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A Gamma Ray CT Computed Tomography for Investigating the Wood Structure

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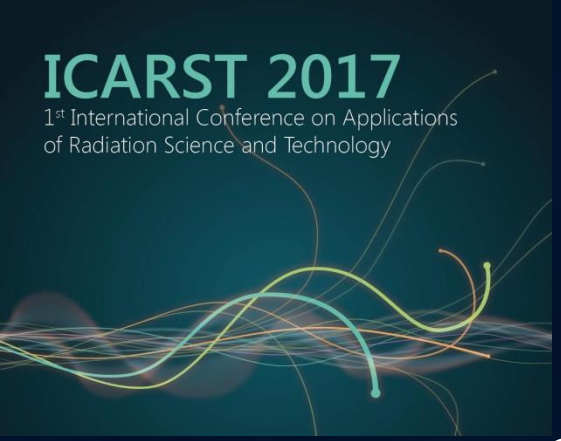
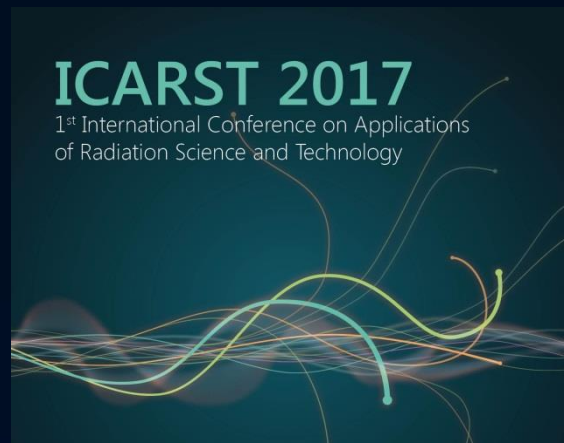


OUTLINE

- Introduction
- Tomography principle
- Materials & system used
- Experiments
- Results
- Conclusion

Objectives

- Preliminary study of a cork oak trees of the Maamoura Forest
- The difference in densities
- Attempt for the Datation by counting number of the rings of growth



MOROCCO

Maamoura Forest is located near to Rabat

CNESTEN is inside the Maamoura Forest

Maâmoura Forest

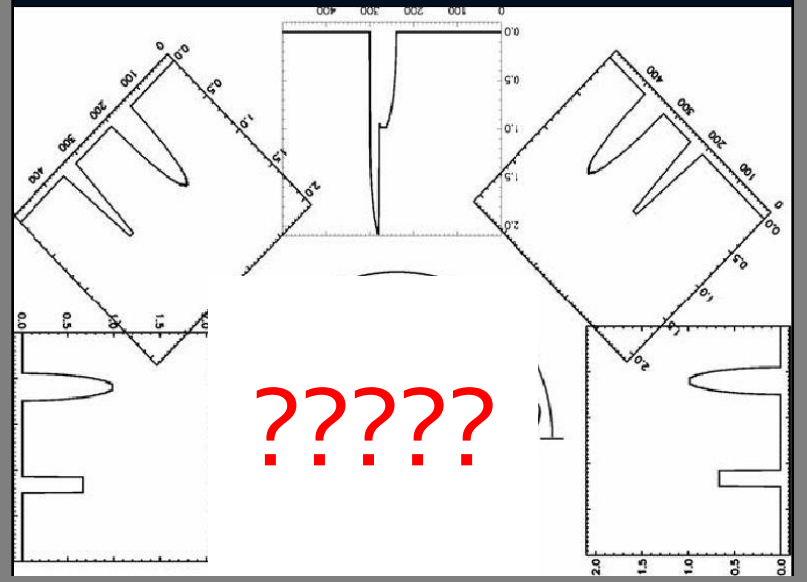
- The Maâmora forest is among the largest s cork oak forests in the world and is the lung of the urban area of Kénitra, Rabat-Salé.
- Approximatively 134 thousand hectares of the forest is filled with cork trees.
- More than 50% of Moroccan's cork trees
- Pine groves, eucalyptus trees and wild pear trees are scattered across the area.

Techniques used in CNESTEN

- Dendrochronolgy
- Dendrochronology is used for datation aims
- Recently another technique is used by studying stable isotopes of carbon, oxygen, and/or hydrogen of tree rings to identify the various climatological, ecological, or hydrological contexts.
- Destructive technique

Tomography

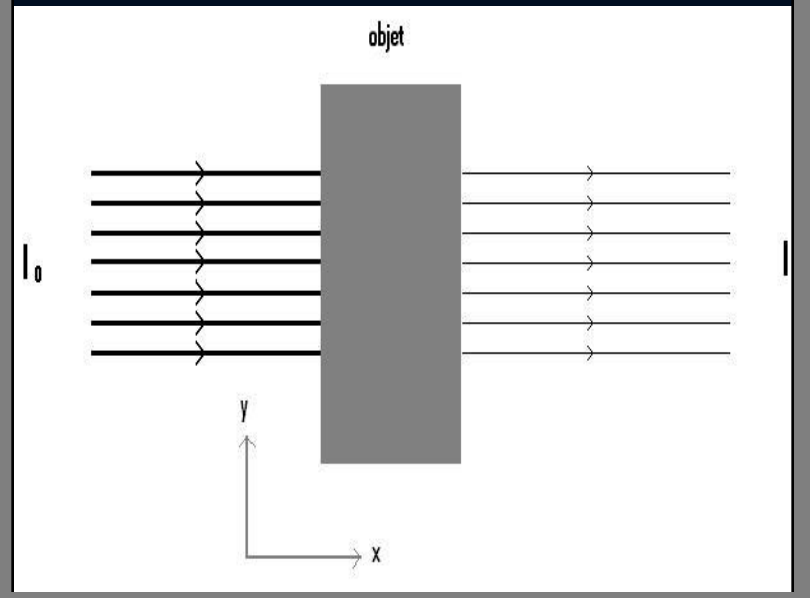
- The tomography is a non-destructive imaging technique.
- This technique gives us an cross sectional images « « slices ».
- The origin of this technique is a Radon Mathematical theorem



$$R[f(x,y)] = \int_0^{\pi} p(u,\theta)\, d\theta$$

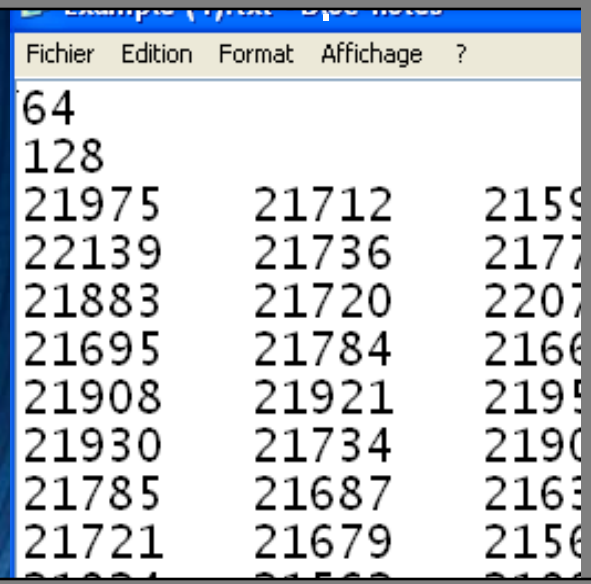
Tomography

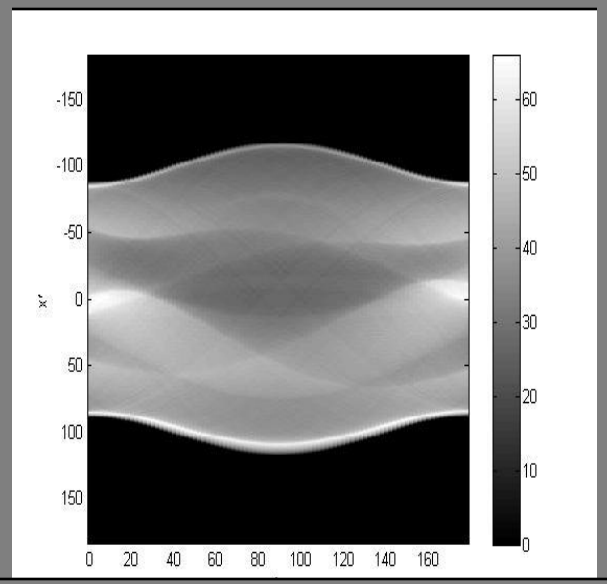
- When gamma rays are directed onto an object, some of the photons interact with the particles of the matter and their energy can be absorbed or scattered.
- Other photons travel completely through the object without interacting
- The number of photons transmitted through an object is depending on the thickness, density and atomic number of the material, and the energy of the individual photons.
- Number of detected photons depends also on a detector efficiency & collimation

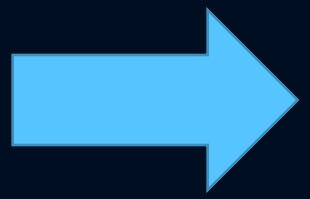


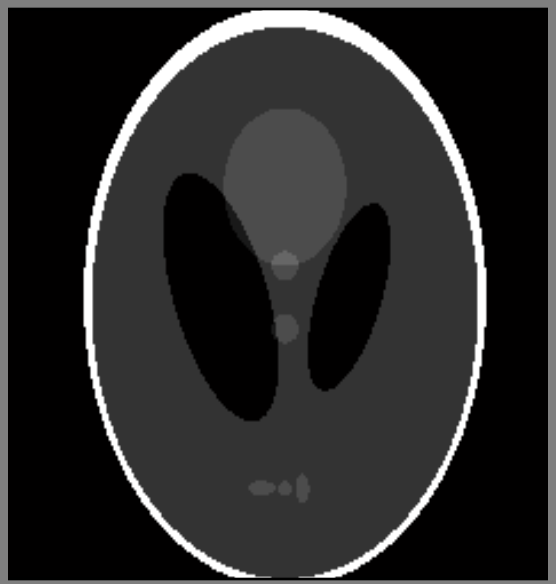
$$I = I_0 e^{(-\mu x)}$$

Tomography principle









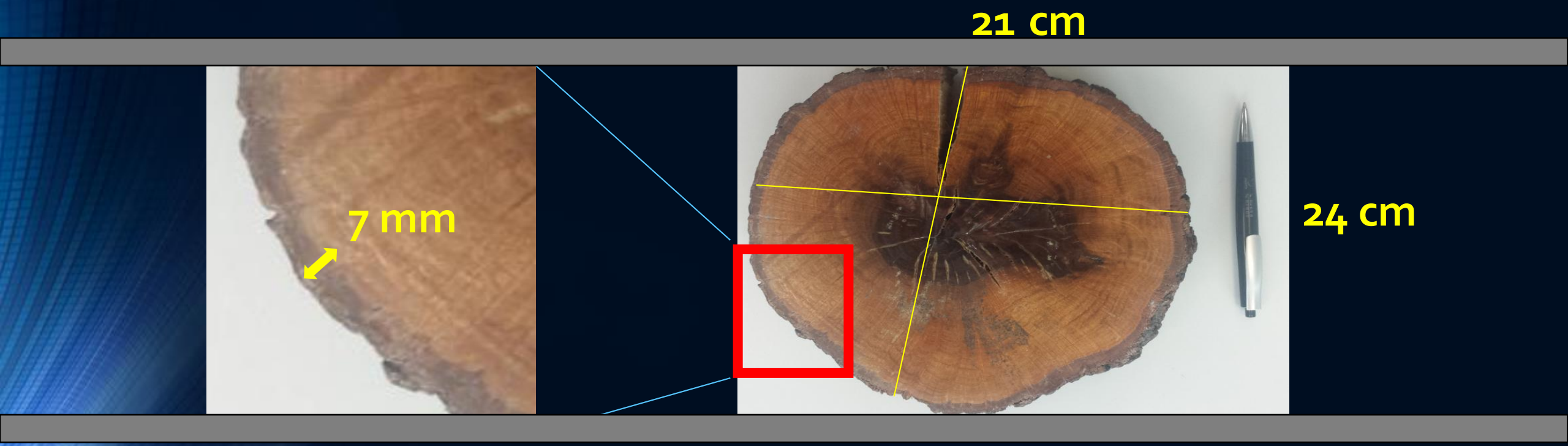
System used & materials

- GORBIT system – Electronic & mechanical solved problems
- French NaI detectors (TTL output)
- AM-241 & CO-60 sources (5mm collimation)
- iGorbit software for Reconstruction
- Matlab for image treatmants

- Cross section of an oak tree

Case studied

- Cork oak tree cross section



Experiments

CO-60 (1,17 & 1,32 MEV)

- 8 mCi

AMERI-241 (59 KEV)

- 500 mCi

	Rotation Step °	Translation Step (mm)	Sinogram Dim	Time
1st	11.25 °	2.5 mm		
2nd	11.25°	1.25 mm		
3rd	2.8125°	2.5 mm		

Image Reconstruction

- iGorbit sotware
- FBP method
- Cosine Filter

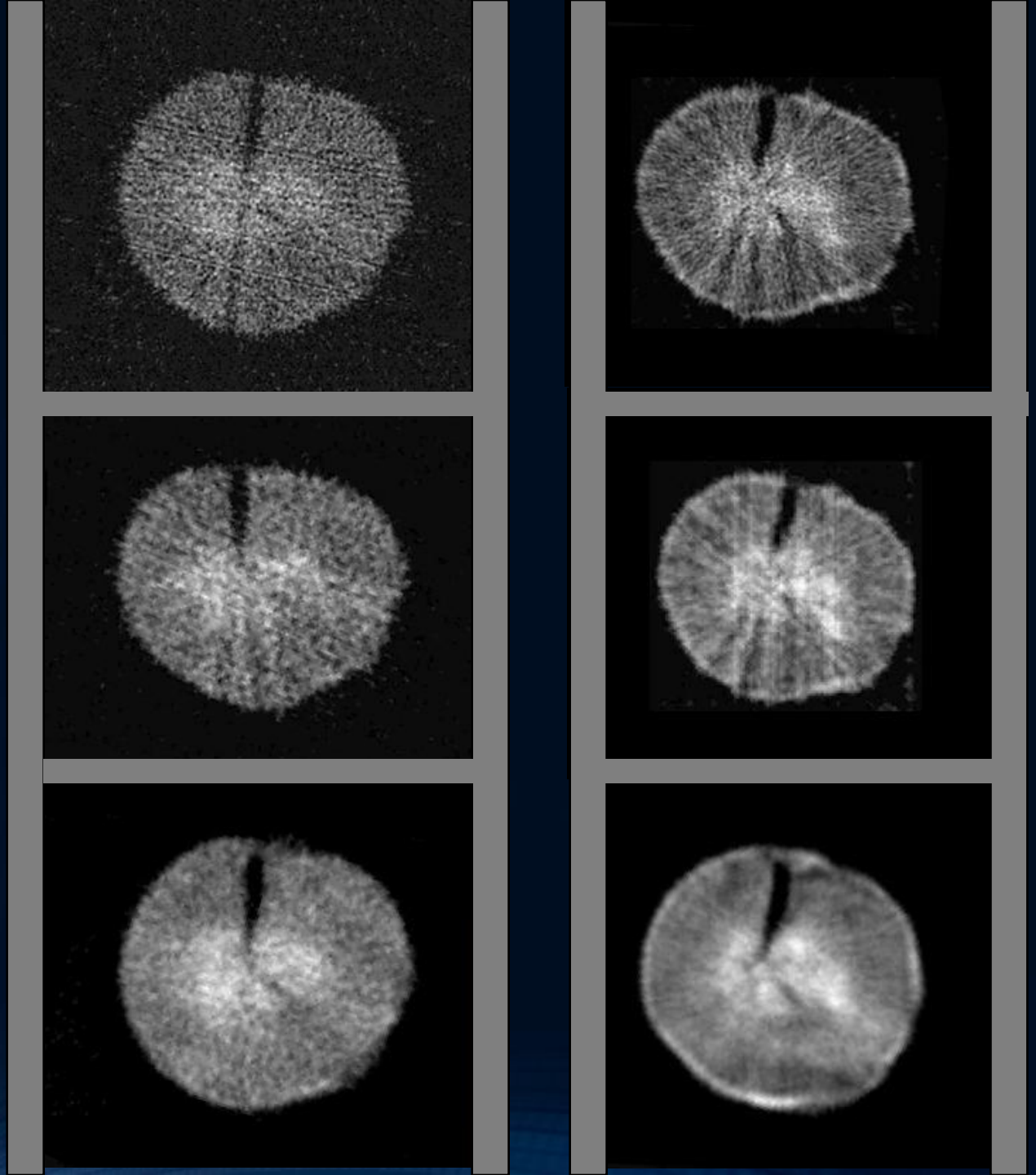
CO

AM

16 projections/ 2.5 mm

16 projections / 1.25 mm

64 projections/ 2.5 mm

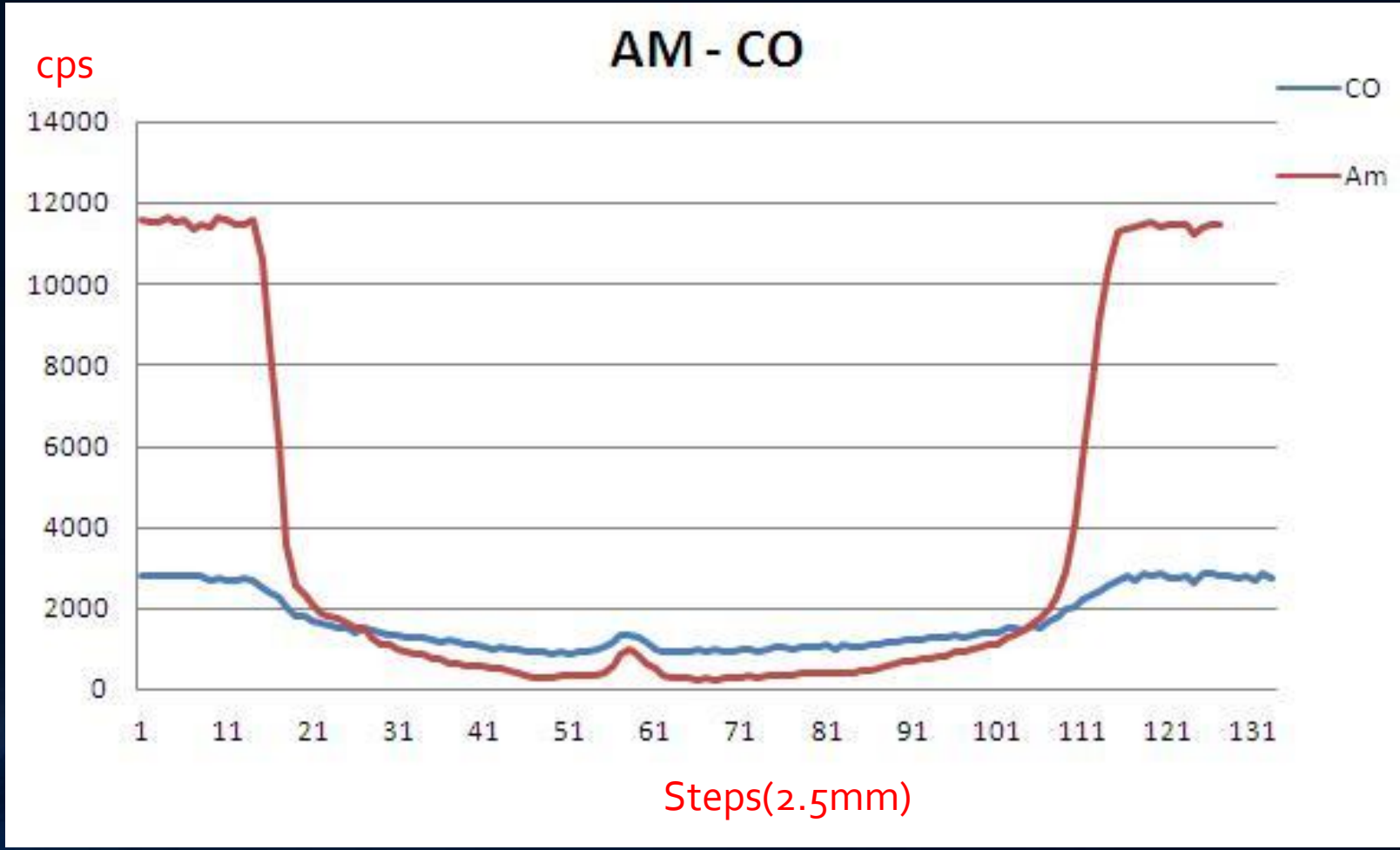


AM vsCO

Am

Max=11240
Min=260

Ratio=43

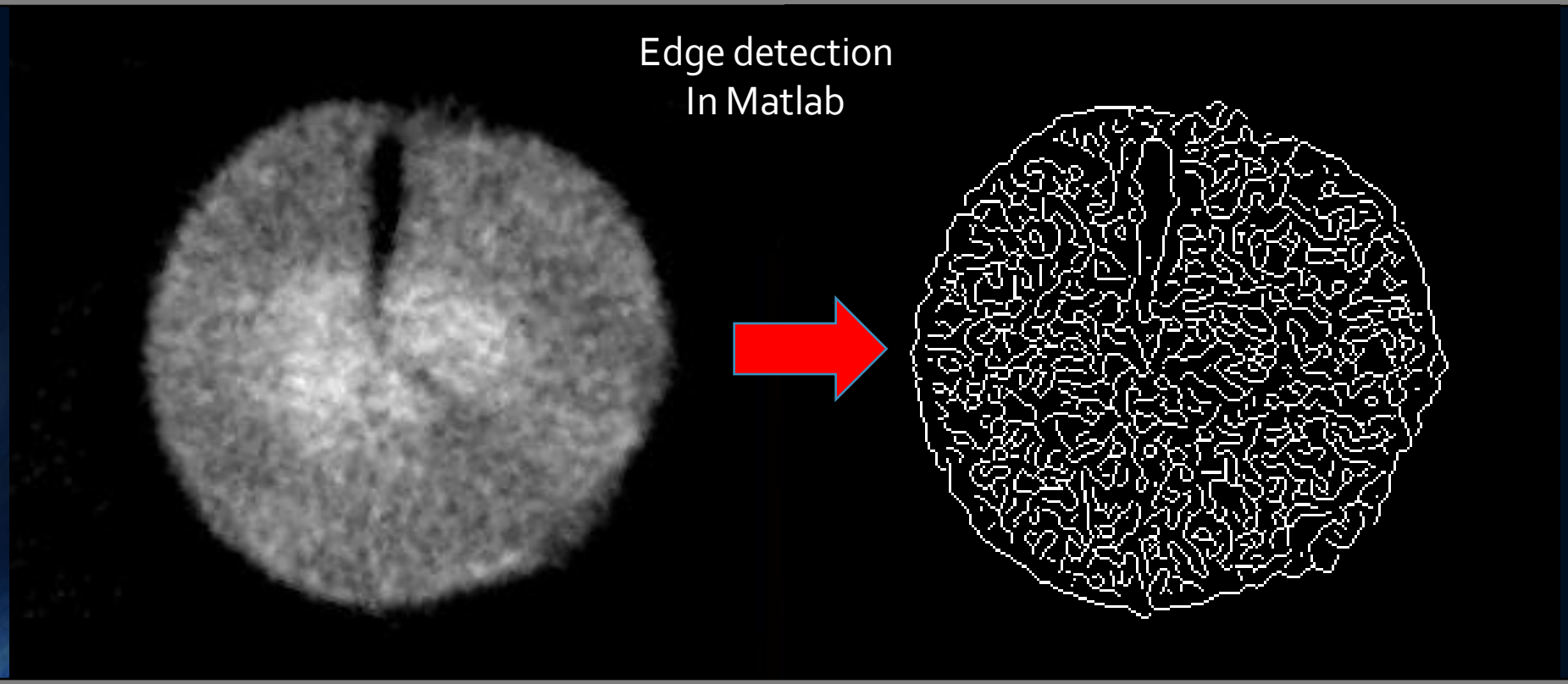


Co

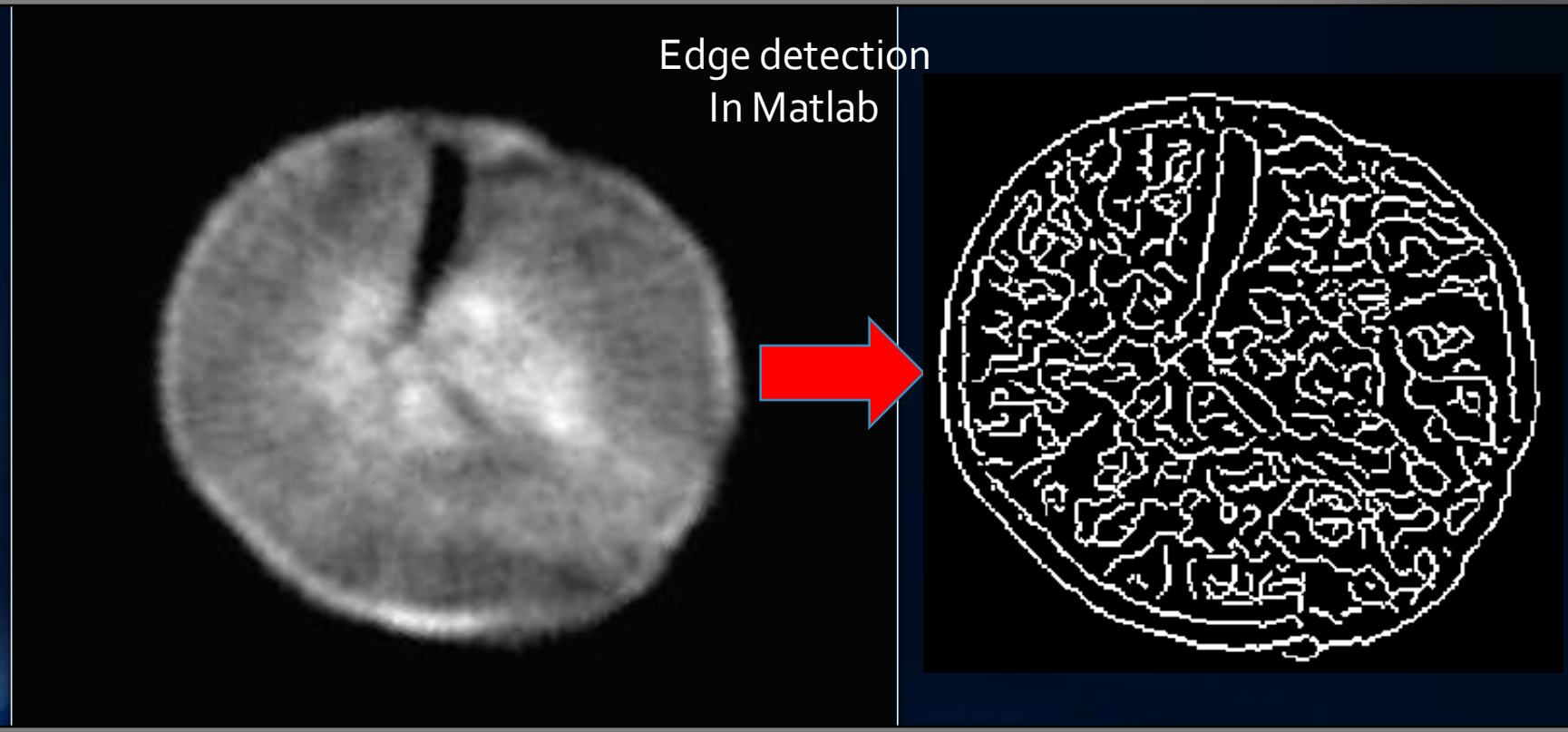
Max=2845
Min=878

Ratio=3

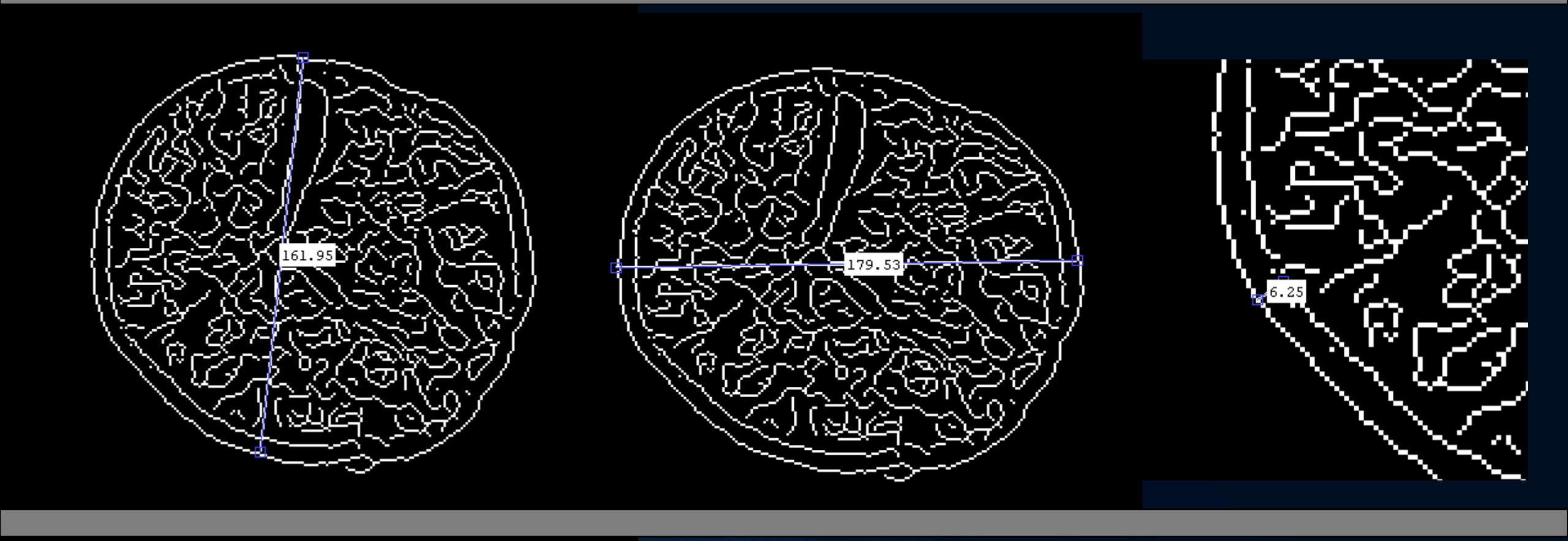
Results Traitment



Results Traitment



Matlab Imaging Tools



Thickness obrained

Real scale

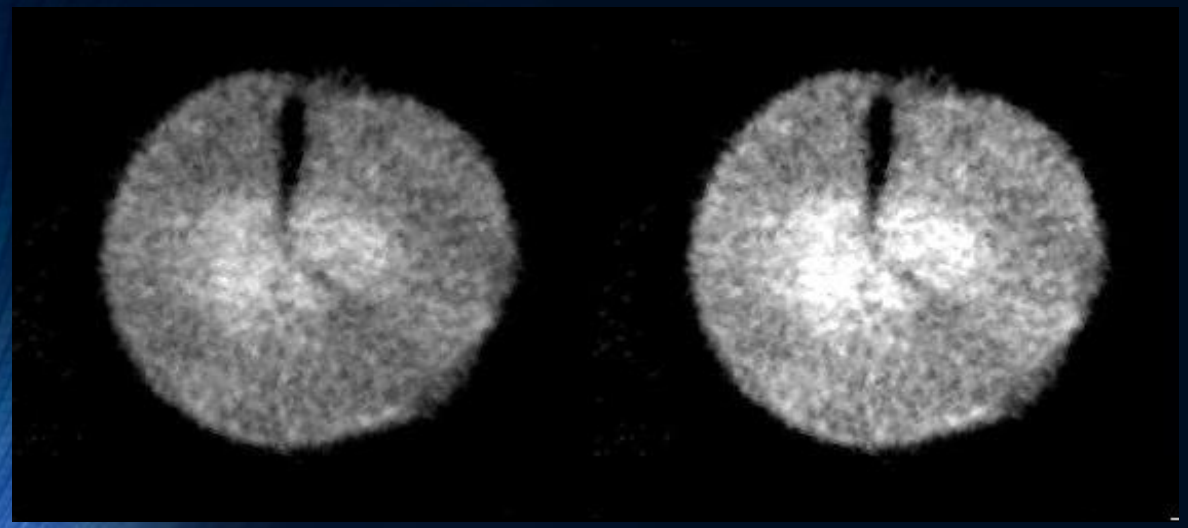
Relative scale

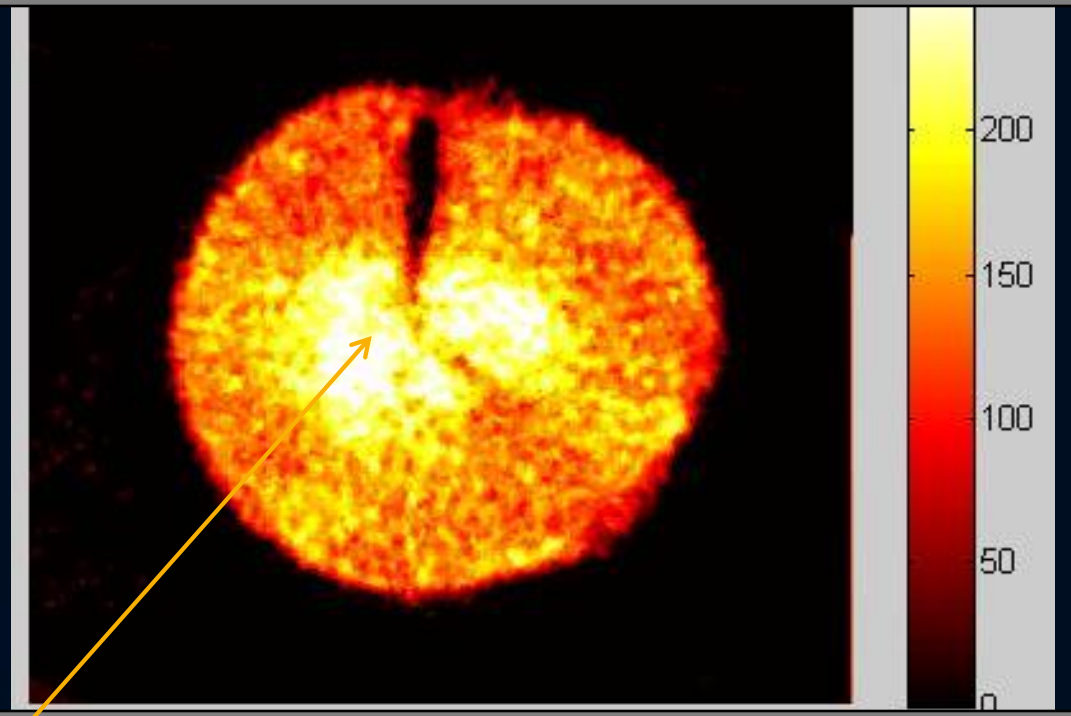
	Real values	Measured by Matlab
D1	21 cm	161.74
D2	24 cm	179.53
E	7 mm	**6.25**

23.28 cm

8 mm

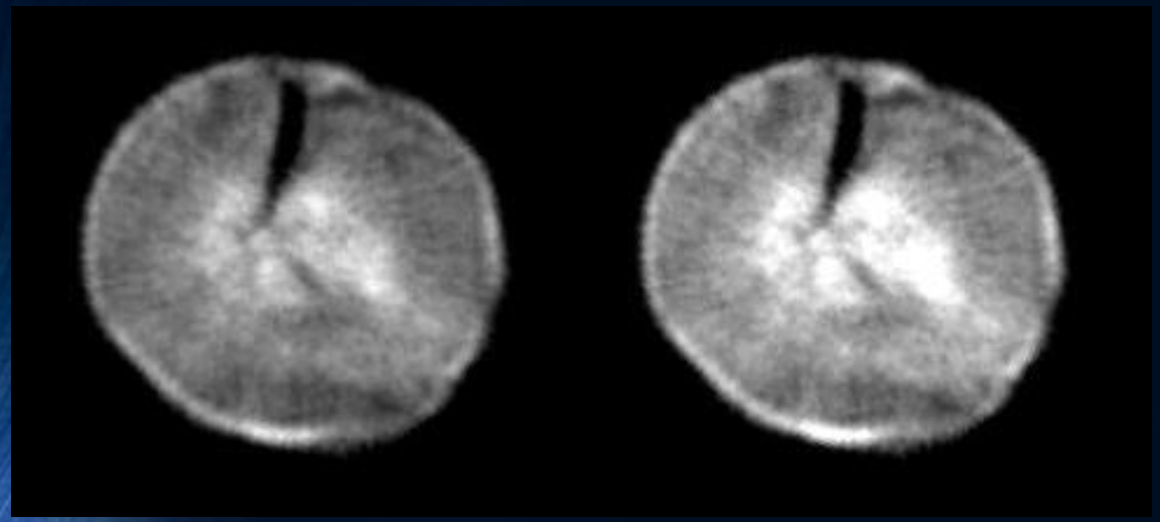
Density Comparaison

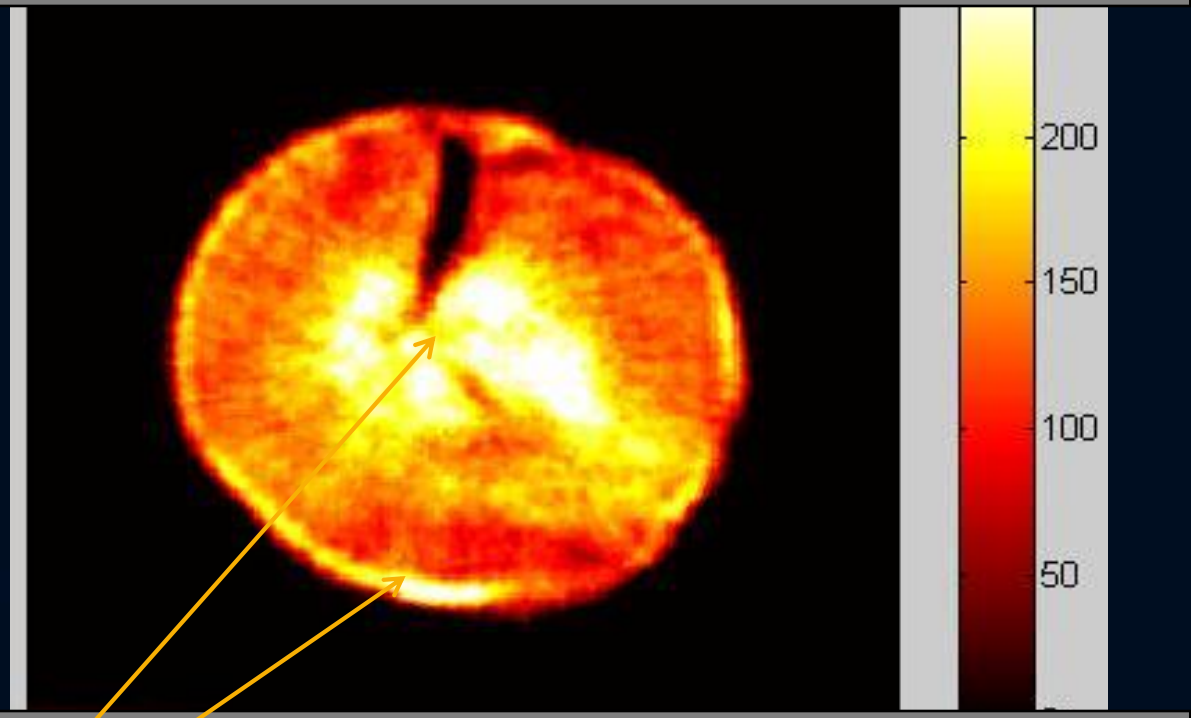




High density

Density Comparaison





High densities

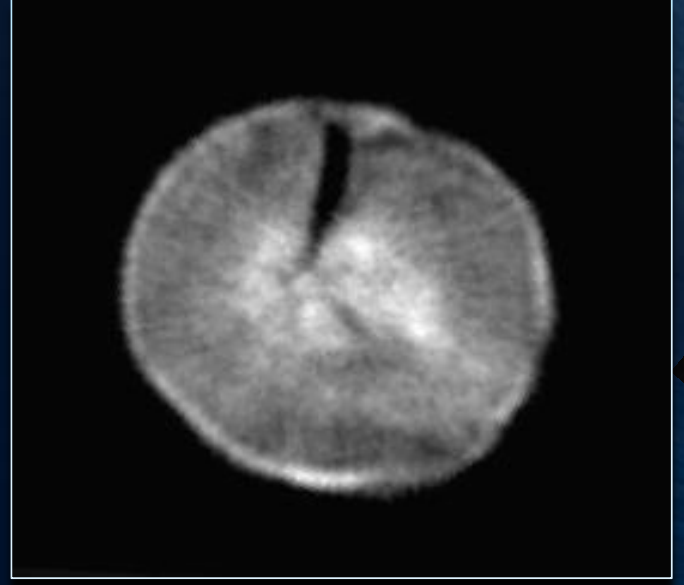
Another image is obtained

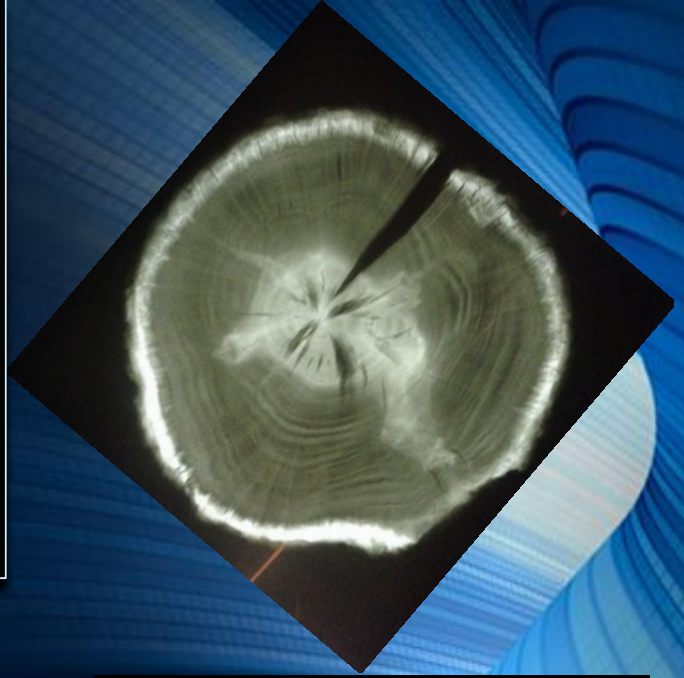
- X ray source
- 70 KV
- 3mA
- 30s

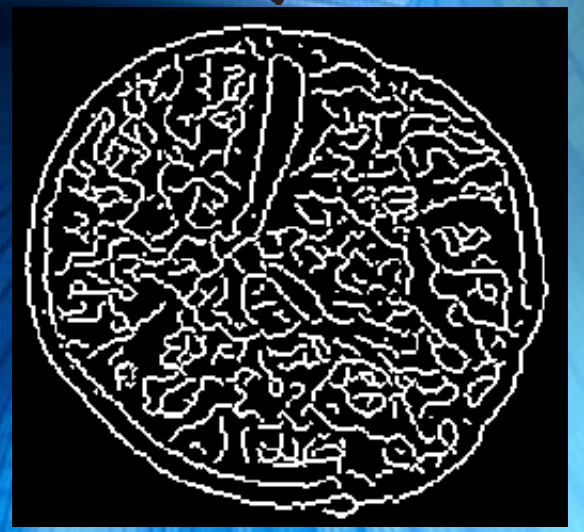
Conclusion

- Am is better for studying the wood
- We can measure the thickness of cork oak trees by CT
- We can observe the density variation
- Datation with tomography?? More resolution

Thank you







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