Introducing a new open-source tool: XCIST (X-ray-based Cancer Imaging Simulation Toolkit)

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Computed tomography (CT) related to cancer

- CT is widely used for cancer detection, diagnosis, and therapeutic response
- But, X-ray radiation from CT could potentially induce cancer
- Improvements to CT could **improve efficacy and reduce radiation dose**
- But, new ideas for improved CT can take years to develop and evaluate
- **Simulation** of new concepts could **speed development of improvements**

Solution

An open-access X-ray/CT simulator to make

accurate, fast, robust, simulation capability widely available

X-ray/CT simulation

Rigorous, physics-based method to predict the images that would be produced by a real (or a hypothetical) scanner

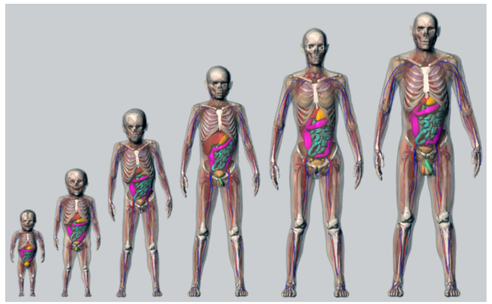
Scanner

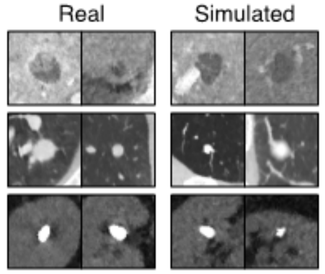
Hardware models (e.g. source, detector)

Physical process models (e.g. transport, detection)

Phantom (patient)

3D digital representation of patient with or without tumors





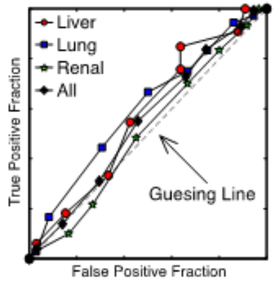
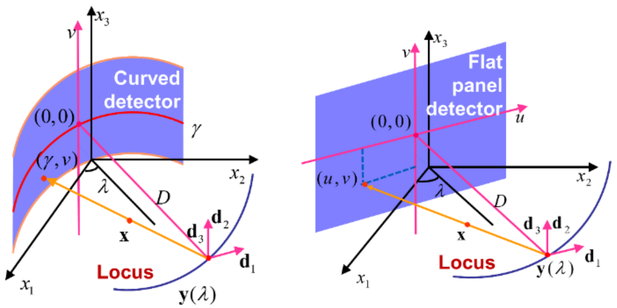


Image reconstruction

Produce 3D image volume from simulated projections



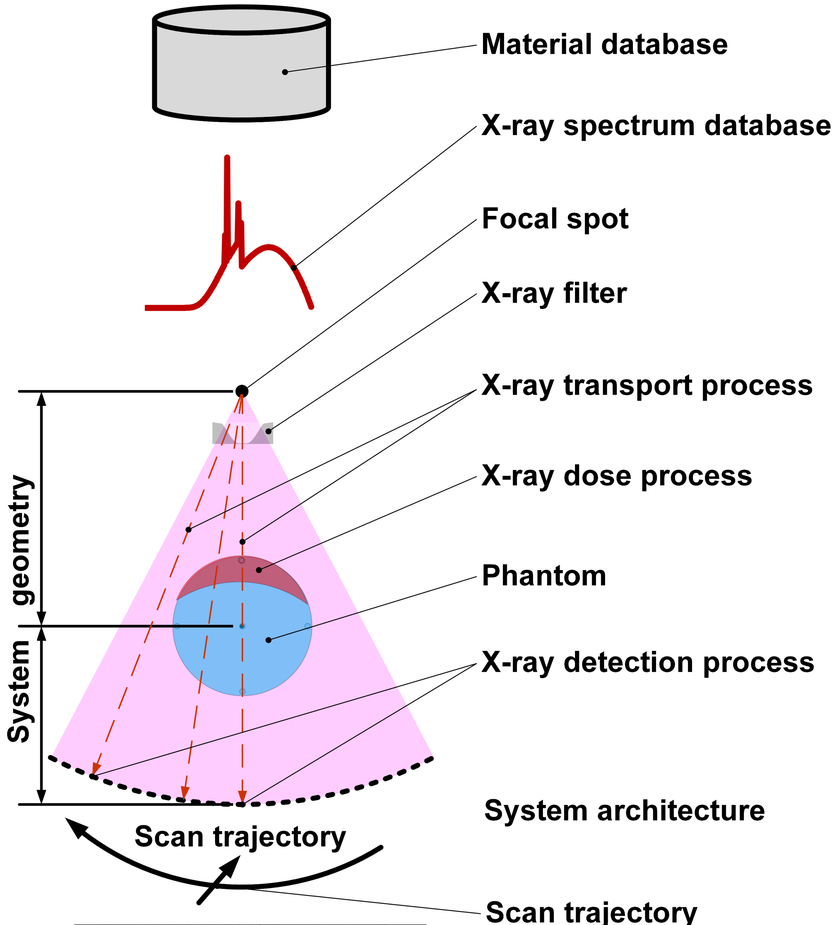
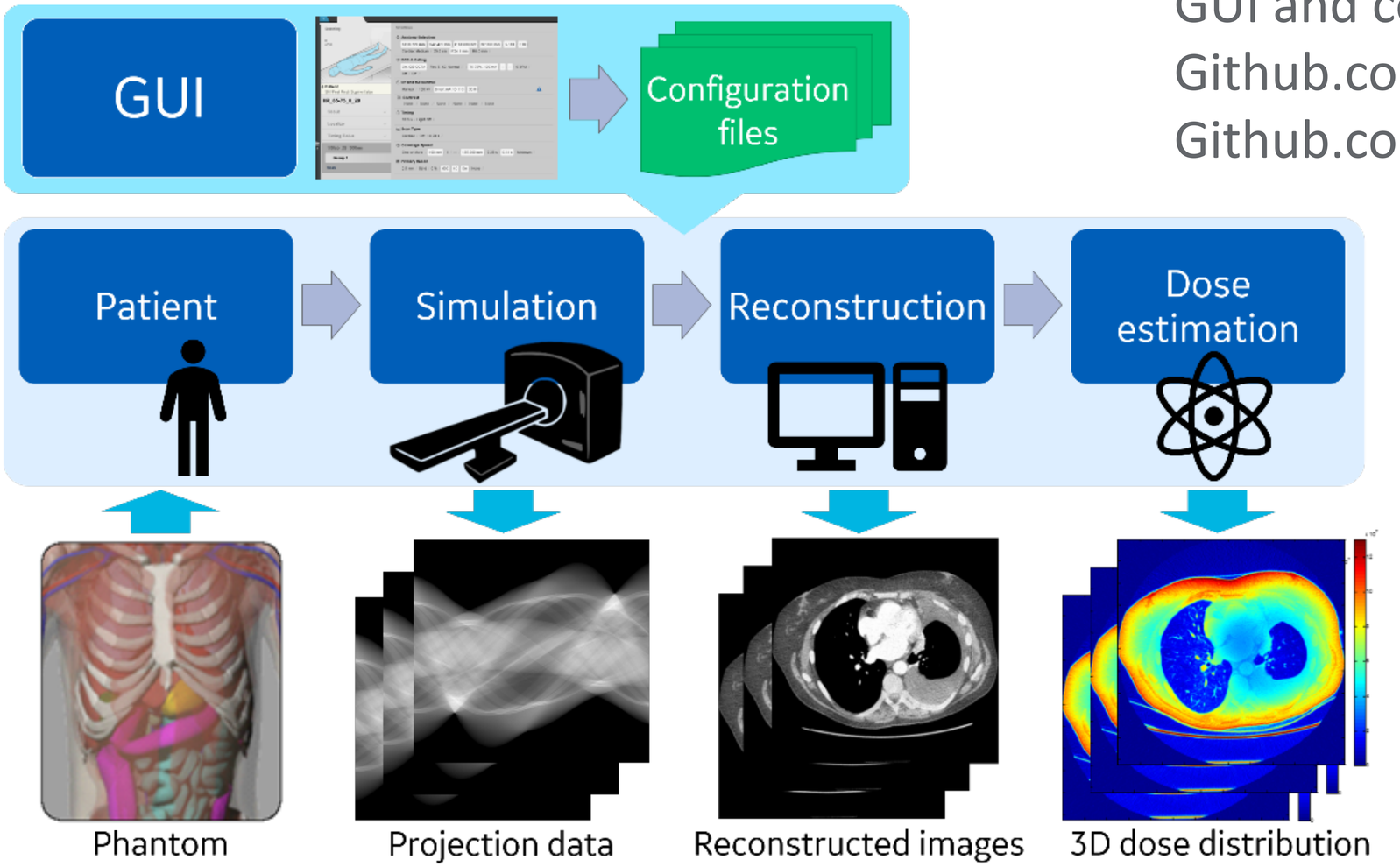
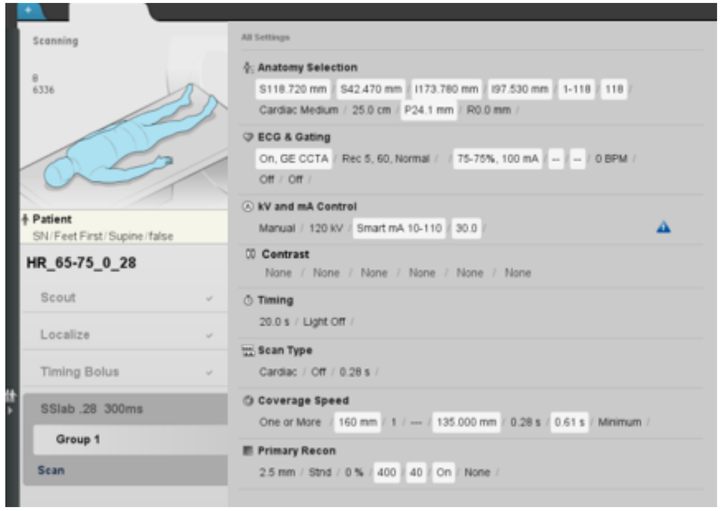


Image reconstruction

Software plan

High-level code: Python
Computationally-intense code: C/C++
GUI and command-line user interfaces
Github.com repository
Github.com documentation





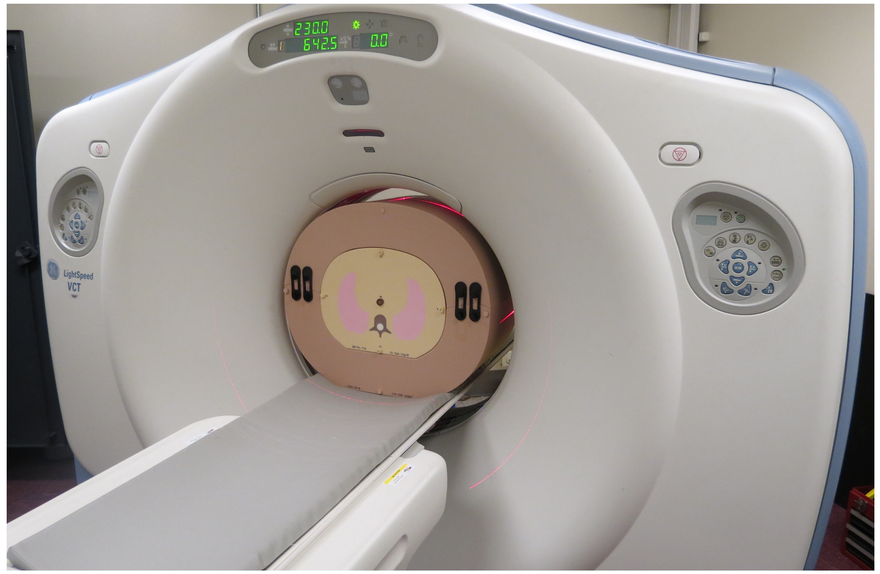
Example GUI

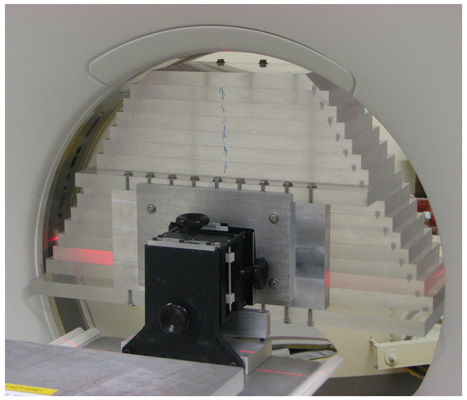
Validation plan

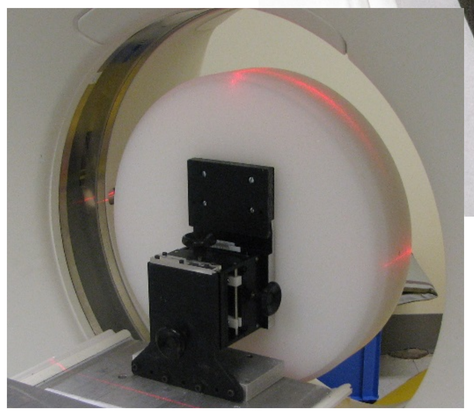
LightSpeed VCT (GE Healthcare)

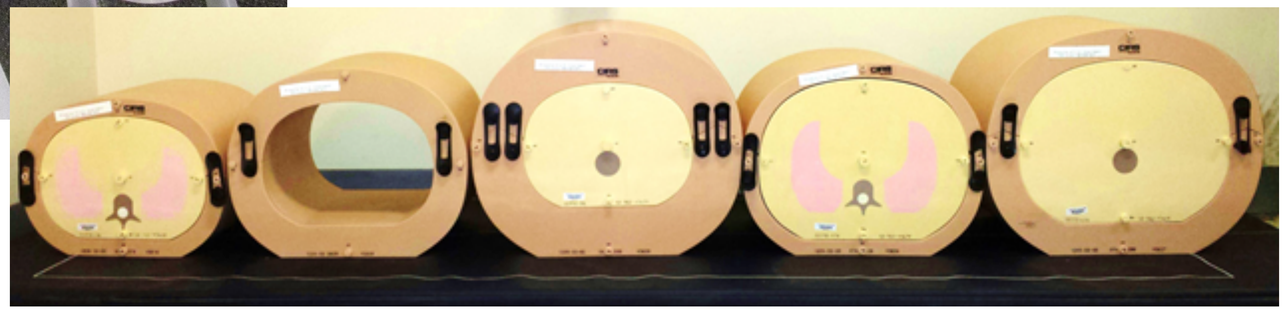
Physics validation: specialized phantoms

Final image and dose validation: pseudo-anthropomorphic phantoms









Our team

GE Research
Niskayuna, NY
Scanner models
Simulation code
Validation

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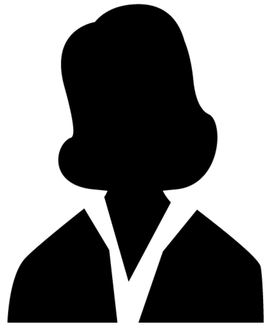
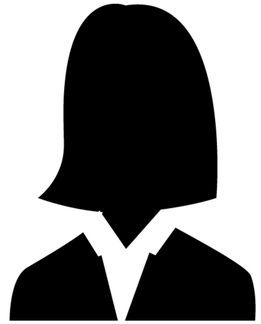
Lowell, MA
Reconstruction

Hengyong Yu

Collaborators

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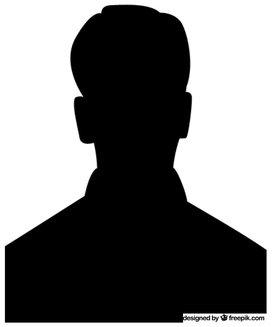
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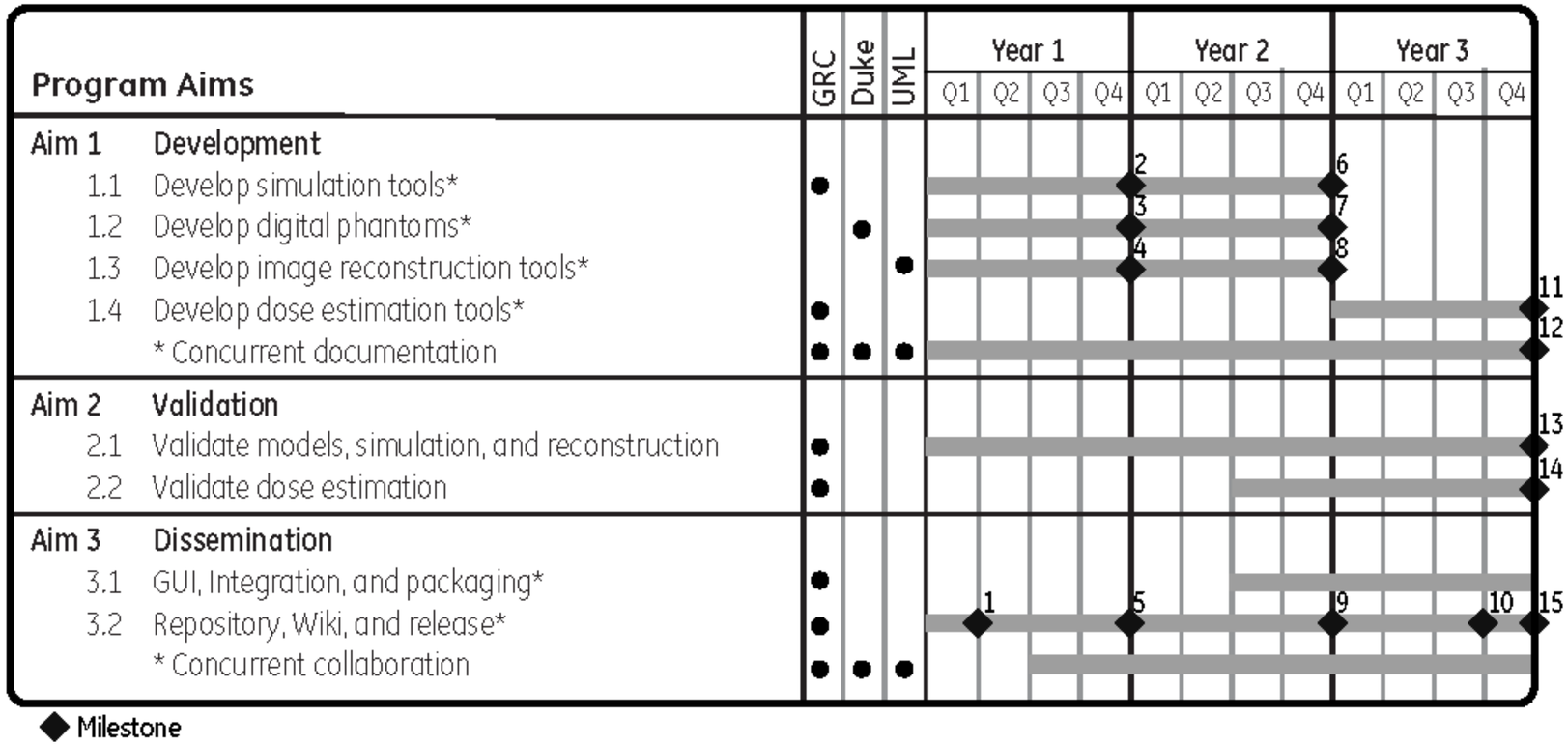
Project Timeline and Milestones



1. Repository set up and publicly available
2. Initial component and system models complete
3. Initial phantoms complete
4. Initial reconstruction tools complete
5. “Alpha” release – basic simulation capability
6. Final simulation capability complete
7. Final phantoms complete
8. Final reconstruction tools complete
9. “Beta” release – full simulation capability
10. Release 0.1 – All components near-final
11. Final dose estimation capability complete
12. Final documentation on repository
13. All component models and CT system model validated
14. Dose estimation validated
15. Release 1.0