



NA-MIC

National Alliance for Medical Image Computing

<http://na-mic.org>

Mechanically Assisted Trans-Rectal Prostate Biopsy

DBP2: Prostate Interventions, Queen's University and JHU

*D. Gobbi, C. Csoma, P. Abolmaesumi,
G. Fichtinger*



Queen's
UNIVERSITY

JOHNS HOPKINS
UNIVERSITY

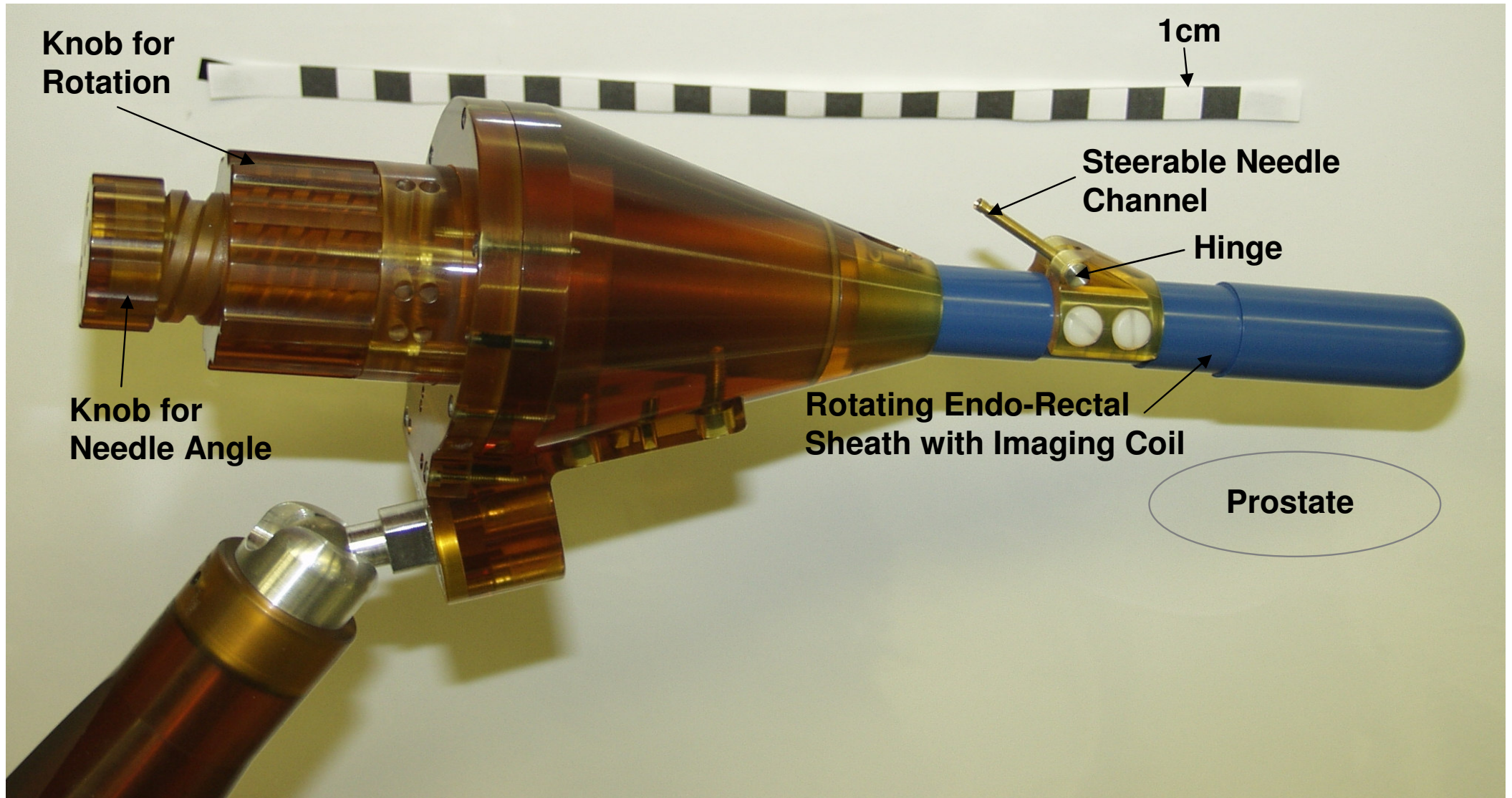


Background

- Prostate cancer
 - Most common subcutaneous cancer in men
 - Estimated 220,000 new cases per year, 28000 deaths
- Confirmation is done via biopsy
 - Transrectal ultrasound (TRUS) guidance is standard
 - Poor localization of probable tumor sites
 - Sensitivity of TRUS is only 60% to 85%
 - MR can provide superior images
- MRI-compatible biopsy robots
 - BRP trans-perineal (JHU/BWH)
 - JHU trans-rectal robot (our current roadmap)



Trans-rectal, MR compatible



A. Krieger, C. Csoma, P. Guion, I. Iordachita, A. K. Singh,
L. L. Whitcomb, G. Fichtinger





Goal for roadmap project

- End-to-end application for MR-guided robotically-assisted trans-rectal prostate biopsy
- Add slicer features relevant to clinical interventional procedures
- Utilize slicer in our diagnostic and therapeutic research programs for prostate cancer



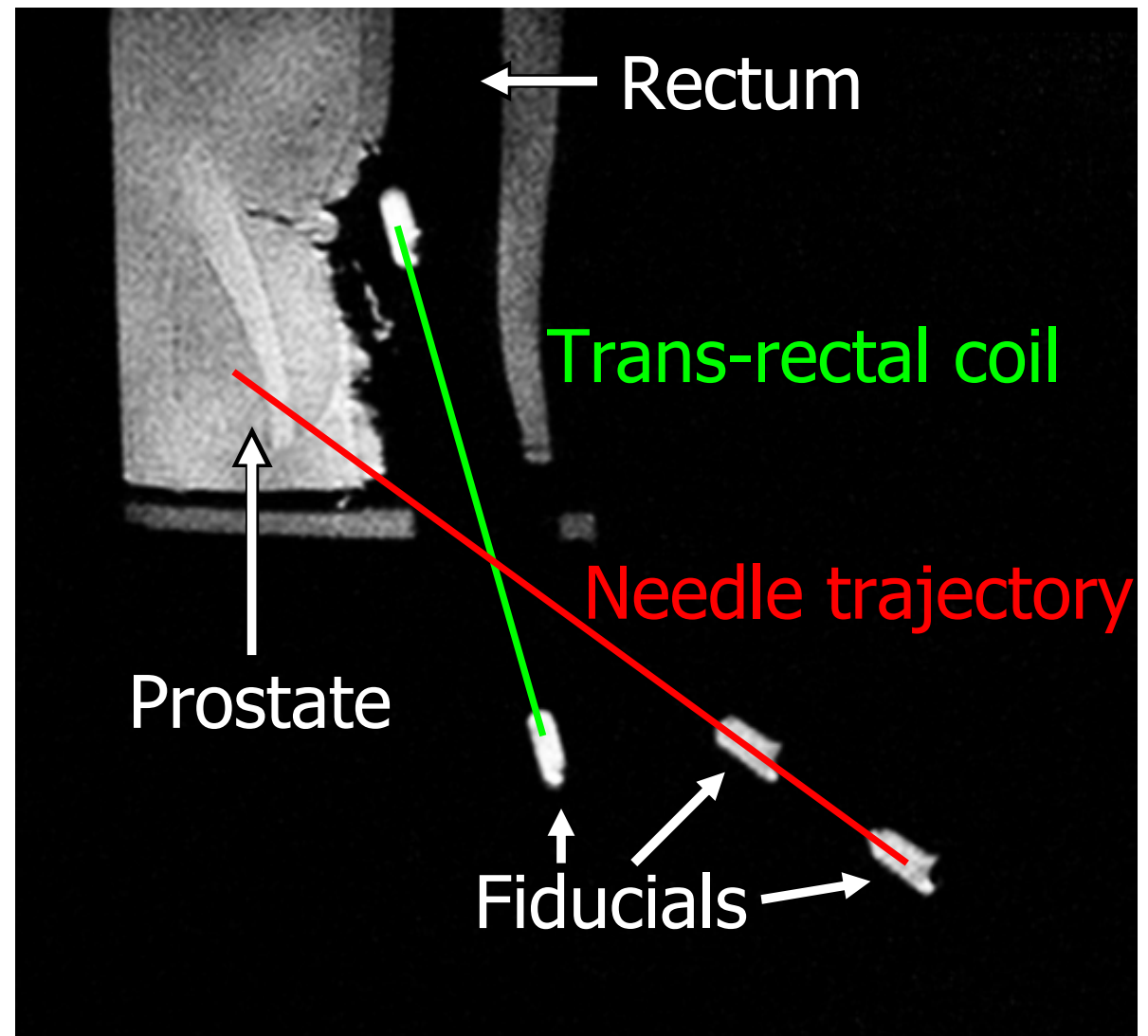
Implementation plan

- Interactive Slicer module
 - Workflow wizard à la EMSegment
- Workflow:
 - Pre-op planning (future)
 - Robot pose calibration
 - Intra-op targeting
 - Post-biopsy verification



Calibration of Robot Pose

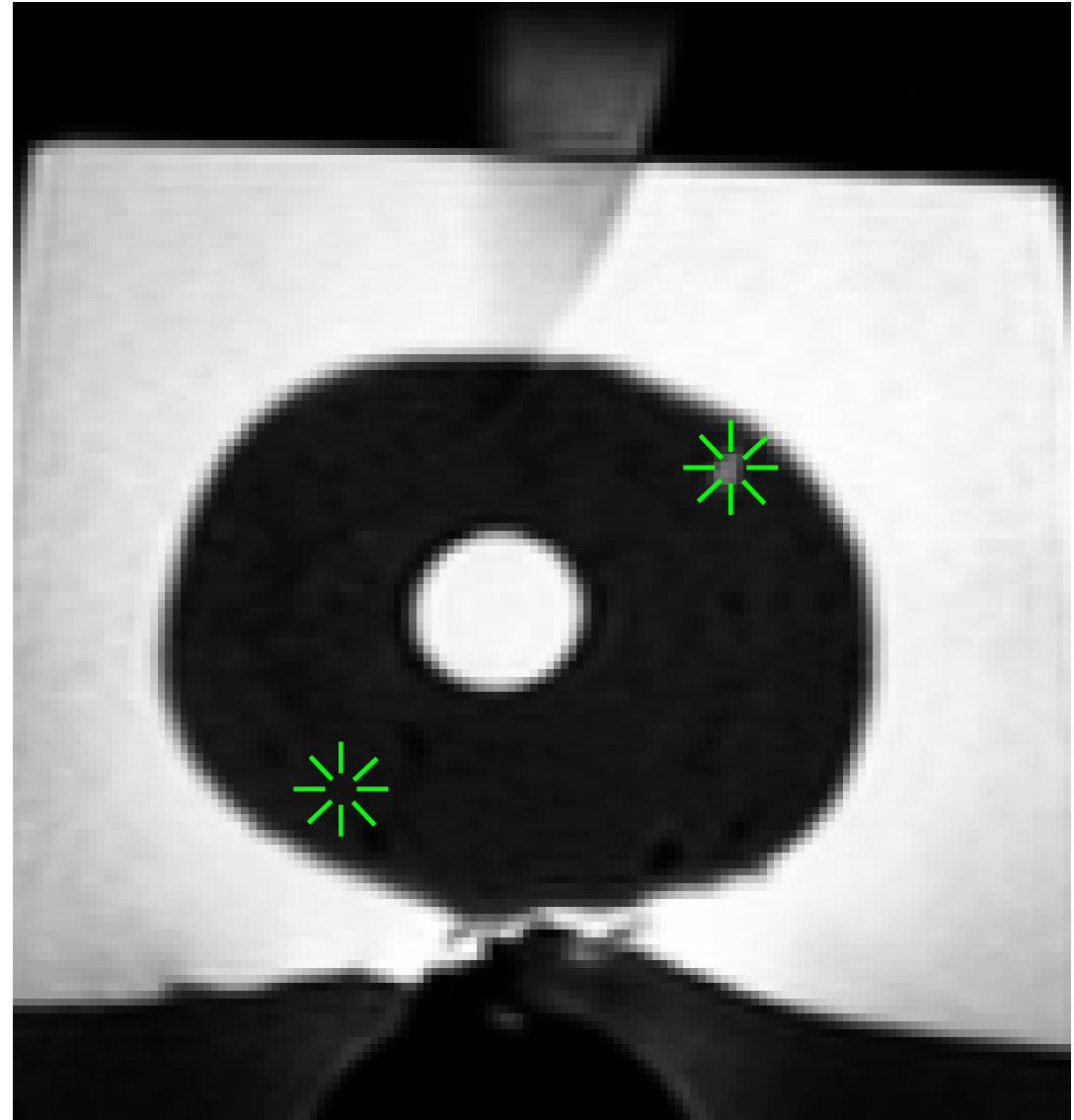
- Load thin-slab calibration image
- Semi-automatic identification of 4 robot fiducials
- Compute robot pose in scanner coords





Targeting biopsy sites

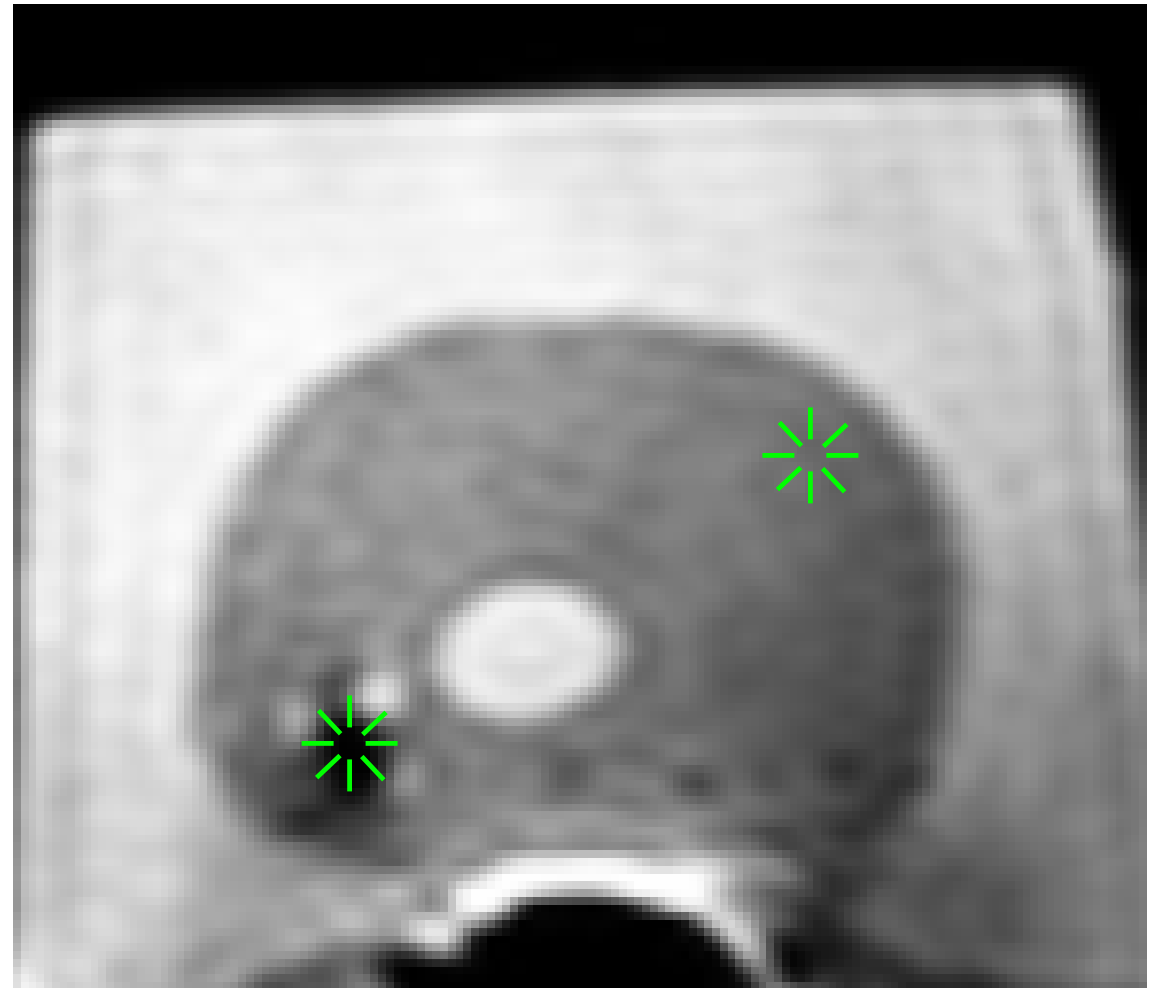
- Load targeting image
- Identify targets with Slicer fids
- Compute robot rotation, needle trajectory, needle depth
- Physician adjusts robot manually and takes biopsy





Verification after biopsy

- Scan after each biopsy (slice or thin slab)
- Compare needle void with planned target
- Some MR distortion is unavoidable





Registration needs

- MR to MR registration
 - Currently, targets are manually placed on intra-op scan based on the pre-op plan
 - Better: pre-op to intra-op registration
 - Must be deformable registration
 - Prone vs. supine, robot in rectum
- MR to US highly desired for future
 - Compare MR to current TRUS procedures



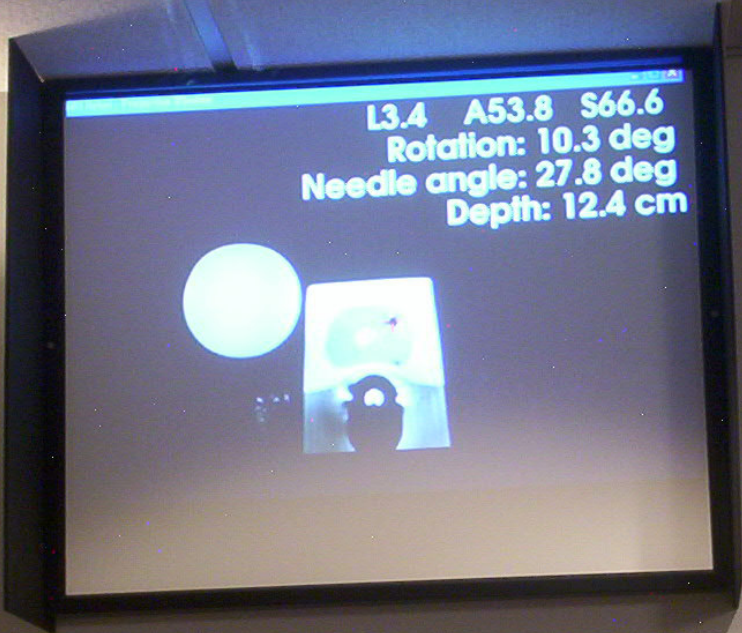
Robot communication needs

- This is a “manual” robot
 - Positioned by hand, no motors
 - Robot joints have encoders, readouts must be displayed to the operator
 - Slicer IGT demon can be used



Display needs

- Dual-display required
 - #1: display by scanner console
 - #2: in-room display for interventionalist
- In-room display properties:
 - Full-screen of most useful Slicer view
 - Ability to select which view appears





Data-handling needs

- Read DICOM oblique orientations
 - Needed for intervention in general
 - Use Slicer's IJK to RAS
- RAS to LPS conversion
 - Planning, targeting is always LPS
 - Scanner consoles are LPS



“Frame of Reference”

- Each procedure can involve several “frames of reference” (FORs)
 - i.e. motion occurs: calibration repeated
 - Need FOR identifier tags for data sets and fiducial lists
 - Data sets with different FORs must not be allowed to be overlaid or compared: very real risk to the patient



Feature Summary

- From NA-MIC
 - Workflow GUI infrastructure
 - Oriented images set from DICOM header
 - Registration
- From Queens/JHU
 - End-to-end application
 - Secondary full-screen display
 - Prostate-specific registration
- Shared
 - Multiple Frame-of-Reference in Slicer