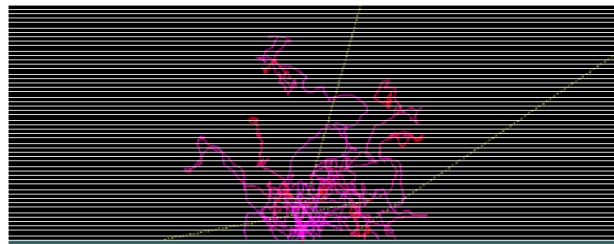


About this presentation

- Introduction to PENELOPE
- Application in breast tomosynthesis
- Project continuation



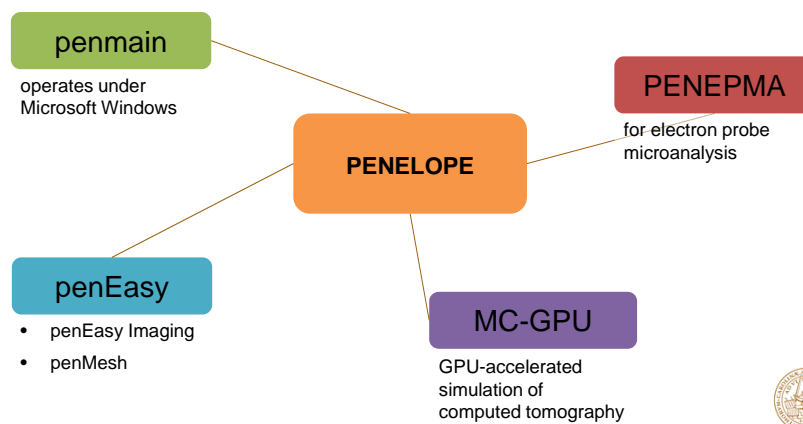
PENELOPE

PENetration and Energy LOss of Positrons and Electrons

- Free and open-source software
- Simulation of electron, photon and positron transport in arbitrary materials
- Energies from a few hundred eV to 1 GeV

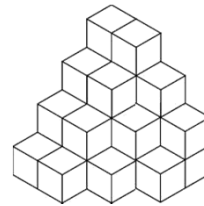
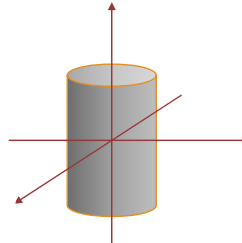
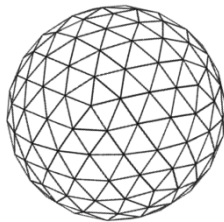


A code system: some adaptations



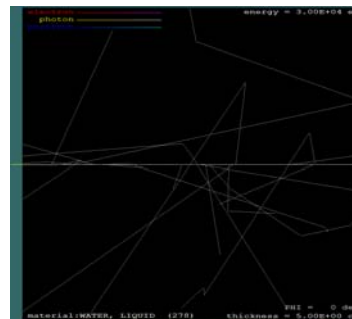
Geometric representations

- Quadric surfaces
- Voxels
- Triangle mesh



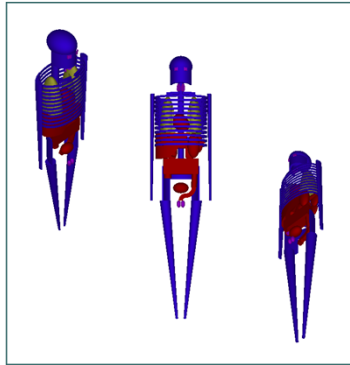
Related software tools

SHOWER: generates electron-photon showers within a slab



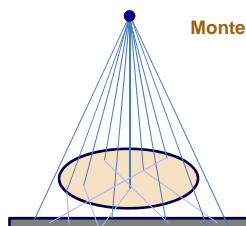
Related software tools

GVIEW2D and GVIEW3D: visualization of quadric geometries

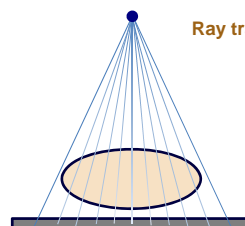


penEasy Imaging

- Combines quadric and voxel geometries
- Three source models
- Tally examples:
 - absorbed dose
 - energy deposition and pulse height spectrum
 - fluence
 - radiographic images:**



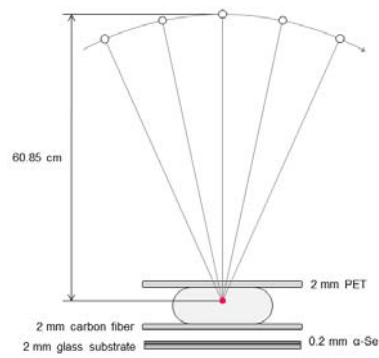
Monte Carlo



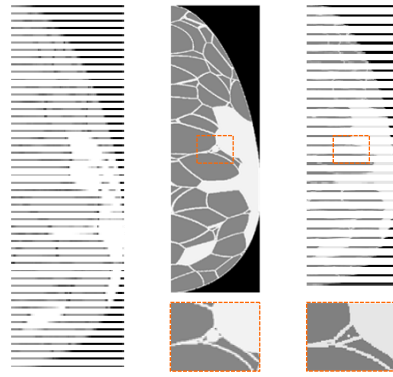
Ray tracing



Application in breast tomosynthesis



MAMMOMAT Inspiration
(Siemens Healthcare)



Voxel breast phantom



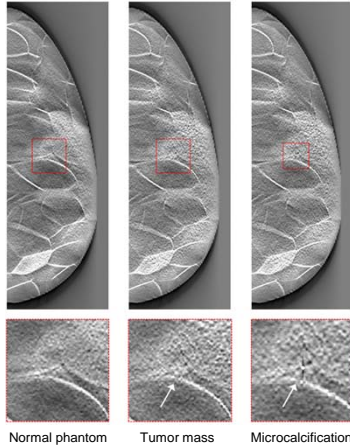
Application in breast tomosynthesis

Simulation of BT in penEasy Imaging:

- Combination of ray tracing and Monte Carlo
- Point source, 19.3 keV (mean 29 kV spectrum energy)
- No simulation of charged particles
- Ideal detector
- Image as only output



Application in breast tomosynthesis



- Ray tracing: 1 h
- Monte Carlo: 2.5 h

→ 25 projections in little over three days



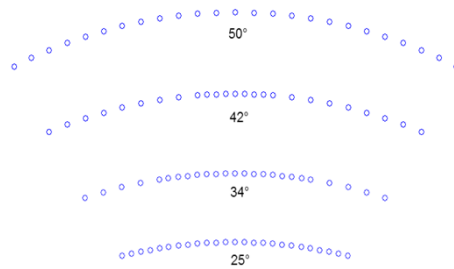
Project continuation

- Accelerate the simulations with MC-GPU
- Compare simulated and measured images
- Include system noise
- Use more realistic models of breast and lesions



Project continuation

- Optimization of breast tomosynthesis with respect to:
 - dose level and dose distribution among projections
 - tube voltage per projection
 - angular range and projection distribution



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