

Software tools for on demand slice reconstruction

Jan-Willem Buurlage
j.buurlage@cwi.nl

Computational Imaging group, CWI, Amsterdam

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Reconstruction for real-time tomography

- It is infeasible to reconstruct entire 3D volume in real-time
- Possible to reconstruct individual slices
- Show these slices in context
 - ▶ 2D slices together in 3D space
 - ▶ Low resolution 3D preview
- In a setup with many degrees of freedom, context is especially important. Show projections and acquisition geometry together with reconstruction
- Rich feedback gives intuition even if the user is unfamiliar with the application

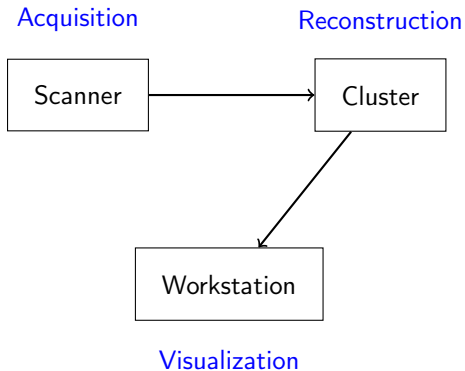
On demand reconstruction

Idea:

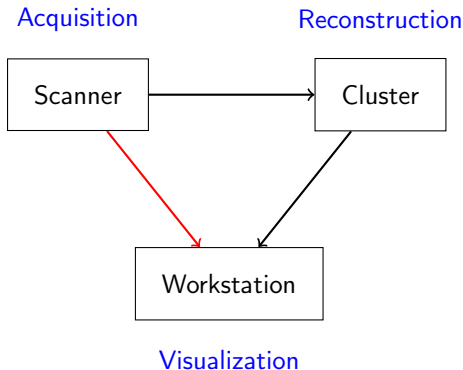
- Show slices of which the orientation can be changed
- While changing the orientation of a slice, a low-resolution preview from a 3D reconstruction is shown
- When a new orientation is chosen, the new slice is reconstructed on-the-fly

To realize this, we need to revisit the way we implement the tomography pipeline.

Simple pipeline

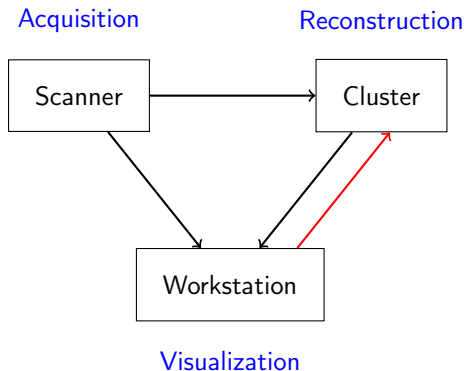


Scanner → Workstation



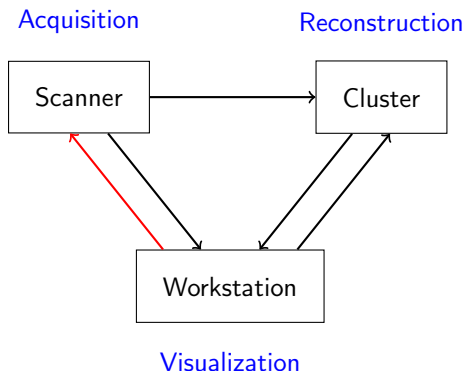
- Show the acquisition geometry together with the reconstruction
- Show the projection images relative to the reconstruction
- Any other (diagnostic) information for the acquisition that is relevant to the reconstruction

Workstation → Cluster



- Reconstruct *on demand*
- The building block for realizing the real-time slicer idea

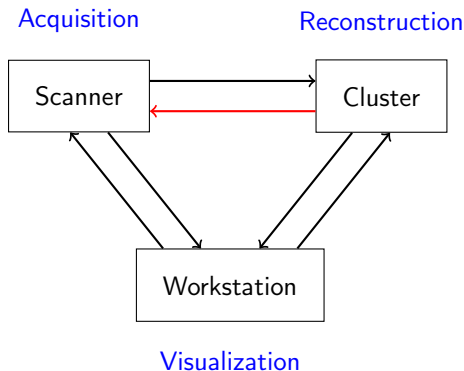
Workstation → Scanner



(Outlook)

- Measure *on demand*, control experiment
- Visualizer and control software in one package

Cluster → Scanner



(Outlook)

- Algorithm controlled dynamic measurements

Outline

1 Motivation

2 Technology and Software

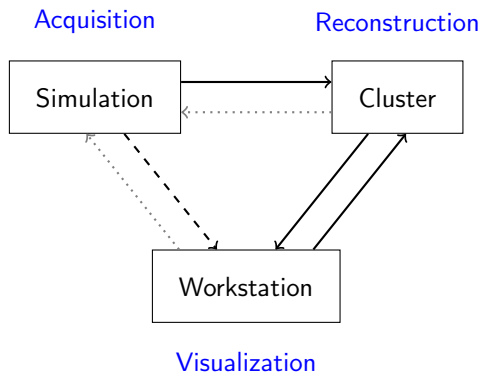
3 Demo

Extending the pipeline

- We want all of the components to be able to interact in real-time
- Communication is done using *packets*, that manage the *scene*, and represent changes, updates, ...
- Important requirement: framework should support all pipeline topologies, arbitrary (physical) locations of components

Slicing tool

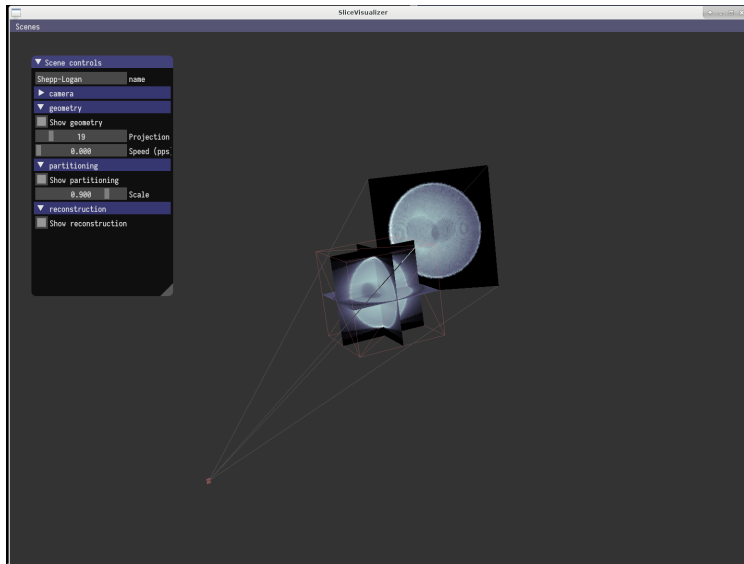
- Current situation:



Slicing tool

- Implementation of the extended pipeline in a software package
- Proof-of-concept; control center for a distributed reconstruction pipeline
- Extensible software. Independent modules:
 - ▶ Scene management
 - ▶ Reconstruction
 - ▶ Geometry
 - ▶ Easy to add more modules, e.g. *Partitioning*
 - ▶ ...

Slicing tool



- Written in C++, with Python bindings available
- Current implementation based on:
 - ▶ ZeroMQ for communication
 - ▶ OpenGL for visualization
- Standardized description of acquisition geometries and data
- Communication protocol based on message passing
- Visualization server as the control center

All these components are independent, and will all be available as open source software.

Code example (Cluster)

```
import tomop

def callback(orientation):
    return slice_data(orientation)

server = tomop.server("Shepp-Logan")

server.set_callback(callback)

server.serve()
```

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Conclusion

- In a real-time setting, we can show and reconstruct (ortho)slices instead of 3D volumes
- By showing these in context, we try to regain some of the intuition we get from a full reconstruction
- We are experimenting with ways to realize a simple real-time pipeline