MR Guided Prostate Interventions

Advantages of MRI

- No ionizing radiation
- High soft-tissue contrast
- High resolution imaging
- True 3D volumetric imaging
- Multi-parametric imaging
  - T1/T2 weighting, Functional, Diffusion, Flow, Temperature, Oxygenation, …
- Can provide “real-time” imaging capabilities
Why MRI?

US | CT | MRI

Close Bore Magnet
Intra-operative MRI – open magnet in the OR

Operating Room

Black, Jolesz et al., Harvard BWH

MRI-Guided Laser Ablation

Black, Jolesz et al., Harvard BWH
**MRI-Guided Laser Ablation**

Black, Jolesz et al., Harvard BWH

**Transperineal Implants & Biopsy**

Tempany et al., Harvard BWH
Transperineal HDR & Biopsy

Why is MRI so hard?

DiMaio, Fischer, Fichtinger et al., JHU
Why is MRI so hard?

Point & Click System Concept

CREDIT: Krieger, Susil, Ménard, Coleman, Singh, Whitcomb, Atalar, Fichtinger (Johns Hopkins and NIH)
Transrectal Prostate Interventions in 3T MRI

1. Translate
2. Rotate
3. Insert needle

The End-Effector (First Prototype)

Signal projection for one tracking coil

CREDIT: Krieger, Susil, Ménard, Coleman, Singh, Whitcomb, Atalar, Fichtinger (Johns Hopkins and NIH)
Human Grade Device

17mm OD

CREDIT: Krieger, Susil, Ménard, Coleman, Singh, Whitcomb, Atalar, Fichtinger (Johns Hopkins and NIH)

The Perk Labs – Laboratories for Percutaneous Surgical Interventions
Robot in Clinical Trials

- From concept to 2 trials in 22 months
- ~50 biopsies & marker seed placements
- No severe adverse events
- Supports 4 clinical trials as validation tool

Example

Language Injection monitoring

canine studies

GOOD BAD

CREDIT: Krieger, Susil, Ménard, Coleman, Singh, Whitcomb, Atalar, Fichtinger (Johns Hopkins and NIH)
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Transperineal Brachytherapy / Biopsy

Robot Position  Patient Position

Mechanical Design

Kinematic Structure  Workspace

Registration of Robot to MRI

Software Interface


Patient workflow & MRI compatibility

The Perk Labs – Laboratories for Percutaneous Surgical Interventions
Other work at Johns Hopkins

Innomedic Robot
**Innomedic CAD/CAM workflow**

- set up on bed
- image
- plan
- move robot
- insert needle manually
- confirm in image

**New wide & short bore magnets coming…**

Field strength 1.5T – 3T
Bore diameter ~ 75 cm
Isocenter depth ~125 cm