



National and Kapodistrian
UNIVERSITY OF ATHENS

Department of Physics
NUCLEAR & PARTICLE PHYSICS SECTION



Optical and Infrared Tomography in Medical Physics

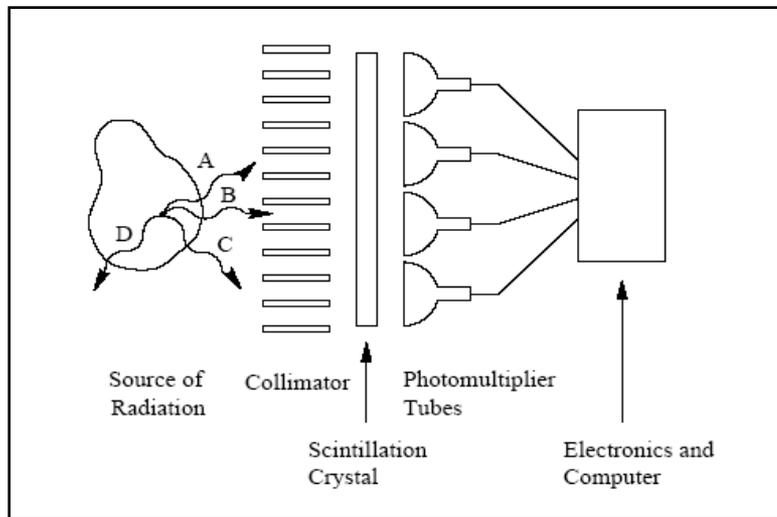
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M. Zioga, M. Mikeli, D. Thanasas and E. Stiliaris

Athens 2012

γ -Camera in SPECT modality

γ -Camera System (principle of operation)



Small Field γ -Camera System



Thermal Camera System



Model Thermovision[®] 550 (AGEMA Infrared Systems) with a built-in 200 lens in the form of high resolution color images (250x188 pixels) .

- It can be used to detect the thermal signatures of objects.

CCD camera



- Model: American Dynamics ADC733 Camera, 1/3", color, DSP, 330 TVL, 0.5 lux, NTSC, 24 VAC/12 VDC

- A simple commercial CCD camera cable of detecting visible light.

Triple Modality



Can provide functional information about tissue abnormalities and identify them with less or even with no radiotracers in some spatial cases (thermal/optical screenings for breast cancer).

Experimental Procedure

- Recorded from 0° – 360° 24 projections with a step of 15° .
- Every projection was sliced 20-30 times along the Z-axis after taking into account energy cuts / offsets in order to reduce the background noise (Compton, thermal or optical).
- Using accelerated ART algorithm for each z-level the tomographic image was reconstructed.
- All the tomographic images were contour plotted creating a 3-D image.

SPECT Imaging

- **Phantom**: 5 different tubes, filled with ^{99m}Tc solution of special concentration **0.25mCi/ml**, immersed in an agar-gel “water-like” solution
- Examination of the system’s quality of projection images, produced by low activity radiation in scattering conditions due to the gel medium.

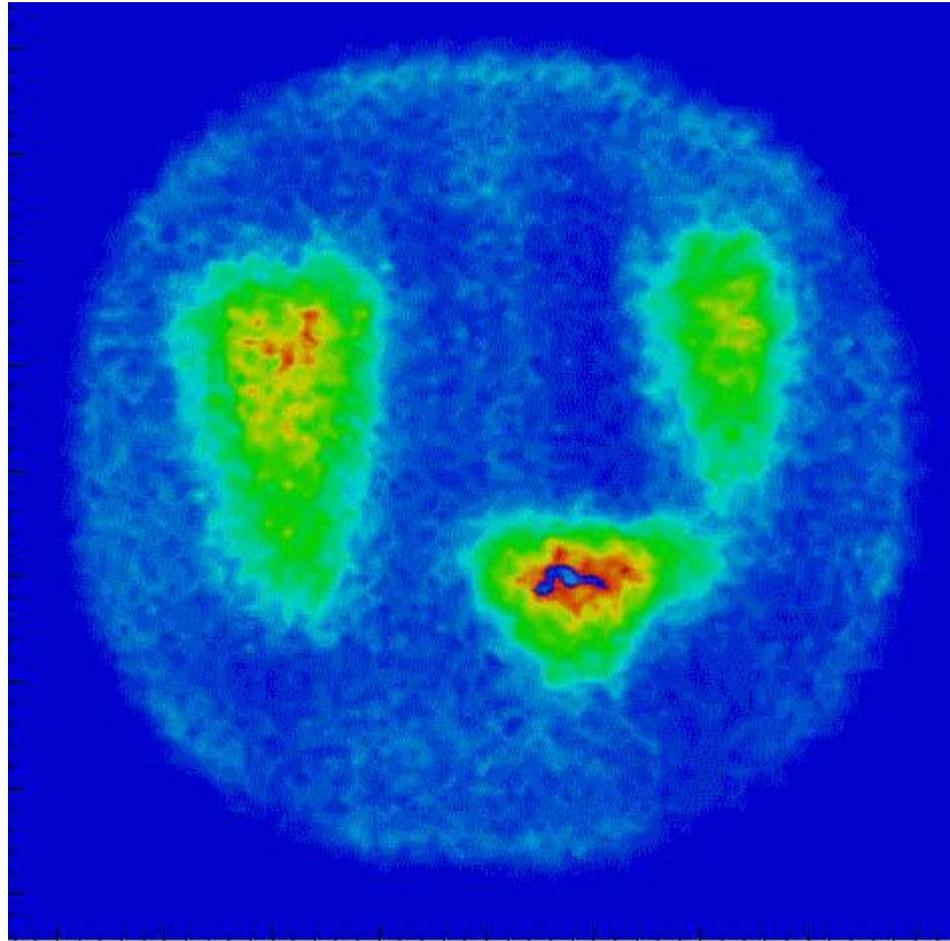
From the side



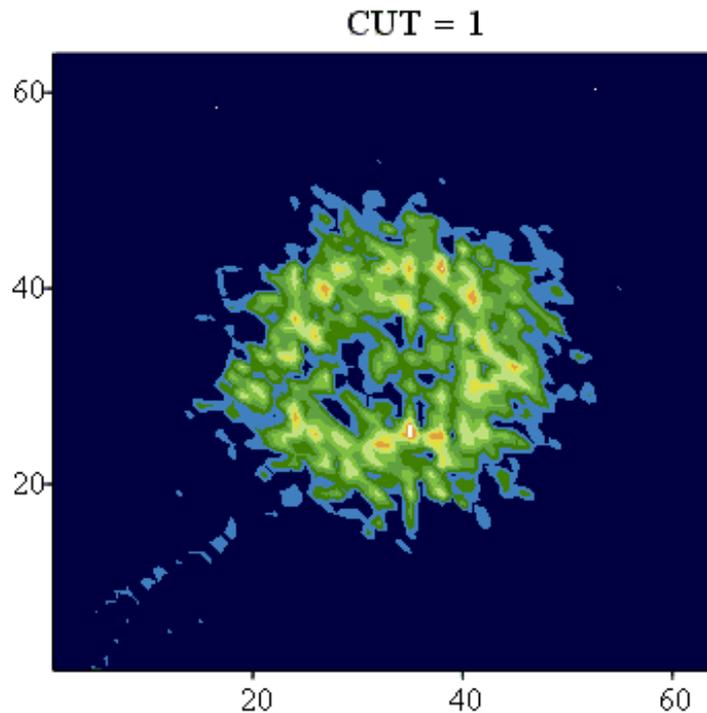
From Above



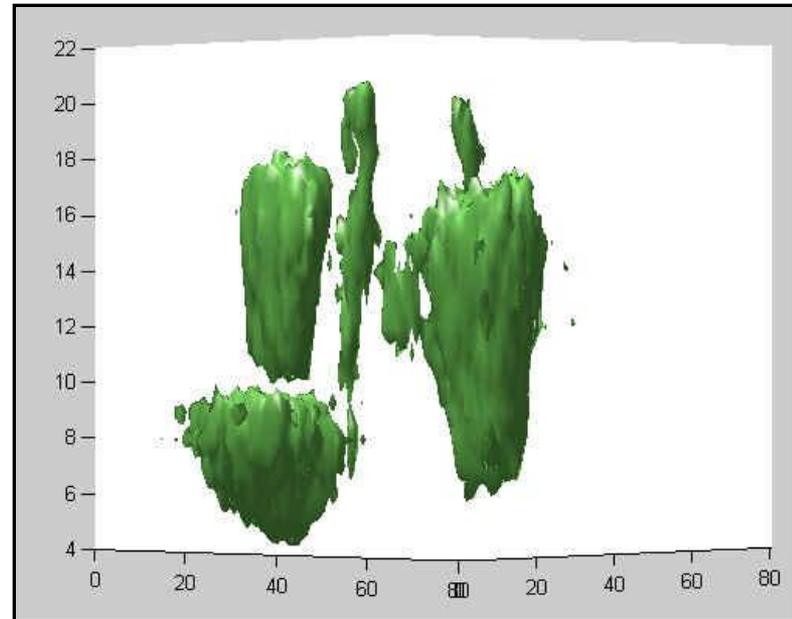
Experimental Gamma Planar Images



2-D (tomograms) and 3-D Reconstructed Images



A.R.T Reconstructed Images
Along the Z-axis



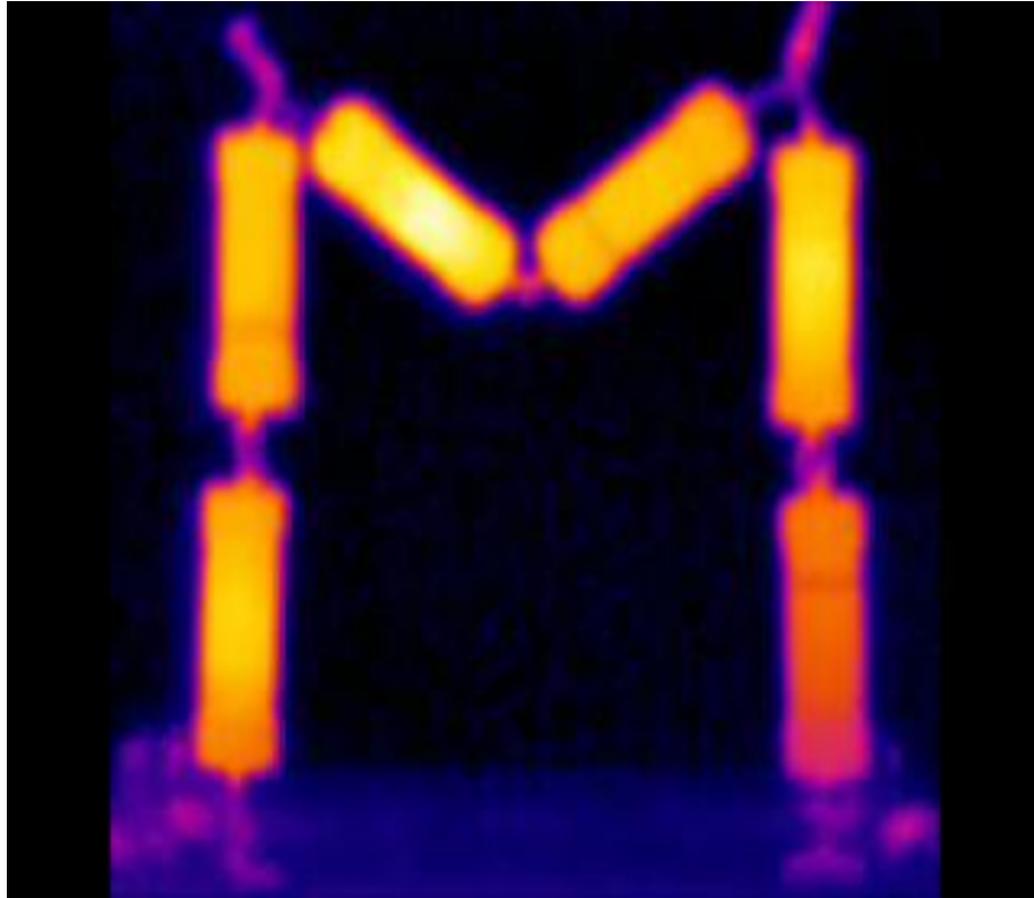
The tomographic levels have been reconstructed using the ART method then they contour plotted for the 3-D representation of the results.

Thermal Imaging

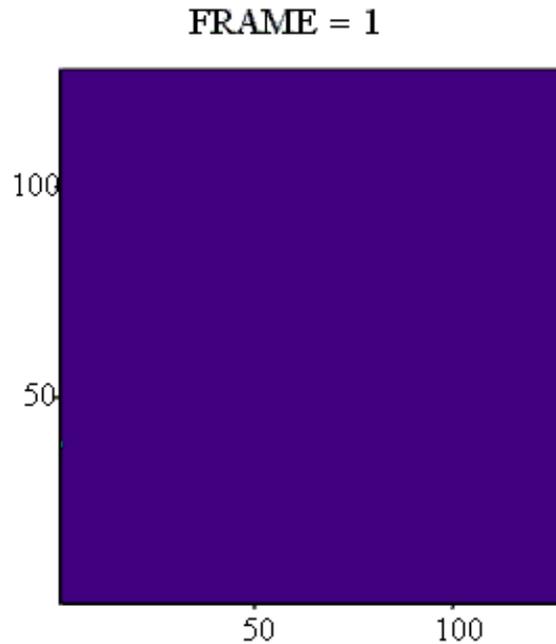
- **Phantom**: six resistances grouped in three pairs of 100 Ω and 50 Ω and alternately connected in series. They are morphed to shape the capital letter “M”, leaving the middle resistor pair out of plane.
- The selected temperature scale was mammal’s core temperatures (35-40 °C)



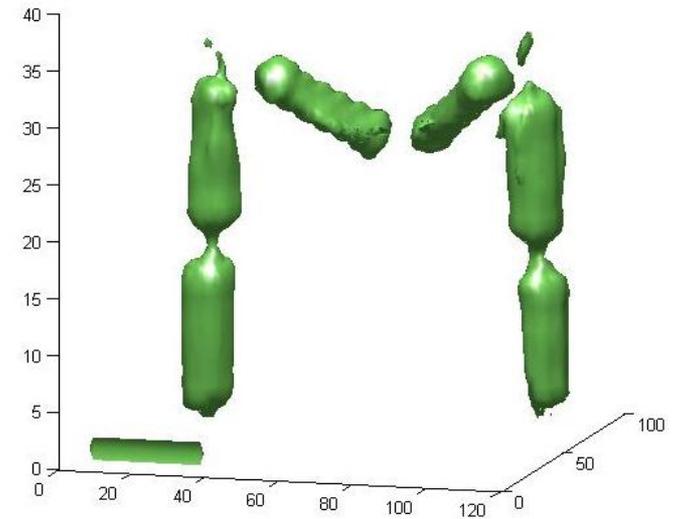
Experimental Thermal Planar Images



2-D (tomograms) and 3-D Reconstructed Images



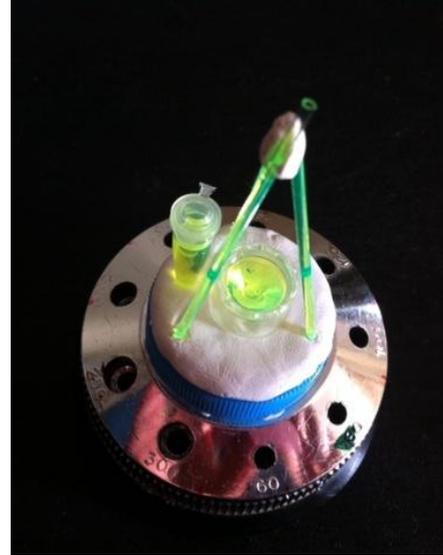
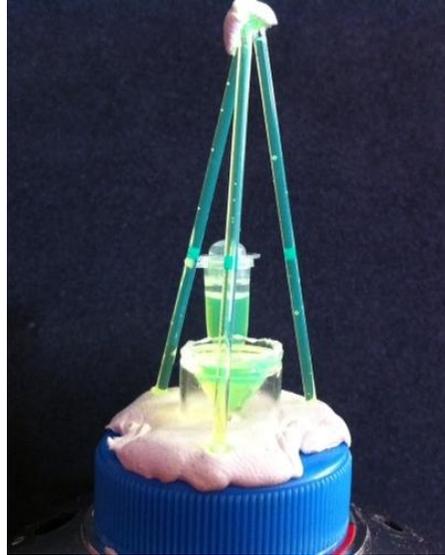
A.R.T Reconstructed Images
Along the Z-axis



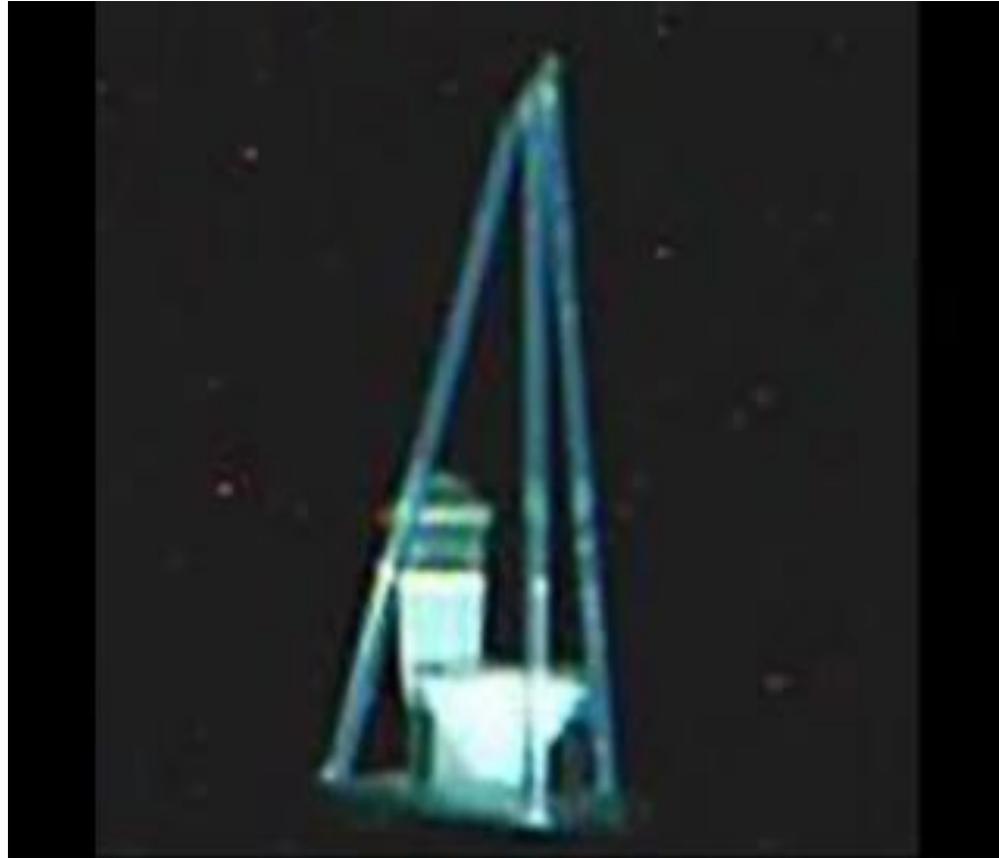
The tomographic levels have been reconstructed using the ART method then they contour plotted for the 3-D representation of the results.

Optical imaging

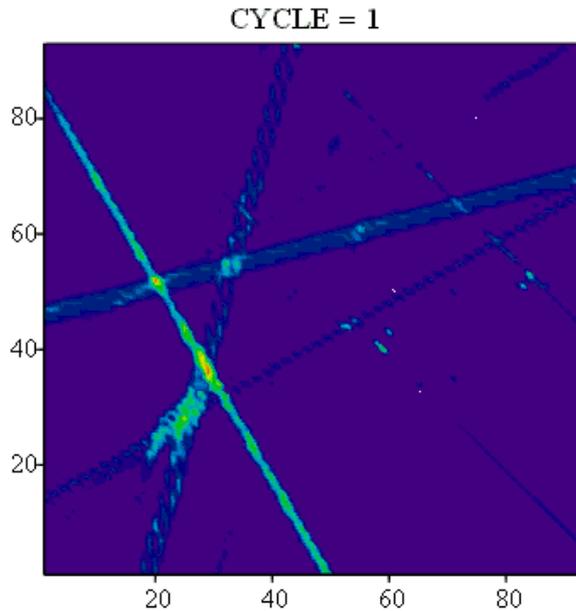
- **Phantom:** Three capillaries sapping a triangle pyramid and two cyli-dro-conoidal tubes on and of axis, all field with fluorescent liquid (Cyalume) capable of emitting on green.



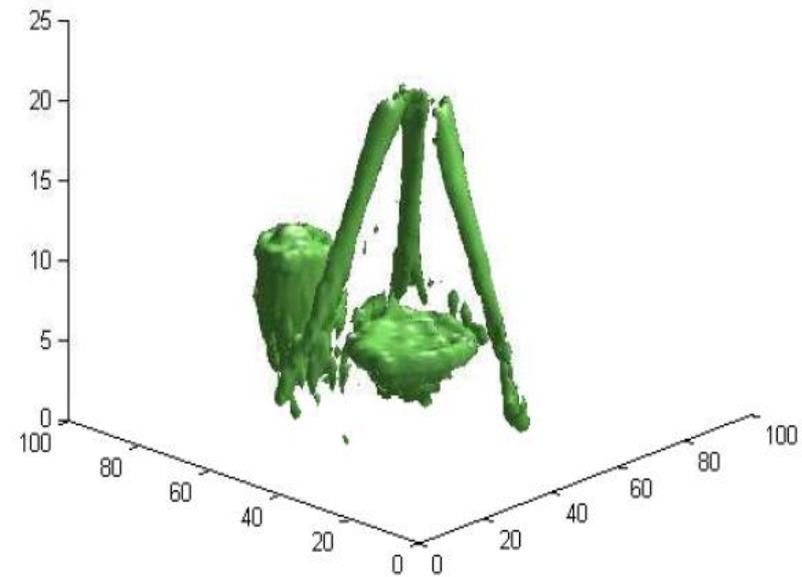
Experimental Optical Planar Images



2-D (tomograms) and 3-D Reconstructed Images



A.R.T Reconstructed Images
Along the Z-axis

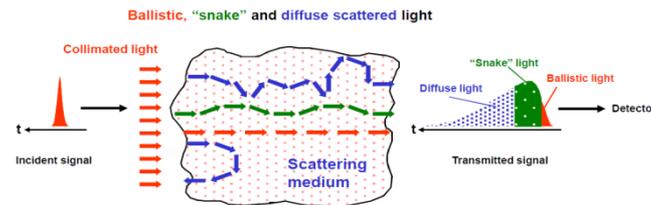


The tomographic levels have been reconstructed using the ART method then they contour plotted for the 3-D representation of the results.

Conclusions and Future Plans

- Two modalities added to SPECT.
- Satisfactory planar images of similar complication in each phantom were obtained.
- The reconstruction algorithms were efficient in all the cases.
- Experimentation on thermal and optical phantoms with background noise.
- Time-Resolved Optical Computed Tomography.

Time-resolved propagation through scattering media



earliest arriving ballistic light ($< \sim 1$ ps) \Rightarrow diffraction-limited resolution (~ 0 m)

next arriving snake light ($< \sim 100$ ps) \Rightarrow degraded resolution (10's – 100's μ m)

later arriving diffuse light ($> \sim 100$ ps) \Rightarrow severely degraded resolution (cm)

