomography – pros, cons and limitations.
- Specifics of tree & environment are evaluated; tomography proposed if there is a good probability that it will provide useful information.

**Accurate tree cross-sectional geometry is important in tomography** in order to most accurately assess the impact of decay or cavities on load-bearing capacity. The location of the decay relative to the geometry of the cross-section can be as or more important than the extent of that decay.



## What do tomograms show?

- Sonic tomogram shows the density of a tree
  - This can give an indication of the mechanical strength of the tree.
  - It can show internal decay not visible from the outside.
  - Cracks and included bark can also be observed.
- Electric Resistance tomogram shows the moisture gradient of the cross section
  - Image integrity not affected as much by cracks or included bark.
  - Can help clarify questionable areas in sonic scan, e.g. if an area of low density is a cavity or if there is material (wood) present.
  - May identify early decay.

## Interpretation of Tomograms:

- Art & Science
- Much practice and guidance needed
- Dissection studies are the best confirmation of tomogram accuracy – do whenever possible to learn!
- Sonic tomograms – watch out for acoustic shadows caused by cracks
- Electric resistance tomograms – harder to interpret, most accurate when species “Type” known.

## How Long Does Tomography Take?

- Manufacturer says simple and quick, but it is usually not.
- 20 min. for scan at one level (small, uniform tree, e.g. 24" DBH w/ smooth, round x-section).
- 1.5 – several hours for larger, gnarly, non-uniform cross section and/or scans at multiple levels.
- Several hours to all day, or multiple days for large, non-uniform trees with complicated shapes and/or scans at multiple levels

## Pros and Cons of Tree Tomography:

- Pros
  - Proven record of applicability in other fields
  - Can see inside tree better than any method available
  - See entire cross-section at once
  - Good graphic output
- Cons
  - Relatively expensive
  - Long Learning Curve
  - Complicated to use
  - Limited use in USA
  - Marginal manual
  - Software could be improved
  - Not useful for roots



### **Managing Client Expectations:**

- Tomography cannot tell us if a tree is “safe” or not.
- Tomography provides information only about the scanned plane(s), not the entire tree.
- A tomogram is a snapshot in time – decay can continue to progress, but so can adaptive growth

### **Good Candidate Trees for Tomography:**

- Specimen trees of high value, such as historic trees.
- Trees that could cause appreciable damage or injury if they failed.
- Large, old trees with interior decay or other structural problems that are difficult to see by other methods.
- Trees for which tomography has a good probability of providing additional information that can be used to help make management decisions about the tree.
- When tomograms would be useful in providing legal or other documentation

### **Poor Candidate Trees for Tomography:**

- Trees that are obvious “Goners”.
- Trees where simpler methods of analysis will provide adequate information, for example visual observation, mallet tapping, probing, etc.
- Trees with multiple structural or health issues that tomography cannot adequately address.

### **Lessons Learned:**

#### Sonic Tomography:

- Old, large trees usually contain some decay
- Even with cracks, sonic tomograms seem reasonably accurate, according to the dissection studies we have done.
- Tree body language often explains tomo anomalies

#### Electric Resistance Tomography:

- Electric tomograms can be enhanced and made more useful by adjusting contrast and electric range profile.
- Electric tomography detects reaction wood
- Electric tomography may detect early decay
- Tree body language often explains tomo anomalies

### **Conclusions:**

- Use tools (such as Tomography) judiciously.
- Make sure the client has a basic understanding of tomography before proposing this technology.
- Use Tomography in concert with all of your other arboricultural knowledge and skills.
- Tomographic information must be taken in context within an overall tree evaluation.



### Conclusions (continued)

- Tomography will not make up for lack of arboricultural knowledge & experience.
- Tomography is a good tool, but like all tools it has limitations.
- Tomography should be taken seriously!

### Tree Tomography Research:

- *Decay Detection in Red Oak Trees Using a Combination of Visual Inspection, Acoustic Testing and Resistance Micro-drilling.* Journal of Arboriculture & Urban Forestry. Vol. 34, No. 1. International Society of Arboriculture. January 2008. Wang et al.
- *Development of Decay in the Sapwood of Trees Wounded by the Use of Decay-Detecting Equipment.* Arborist News. International Society of Arboriculture. December 2010. Schwarze.
- *Diagnosis & Prognosis of the Development of Wood Decay in Urban Trees.* En Spec Pty. Ltd. 2008. Schwarze.
- *Quantifying Wood Decay in Sydney Blue gum (Eucalyptus saligna) Trees.* International Society of Arboriculture. Journal of Arboriculture & Urban Forestry. Vol. 36. No. 6. November 2010.

### Other Useful Information:

- Link to tomography information on D. Ellis web site: <http://www.decah.com/picus.html>
- *Basic Aspects of Mechanical Stability of Tree Cross-Sections.* Rinn. Arborist News. February 2011. Pp. 52-54.
- *Shell-wall Thickness & Breaking Safety of Mature Trees.* Ibid. Western Arborist. Fall 2013. Pp. 14 – 18.

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