

Accurate biopsy-needle depth estimation in limited-angle tomography using multi-view geometry

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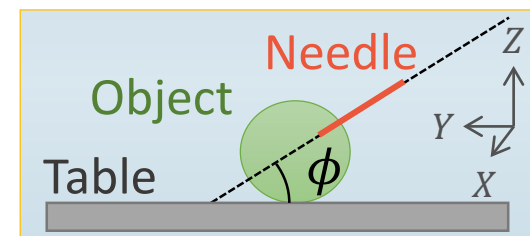
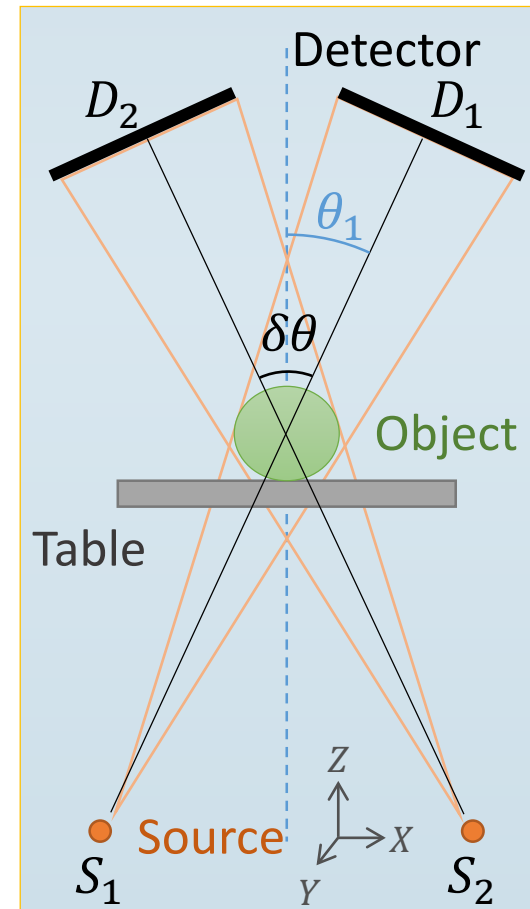
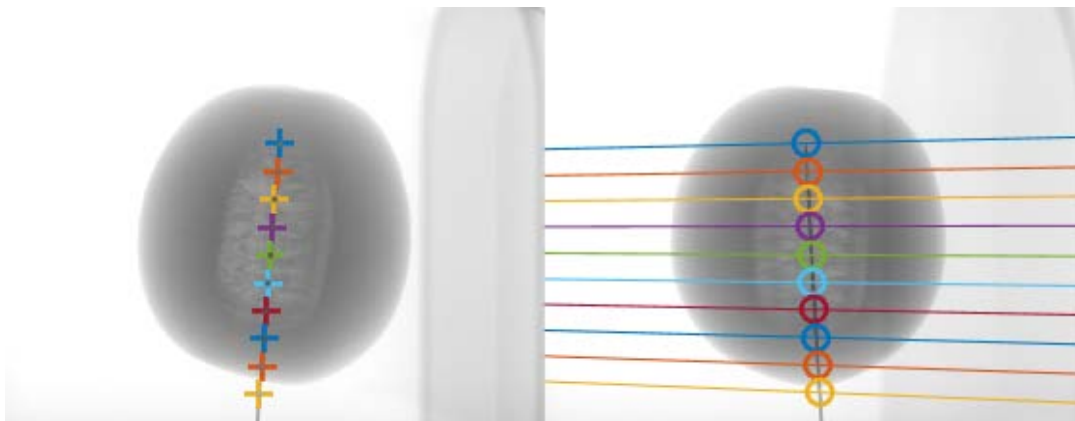
Limited-angle X-ray

- During Image-Guided Interventions (IGI) the physician has no direct view of the employed surgical tools
- A C-arm X-ray system offers guidance by
 - Volume reconstruction after a **fully rotational scan**
 - + “Perfect” position info.
 - Disrupts procedure
 - **Limited-angle tomography**
 - + Physician can stay close to the patient
 - Loss of depth information (complex reconstruction methods)



Multiple View Geometry for a C-arm

- Model the geometry of the C-arm
- Capture two X-ray images under a slightly different C-arm angle $\delta\theta$
- Find the needle in one of the images and use epipolar geometry to find corresponding points in the other image
- Triangulate the 3D position of the needle



Accurate detection results

- Position estimation error quickly drops when increasing $\delta\theta$
- For $\delta\theta > 5^\circ$:
 - 95% of errors smaller than the voxel size
 - 100% of errors below 3 times the voxel size
- Accurate depth estimation for very small C-arm angles!
- Results can be improved by modelling the needle

