A-18

GPU ENABLED IMAGE RECONSTRUCTION FOR EMISSION TOMOGRAPHY

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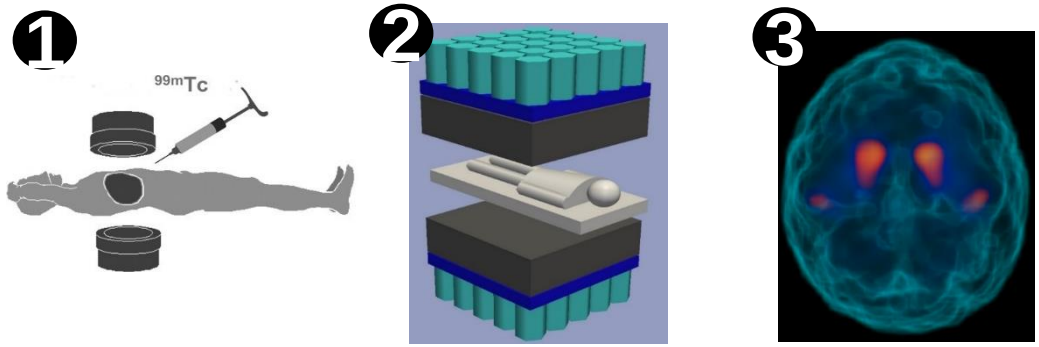
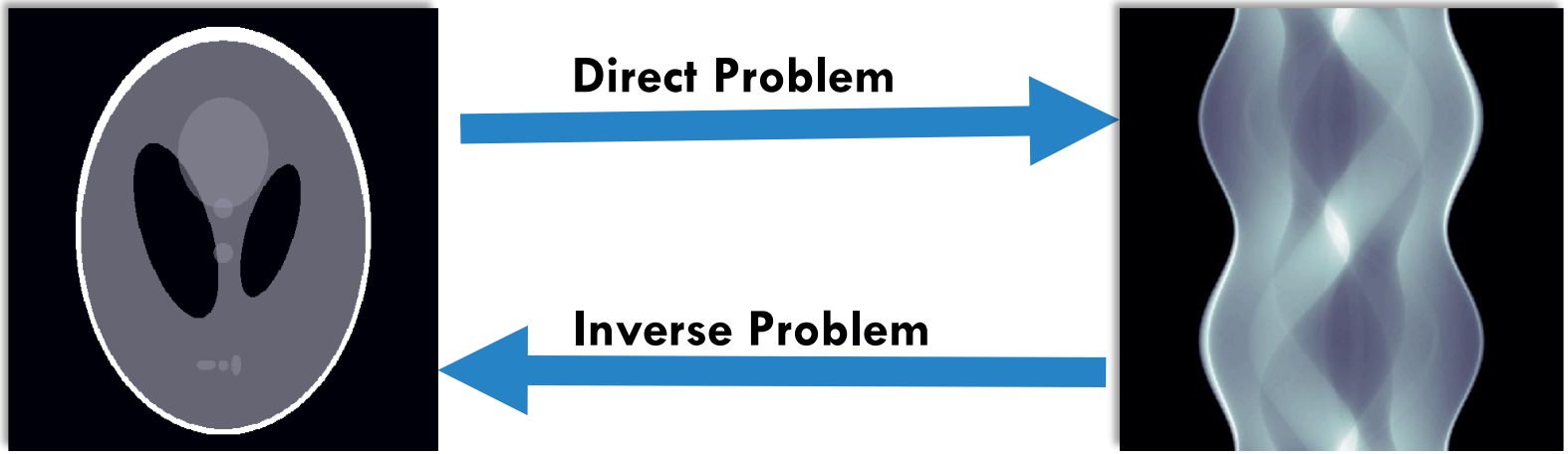
SINGLE PHOTON EMISSION COMPUTED TOMOGRAPHY: AN INVERSE PROBLEM

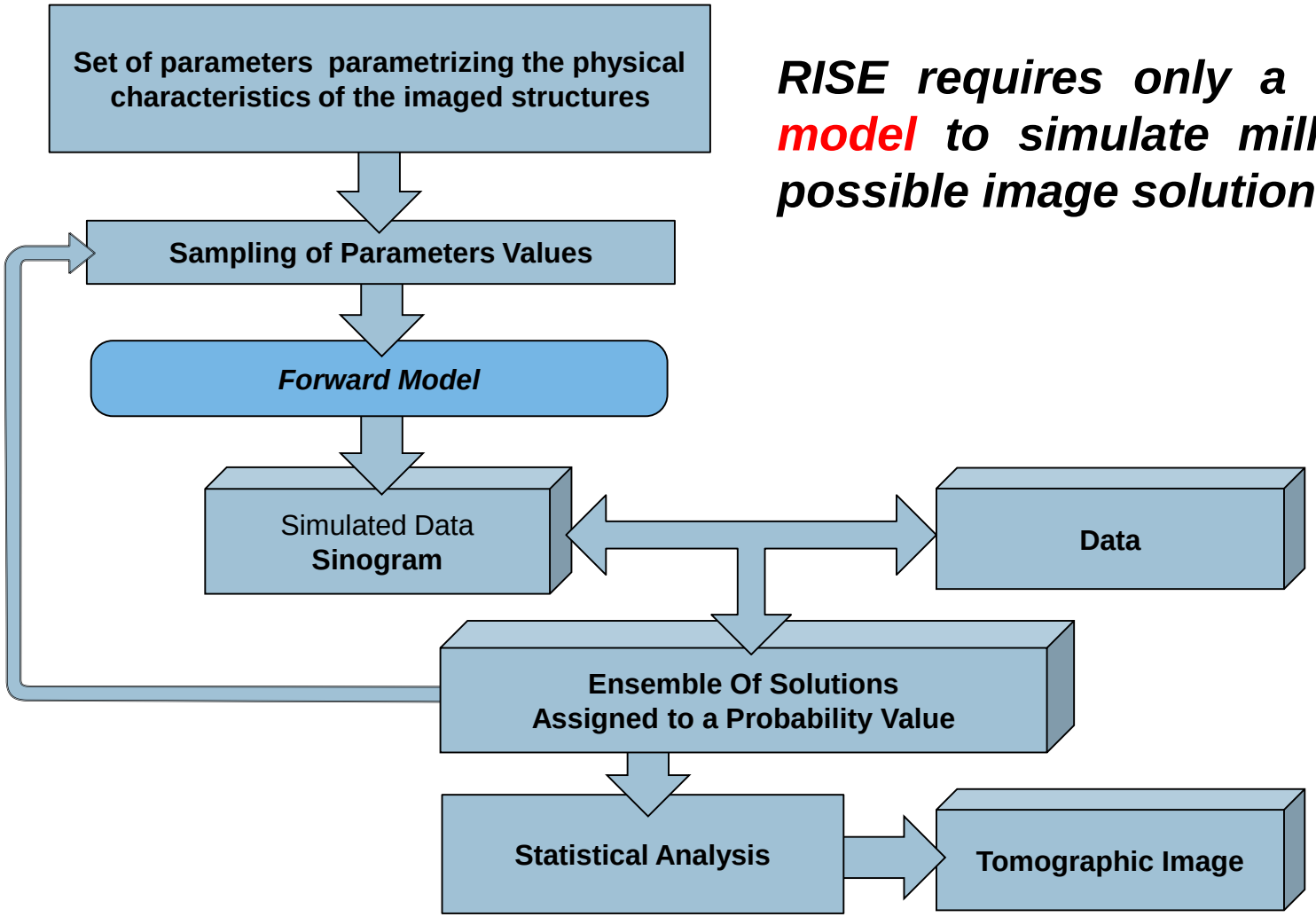




Object: Tomographic (or volumetric) image

Data: Projections of the activity distribution at different angles

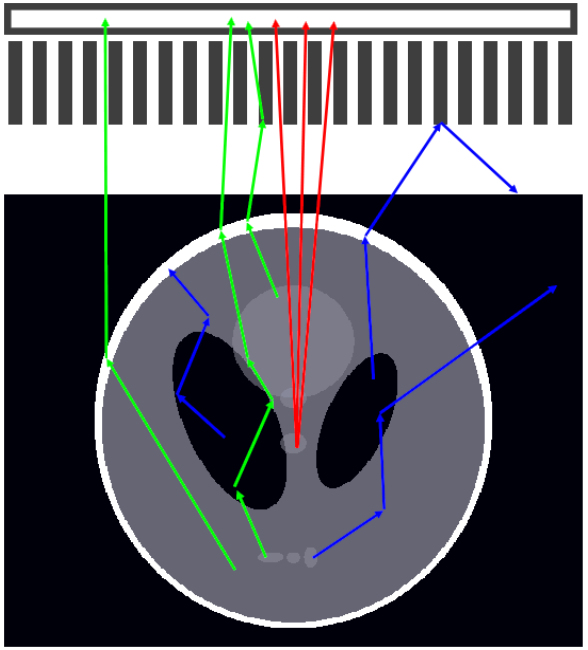
IMAGE RECONSTRUCTION FROM SIMULATIONS ENSEMBLE (RISE)



RISE requires only a forward model to simulate millions of possible image solutions.

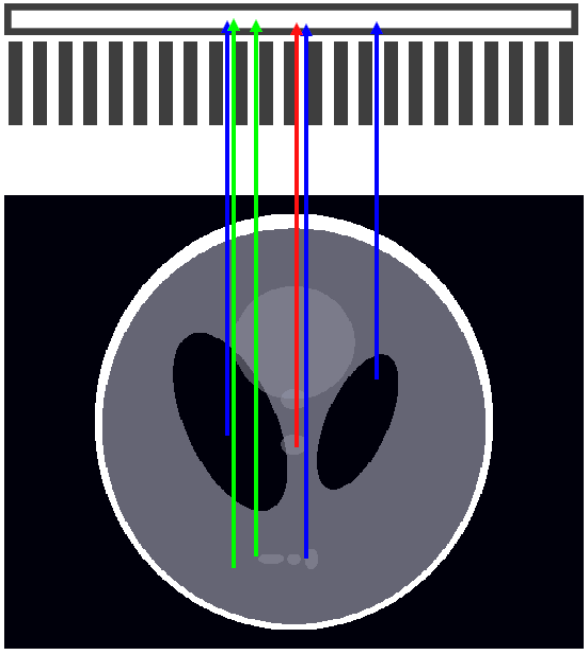
THE FORWARD MODEL

Model A:
A stochastic (GATE) model



- Simulation of the physical processes determining the propagation of photons in the body:
    1. Photon Absorption
    2. Compton Scattering

Model B:
A geometrical ray-tracing model



- Analytic calculation of ray sums emitted from the voxels/pixels.
- Does not model stochastic procedures such as multiple scattering.

CPU VS GPU IMLEMENTATION

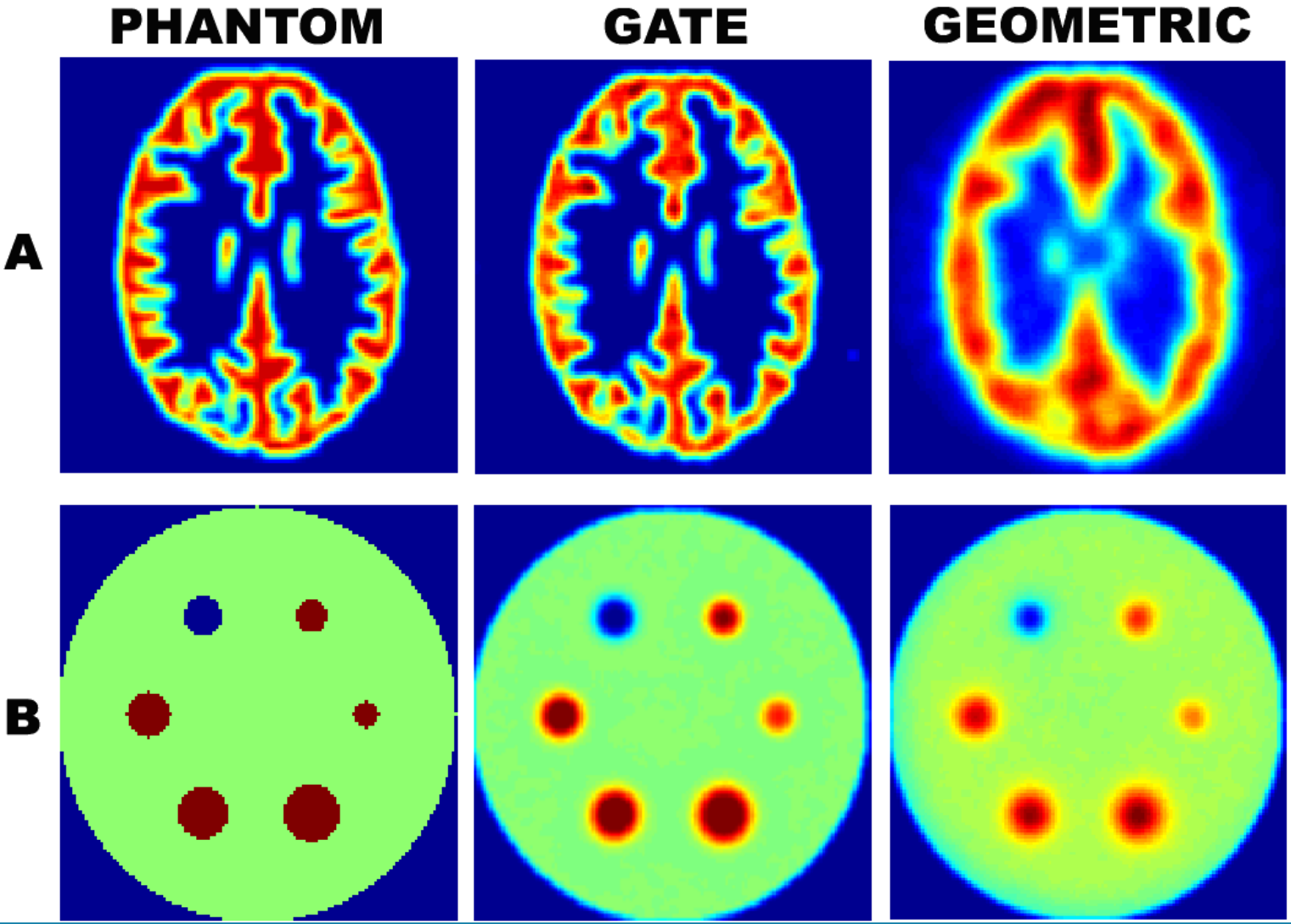
Construction of the ensemble of solutions

UNIT	NUMBER OF PROC. UNITS	PROJECTIONS	IMAGE SIZE	NUMBER OF SOLUTIONS	AVERAGE PER SOLUTION (s)
CPU Xeon X5650 2.7 GHz 48GB RAM	6 (36 cores)	48	128^2	$3 \cdot 10^6$	0.004
GPU Geforce RTX 2080 Ti 11GB GDDR6	1	48	128^2	$3 \cdot 10^6$	0.0001

Forward Model Construction (CPU Xeon X5650 2.7 GHz 48GB RAM)

FORWARD MODEL	NUMBER OF PROC. UNITS	PROJECTIONS/RAYS	IMAGE SIZE	NUMBER OF PHOTONS	TOTAL SIMULATION TIME
A. Stochastic/GATE	40 (240 cores)	48x182	128^3	$12 \cdot 10^9$	2880 h
B. Geometric	6 (36 cores)	48x182	128^2	--	7 s

RECONSTRUCTION RESULTS



CONCLUSIONS

- The GATE forward model led to a higher image reconstruction accuracy and improved image contrast.
- Scattering and background effects are absent in the images reconstructed with the GATE forward model.
- The utilization of GPU resources is necessary for the GATE simulation in real and preclinical case studies.