

# Software tools for on demand slice reconstruction

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Focused Mini-Workshop on Real-Time Tomography

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Tooling for RT tomography

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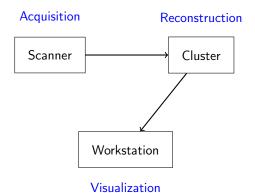
- It is infeasible to reconstruct entire 3D volume in real-time
- Possible to reconstruct individual slices
- Show these slices in context
  - 2D slices together in 3D space
  - Low resolution 3D preview
- In a setup with many degrees of freedom, context is especially important. Show projections and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

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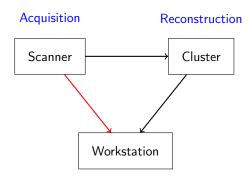
Idea:

- 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.



### $\mathsf{Scanner} \to \mathsf{Workstation}$

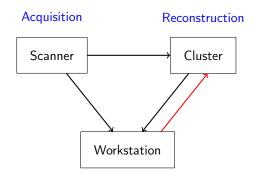


Visualization

- 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

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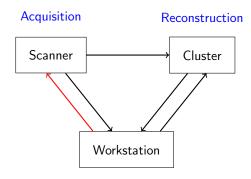
## $\mathsf{Workstation} \to \mathsf{Cluster}$



Visualization

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

## $\mathsf{Workstation} \to \mathsf{Scanner}$



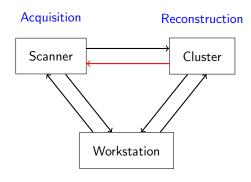
Visualization

(Outlook)

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

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# $\mathsf{Cluster} \to \mathsf{Scanner}$



Visualization

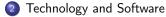
(Outlook)

• Algorithm controlled dynamic measurements

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#### Outline





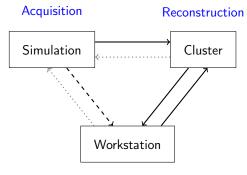


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- We want all of the components to be able to interact in real-time
- Communication is done using *packets*, that manage the *scene*, and represent changes, updates, ...
- Important requirement: framework should support all pipeline topologies, arbitrary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

## Slicing tool

• Current situation:



Visualization

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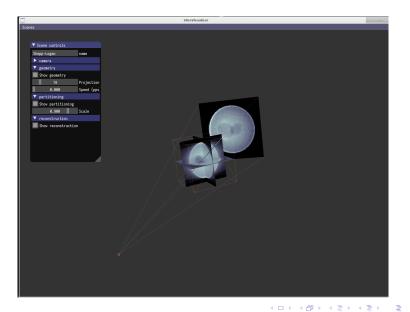
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- Implementation of the extended pipeline in a software package
- Proof-of-concept; control center for a distributed reconstruction pipeline
- Extensible software. Independent modules:
  - Scene management
  - Reconstruction
  - Geometry
  - ► Easy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

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# 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.

```
import tomop
```

```
def callback(orientation):
return slice_data(orientation)
```

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

```
server.set_callback(callback)
```

```
server.serve()
```

## Outline







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Tooling for RT tomography

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- 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

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