Personalized Medical Robotics

Allison M. Okamura
Department of Mechanical Engineering
Stanford University

Personalized Medical Robotics

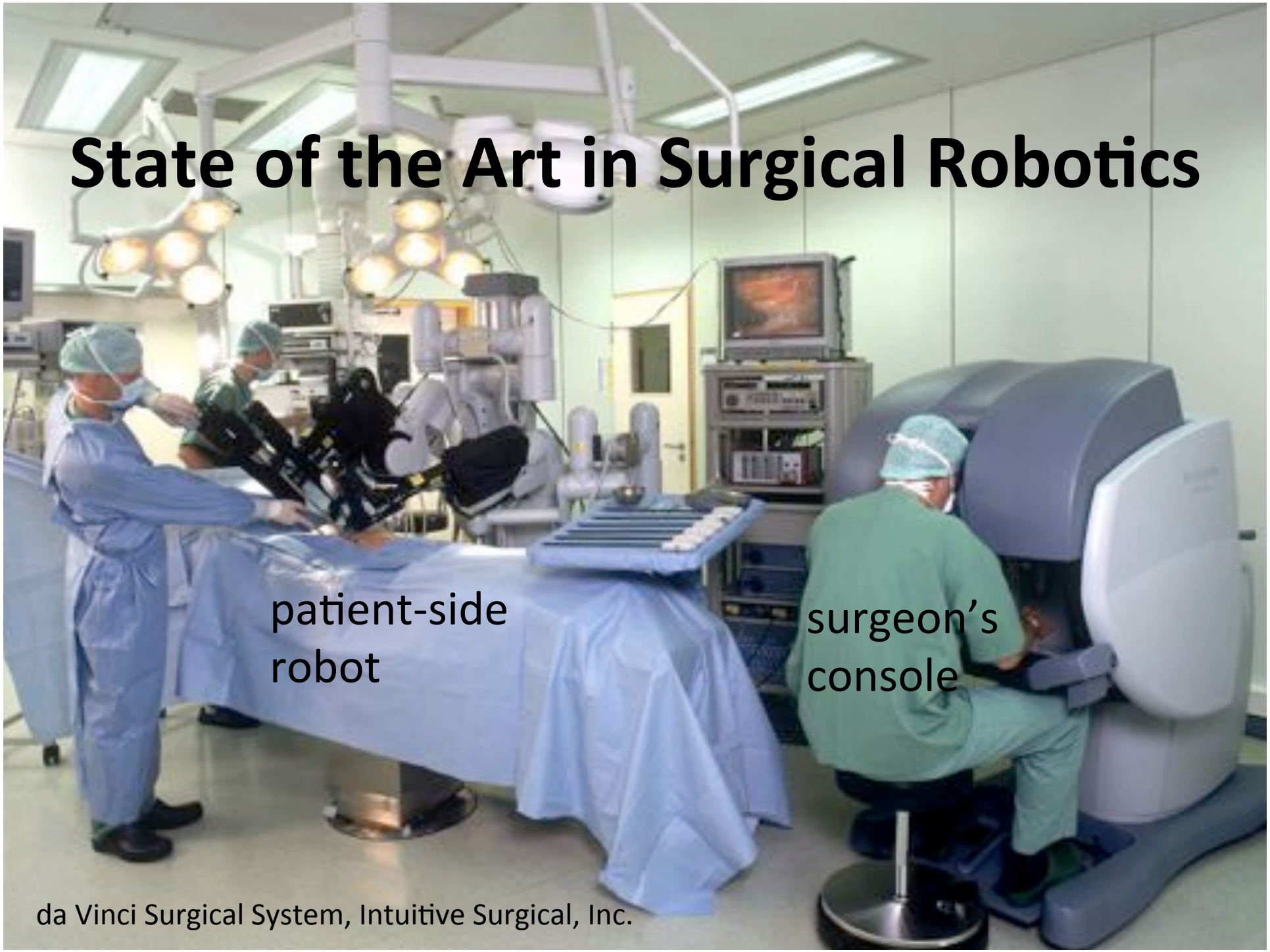
- Why use medical robots?
- Challenges for the design of surgical robots
- "Personalized" robots:
  - Untethered devices
  - Steerable needles
  - Active cannulas
- The power of medical robotics: access and information

Robots are…

Intuitive Surgical, Inc.

- Accurate and precise; untiring
- Smaller or larger than people (as needed)
- Remotely operated (as needed)
- Connected to computers, which gives them access to **information**

State of the Art in Surgical Robotics



da Vinci Surgical System, Intuitive Surgical, Inc.

open surgery

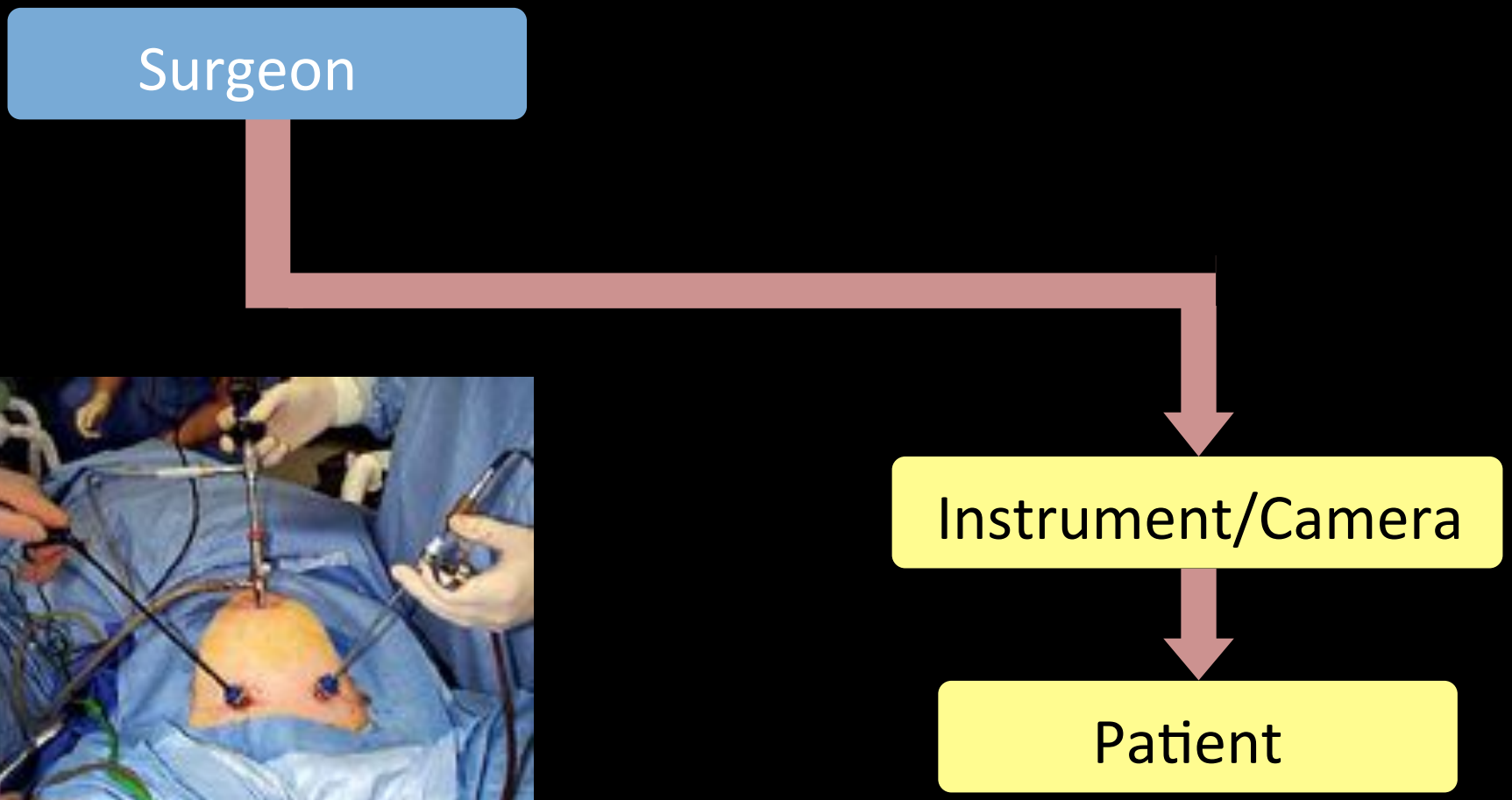
Surgeon

Patient

Image source: www.physicianphotos.com

minimally invasive surgery

Image source: www.womenssurgerygroup.com



teleoperated robot-assisted minimally invasive surgery

Surgeon

Master Console

Patient-Side Robot

Instrument/Camera

Patient

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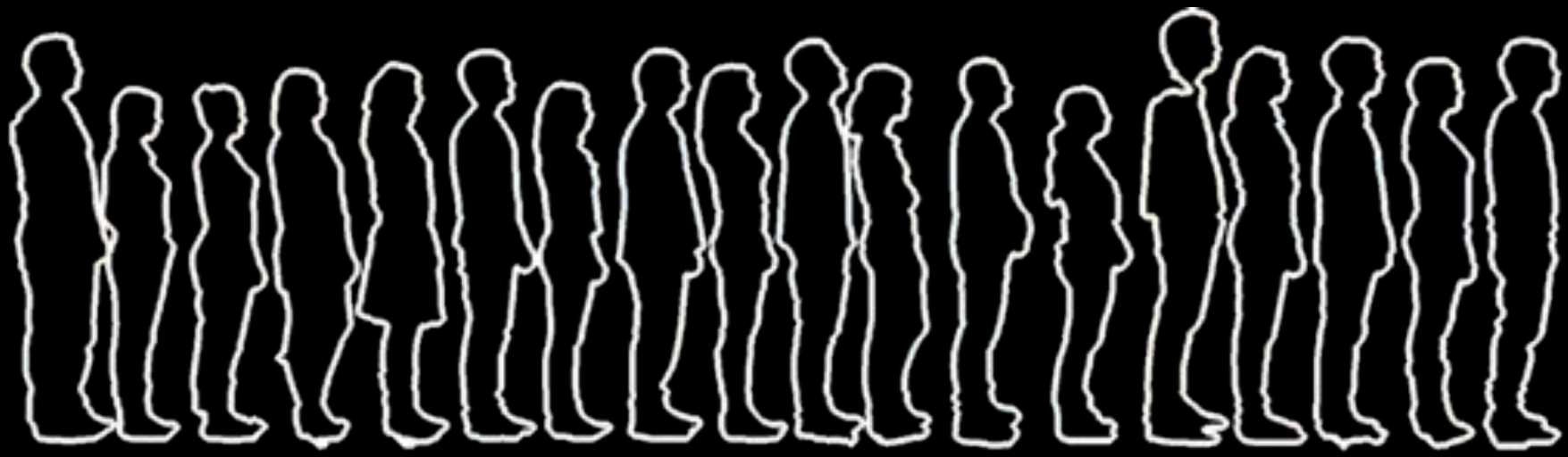
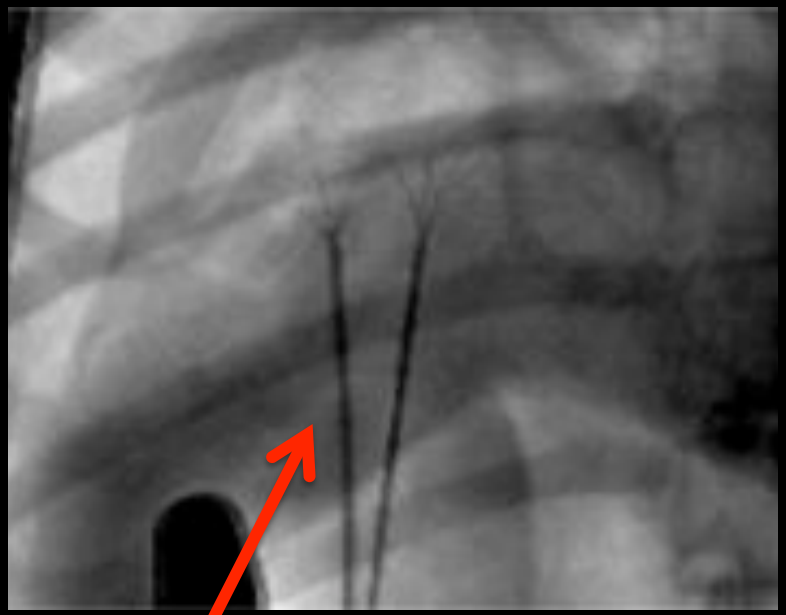
People come in all shapes and sizes



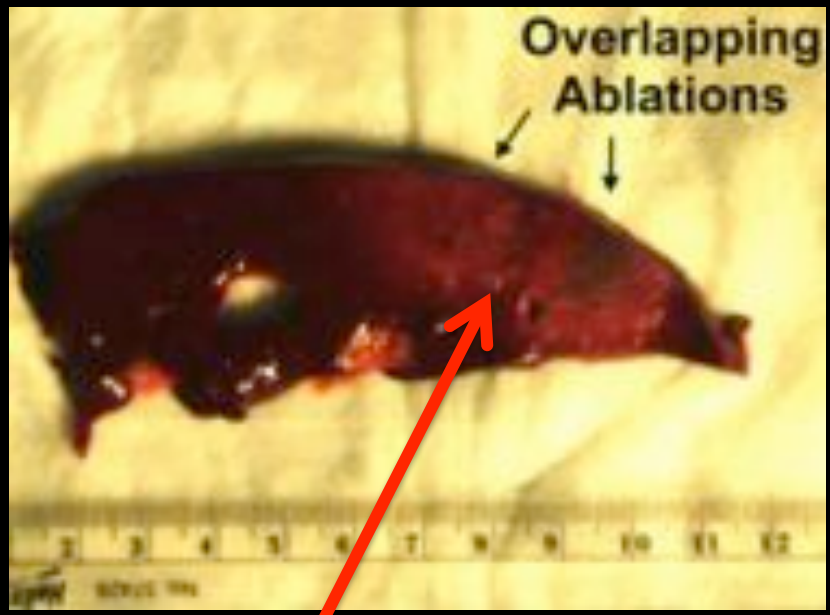
People come in all shapes and sizes

People come with different medical challenges

People come with different medical challenges



Ablation instruments



Ablated tissue

We need surgical robots that are:

As small as possible

Able to move in curved paths

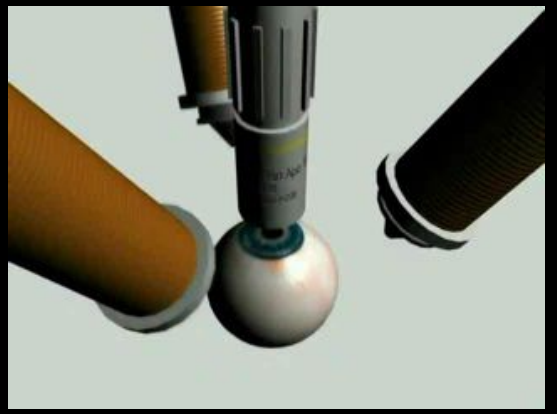
Capable of enabling diagnosis
and delivering therapy

Capable of being used for a
specific procedure with a *specific patient*

Cochlear implants
(courtesy Robert Webster III, Vanderbilt University)

Capsule robots
(courtesy Pietro Valdastri, Vanderbilt University)

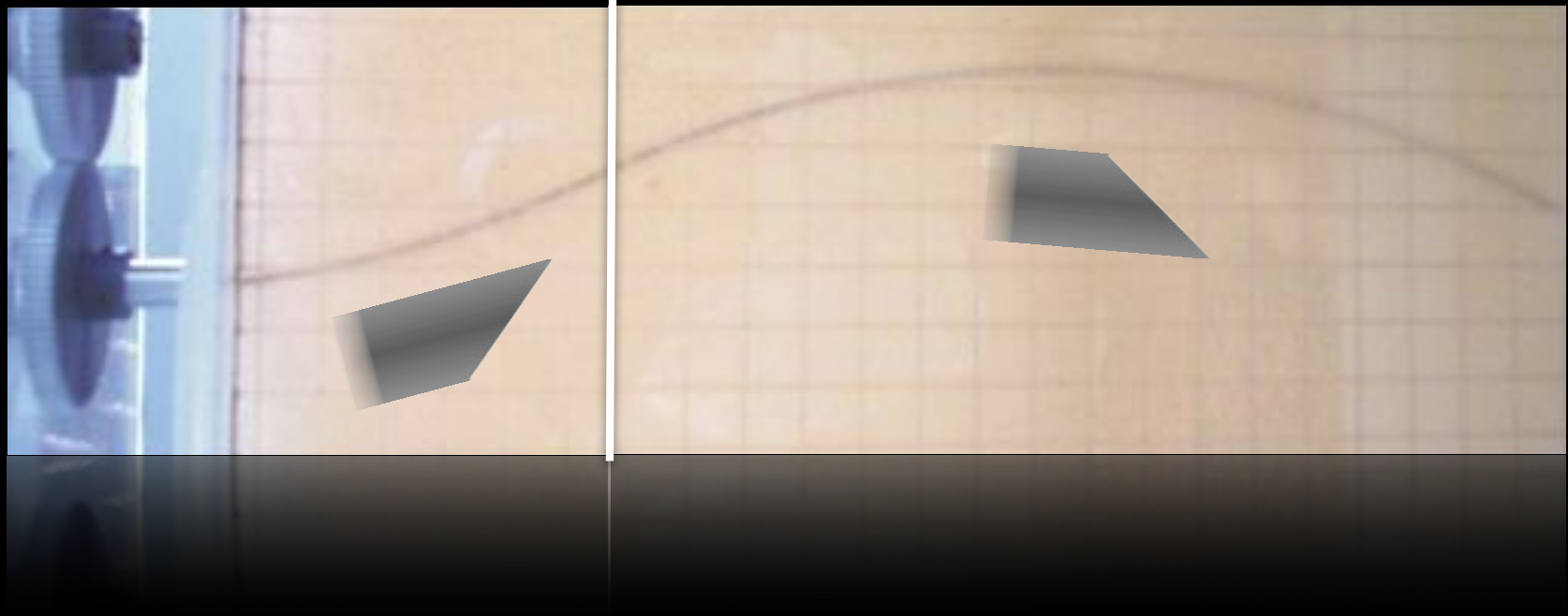
Magnetic Swimmers
(courtesy Jake Abbott, University of Utah)

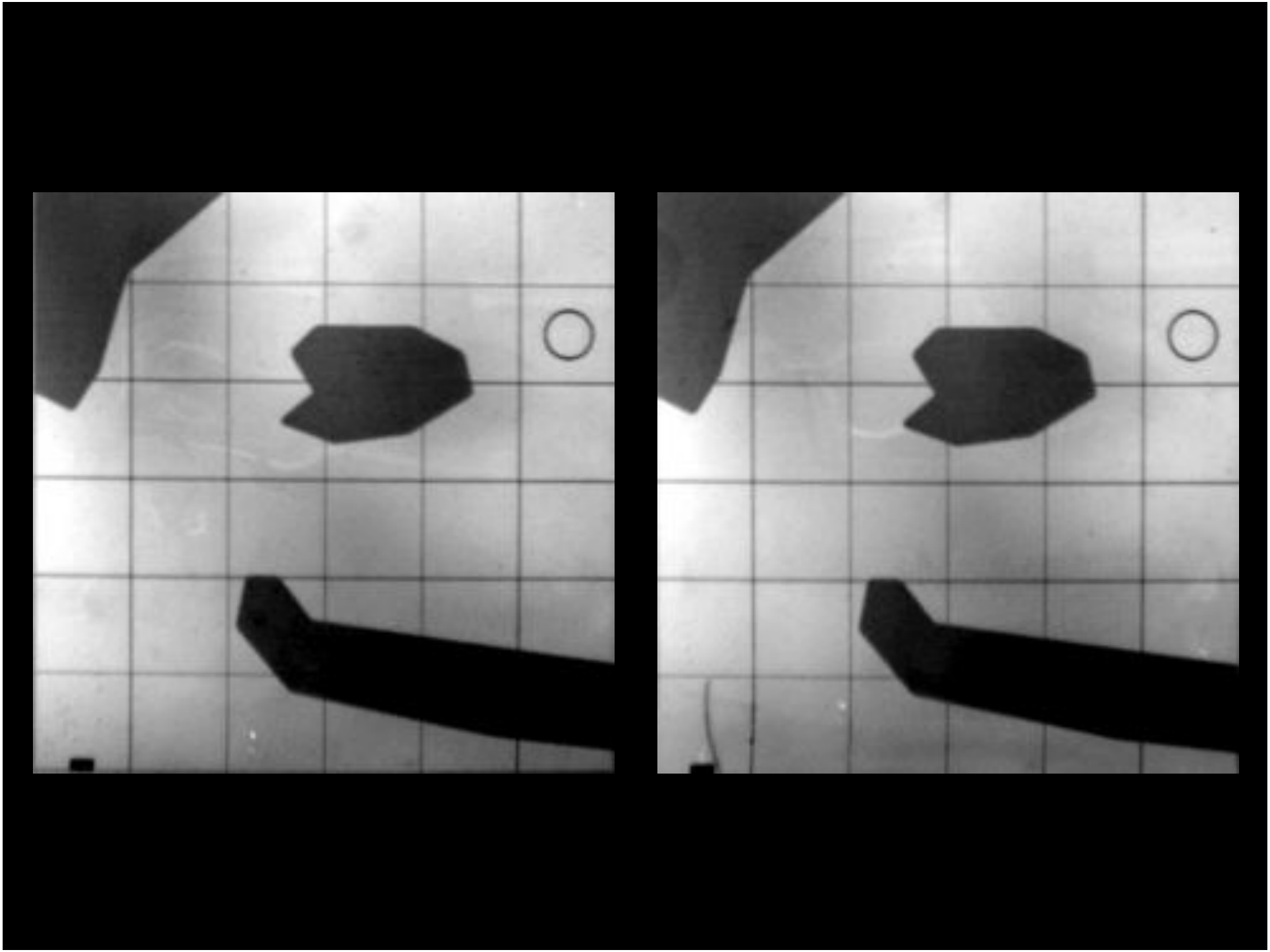


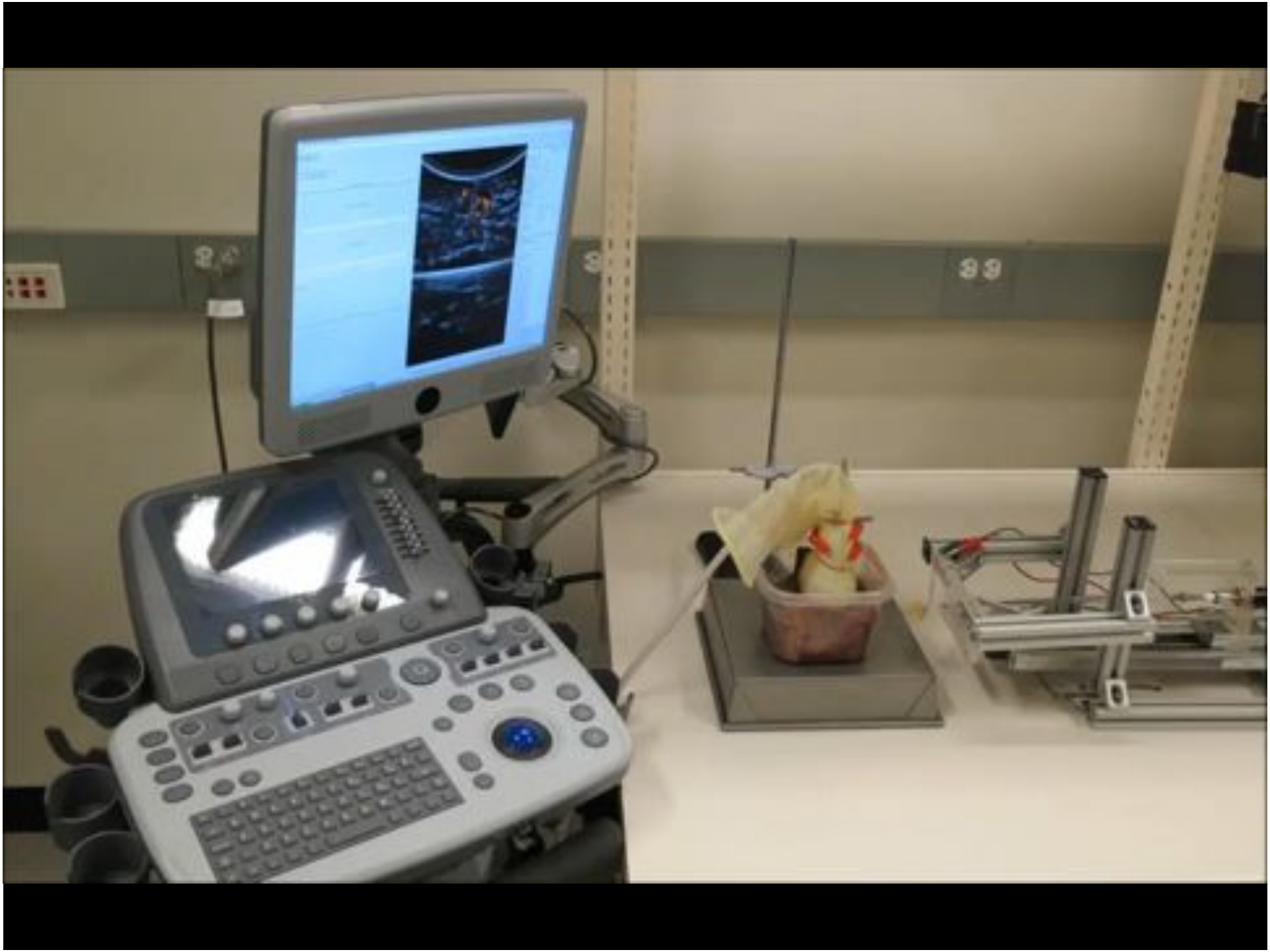
Steerable Needles

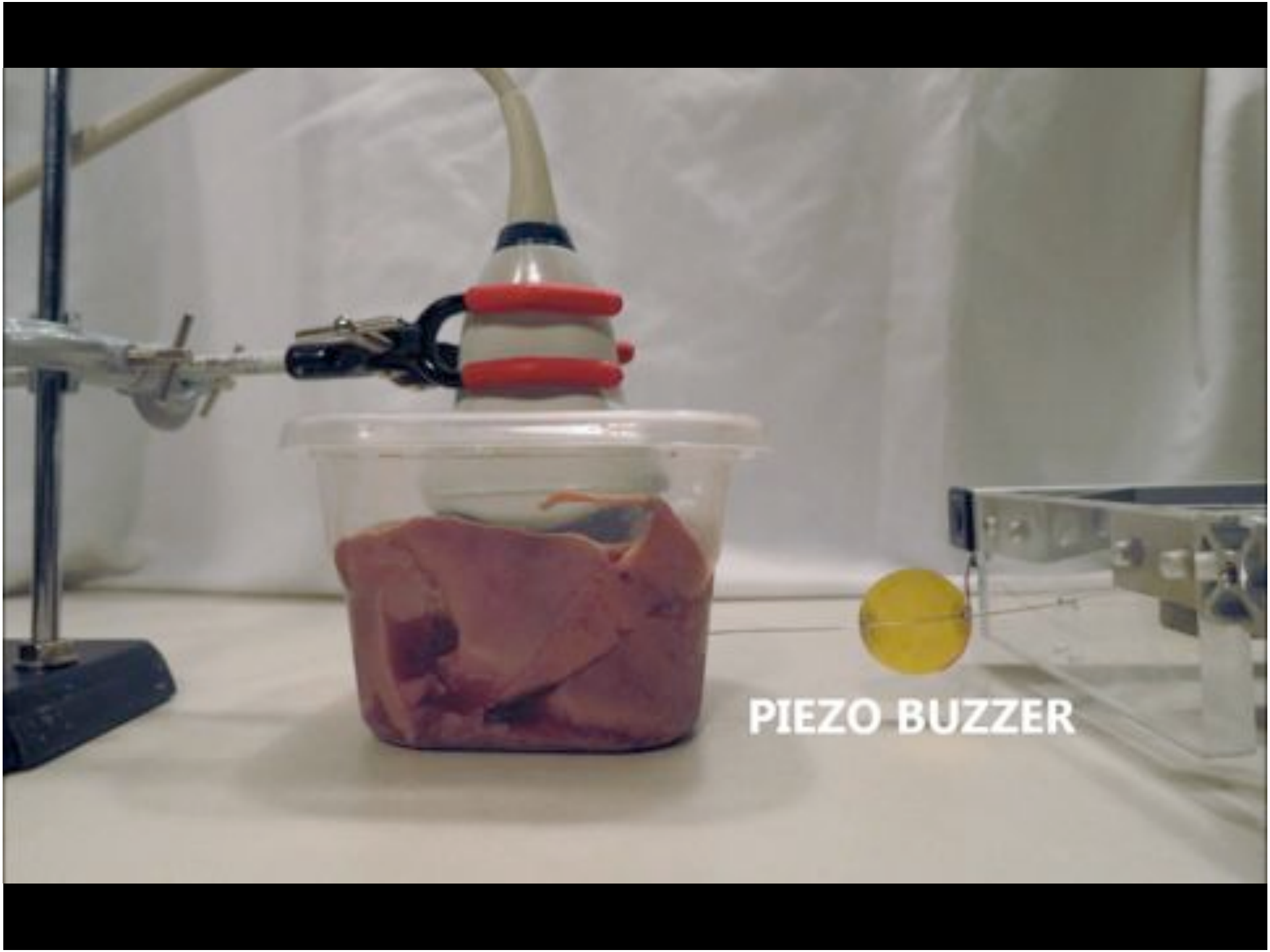
Rotation

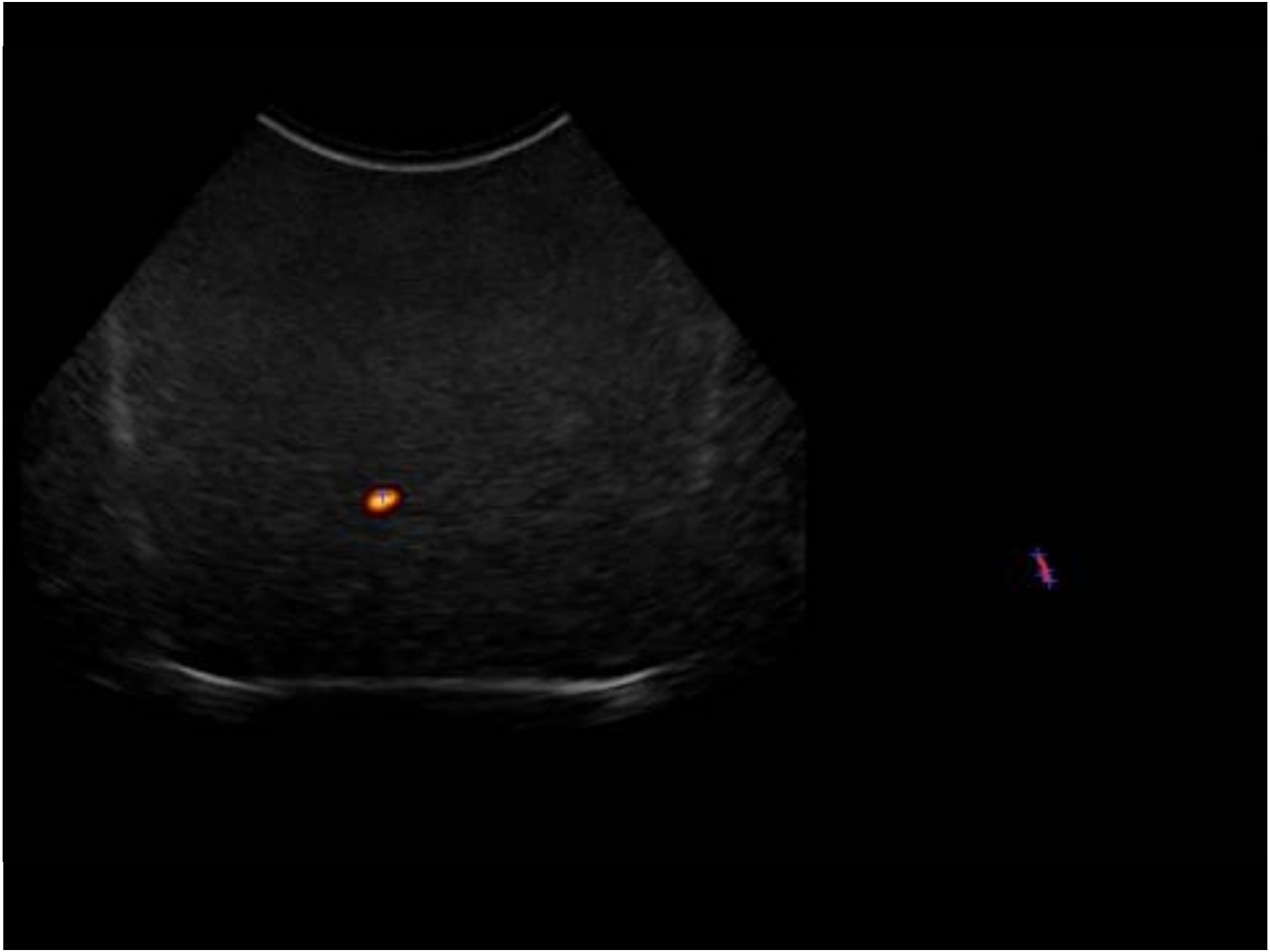
Insertion



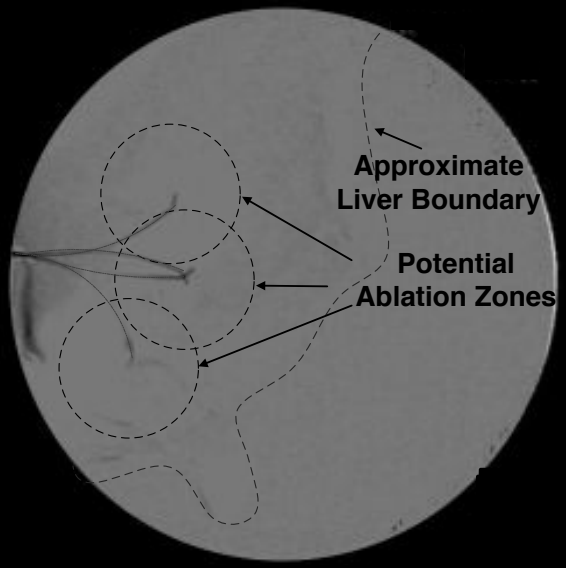




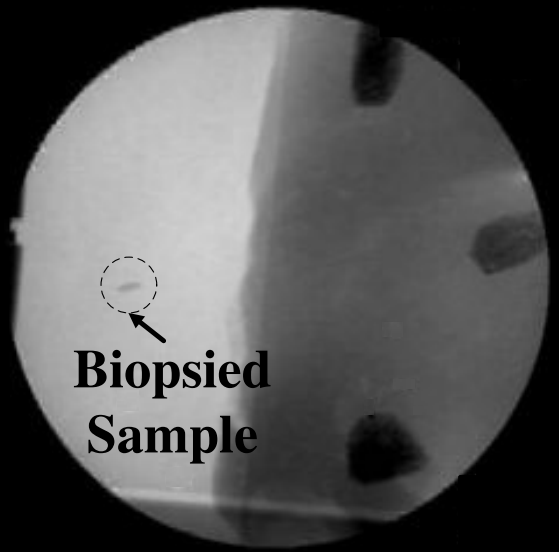

PIEZO BUZZER



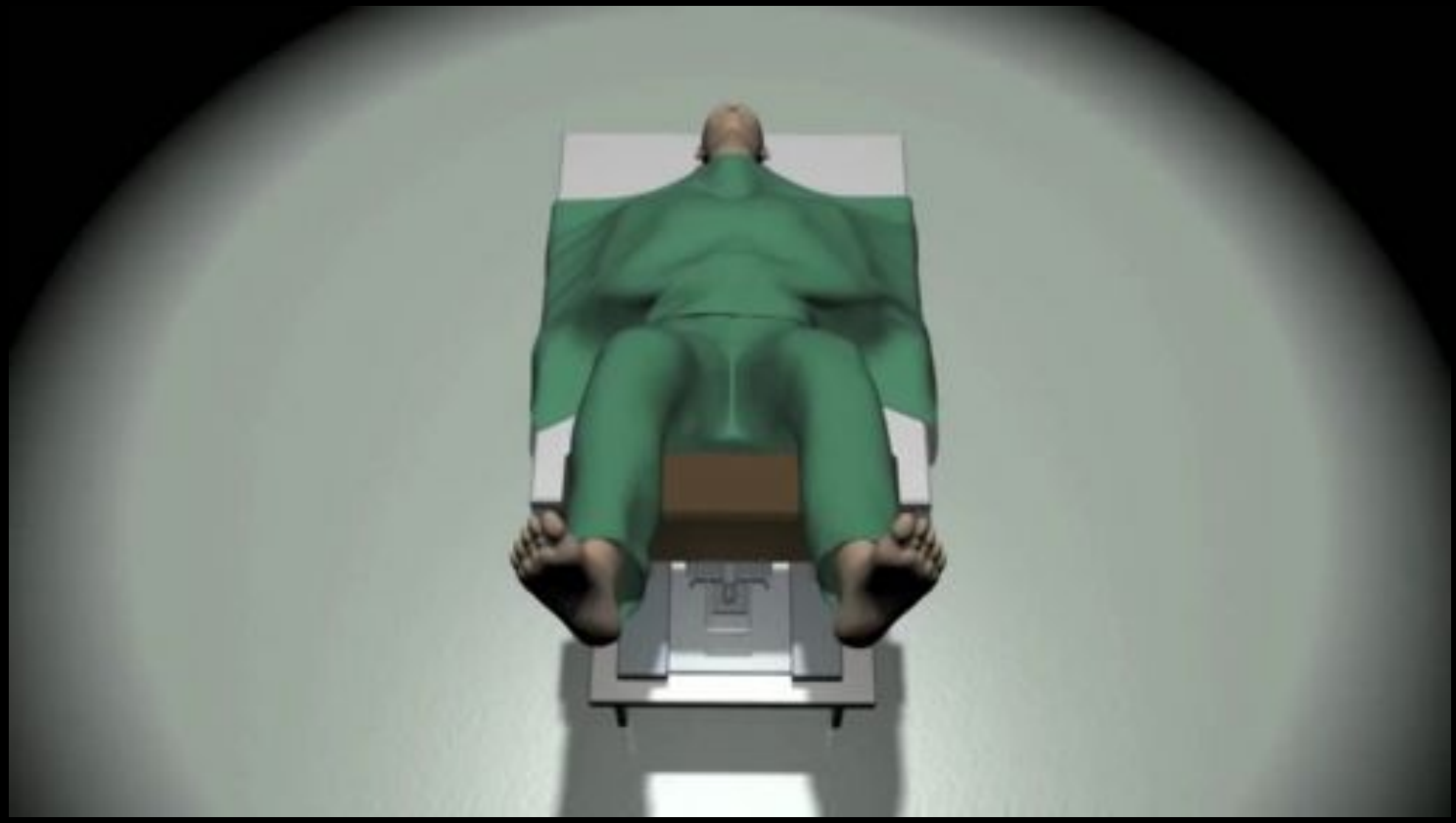
Ablation



Biopsy



Before the intervention: Planning and Simulation



Courtesy N. Chentanez, R. Alterovitz, D. Ritchie, L. Cho, K. Hauser, K. Goldberg, J. Shewchuk, and J. F. O'Brien (University of California, Berkeley and University of North Carolina, Chapel Hill)

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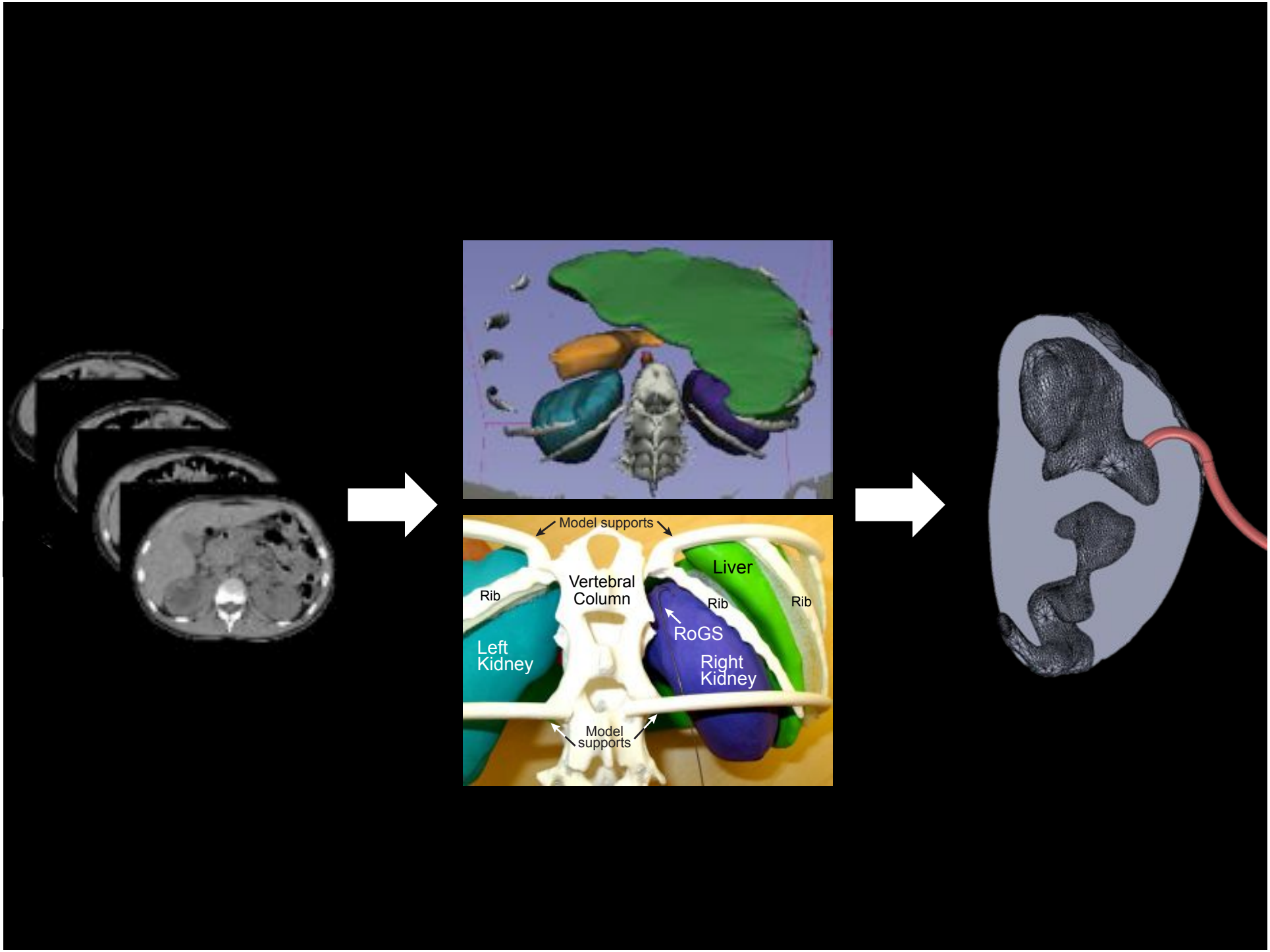
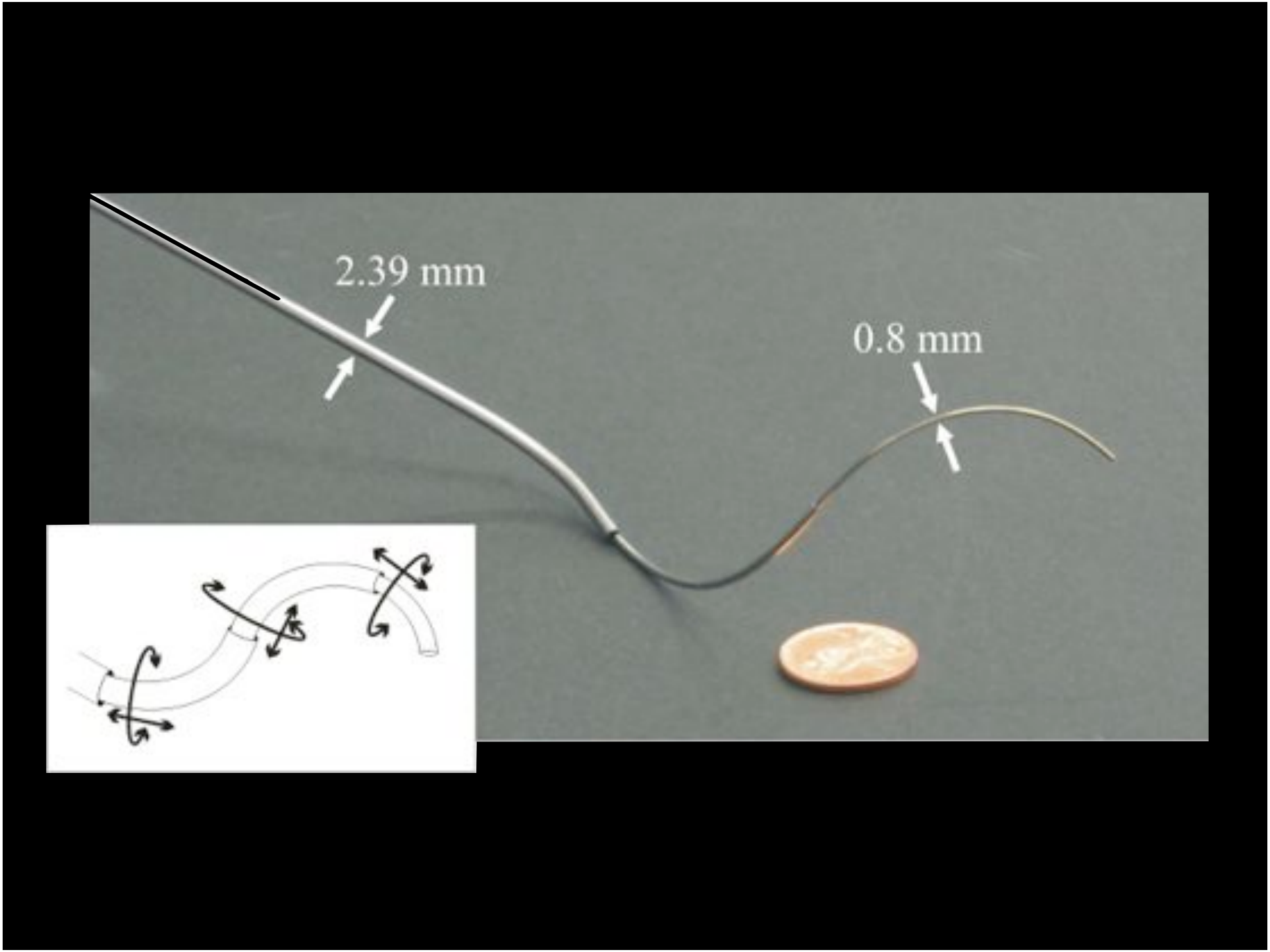
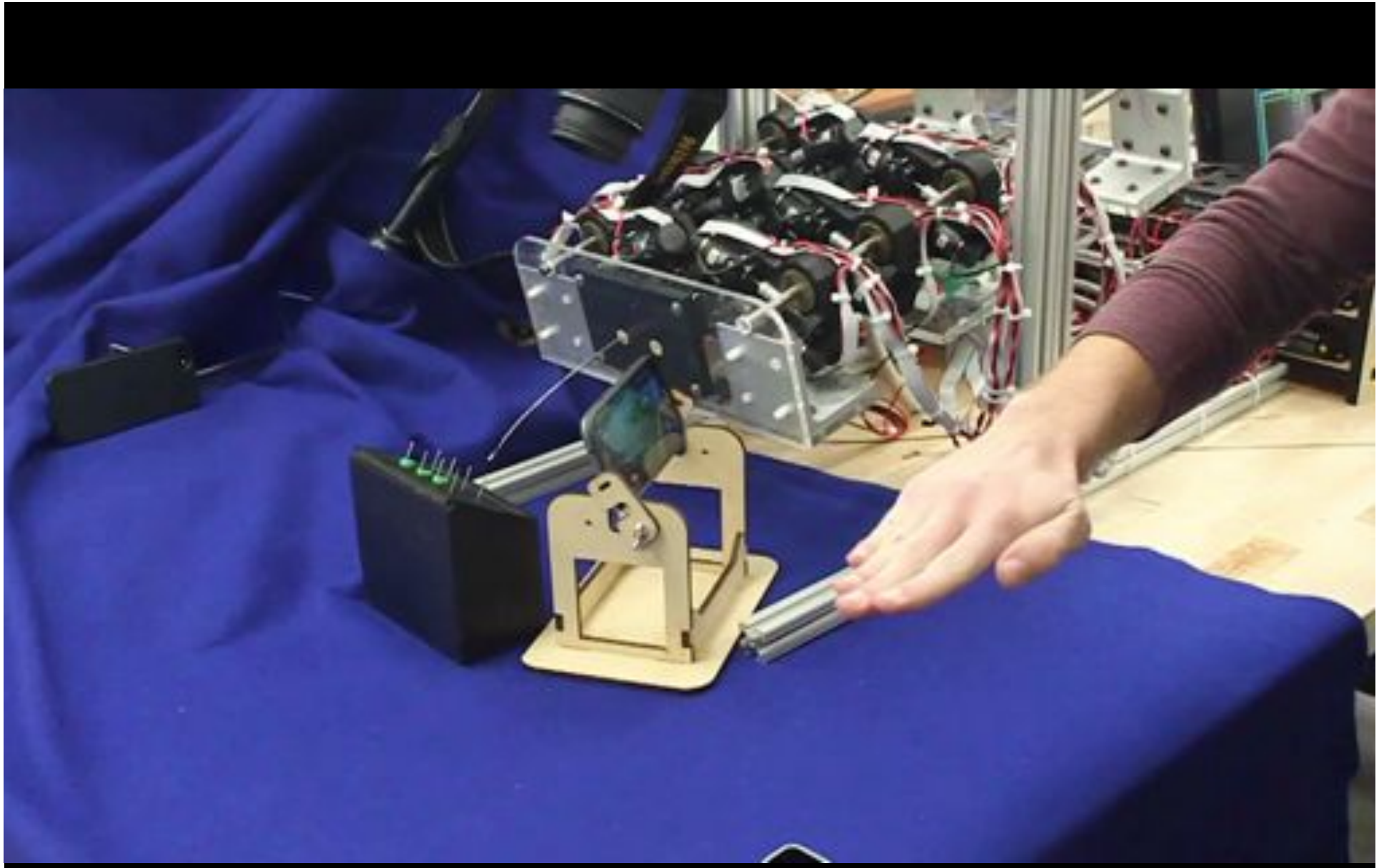

Model supports
Liver
Vertebral Column
Rib
Rib
Rib
RoGS
Left Kidney
Right Kidney
Model supports

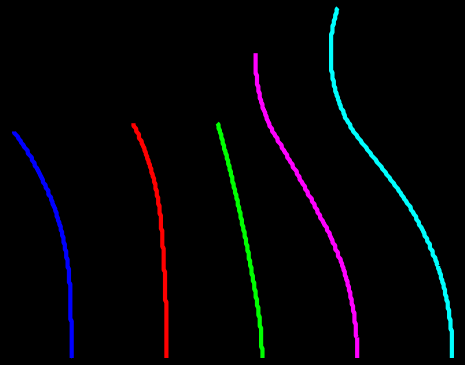
Active Cannulas


2.39 mm
0.8 mm



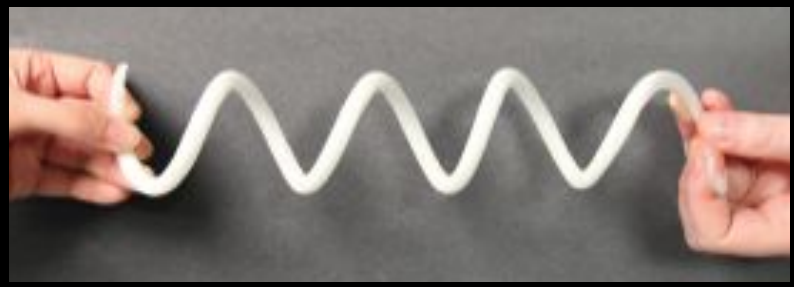
Video courtesy Robert Webster III (Vanderbilt University)

Patient-specific robot production



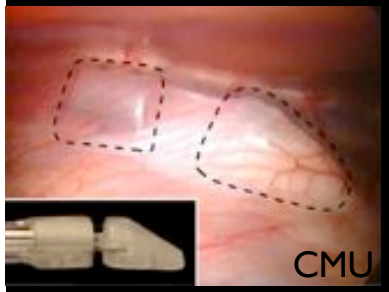
Select from
pre-fabricated parts

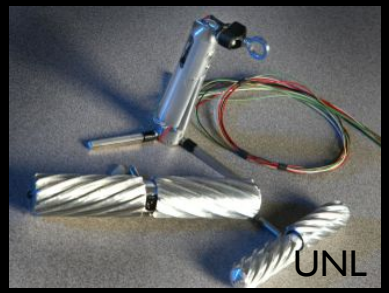
Makerbot flexible filament

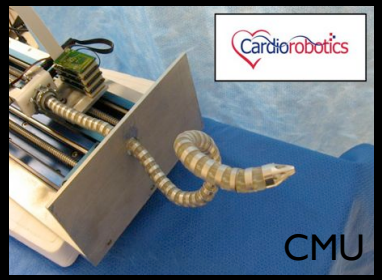


Print 3D
parts onsite

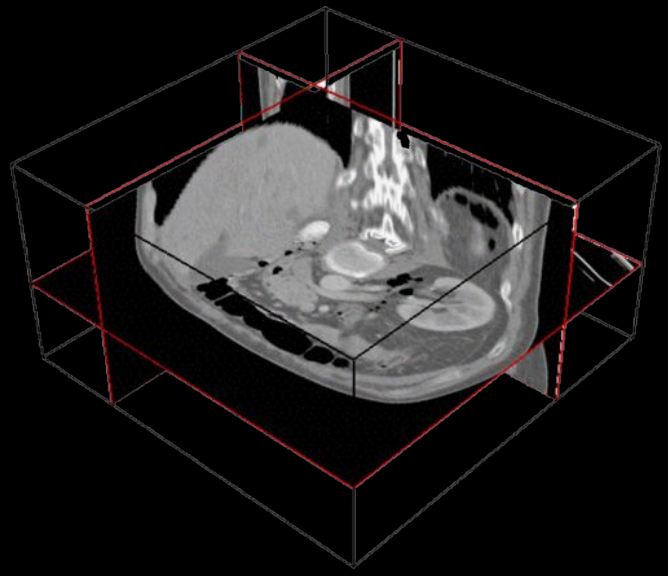
Medical Robotics







Access + Information



Key features of robot-assisted interventions

- Quantitative descriptions of patient state
- Use of models to plan intervention
- Design of devices, control, and processes to connect information to action (= robotics)
- Incorporate human input in a natural way

Ultimate goal: Improve health and quality of life

Thank You

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the National Science Foundation, Johns Hopkins University,
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