National Cancer Institute

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
National Institutes of Health

An Open Science Framework for Assessment of Technologies In Image-Guided Interventions

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CANCER IMAGING PROGRAM

Outline

1. **Background**
2. **IGI Open Science Framework**
   - **Extramural Collaborations**
   - **Technology Assessment IGI Work Group →Task Groups**

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Overarching Goal in IGI

- **Perform better informed, more accurate and less invasive focal treatments**
  - ***Imaging*: Anatomic, Functional, Molecular**
  - ***Guidance*: Image fusion, tracking, robotics, dose painting, and feedback**
  - ***Interventions*: Needles, catheters, energy sources, targeted drug nanocarriers, surgery**

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Image-Guided Procedures

1. Biopsy: tumor heterogeneity and TME, 'omics' studies, drug development, and response evaluation
2. Surgical oncology
3. Minimally invasive therapies (e.g., laser, FUS, RT)
4. Focal drug delivery: Catheter, micro and nanoplatforms, including theronostics

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Integrated Solutions

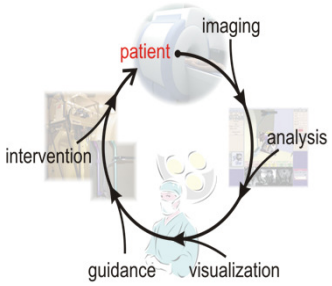

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Image-Guided Surgery

- Goal:
  - Complete resection
  - No functional deficit
- Surgeon needs to see:
  - Lesion and define margins
  - Critical structures
  - Relationship between lesion and normal areas
- Tools required for:
  - Pre-operative planning
  - Surgical decision-making

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Robot Assisted Prostate Surgery

da Vinci® System **- Intuitive Surgical**

- **High resolution**
- **Magnified images**
- **Specialized equipment: micro-dissection**

Minimally Invasive

- **Decreased Pain / Blood Loss / Hospital Stay**
- **Improved visualization and protection of NVB and neighboring structures**

Est. >100,000 procedures / year

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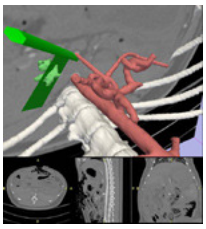
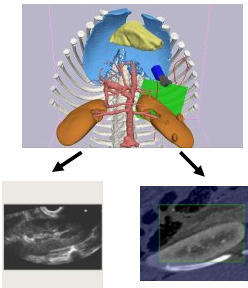
Image Registered Endoscopies

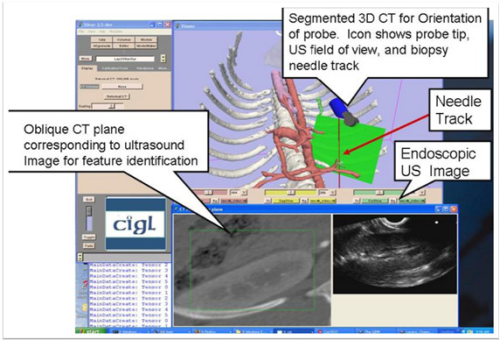




Vosburgh (Harvard)

US CT + US

3D CT-Guided Endoscopic Ultrasound



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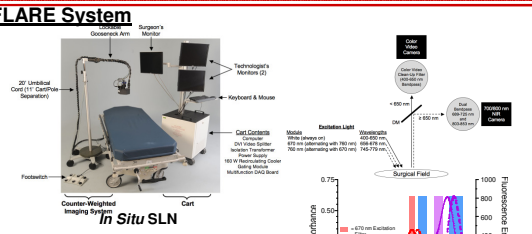
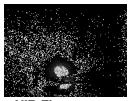
Fluorescence-Assisted Resection

FLARE System



In Situ SLN

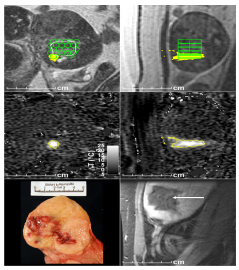


NIR Fluorescence

Color Video

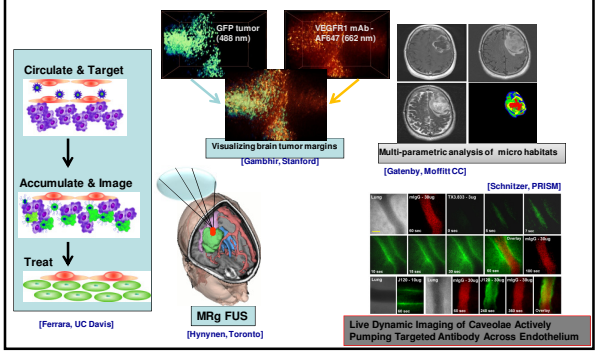
Frangioni (Harvard) 10

MR-guided Focused Ultrasound

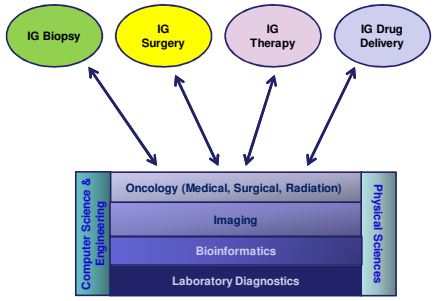


Tempany, Jolesz (Harvard) 11

IGI: Convergence of multi-modality imaging, molecular and informatics sciences toward individualized treatment of cancer



Foundations of IGI



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Why an Open Science Approach in IGI?

- Technology-driven multi-disciplinary field
- Innovation inflation: Variety of options and approaches

➢ Need for multi-center assessment of technologies
➢ Need for more seamless translations

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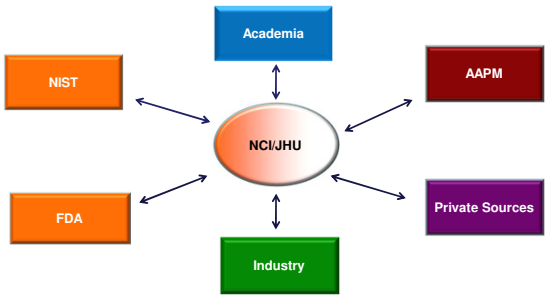
Collaboration on an Open Science Framework for Assessment of Technologies in IGI



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AAPM - TAC

- **Technology Assessment Committee**
  - **Work Group: Assessment of Technologies in IGI**

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Technology Assessment

1. **Identification of assessment topic & objectives**
2. **Validation data sets: simulation, phantom, pre-clinical, clinical**
3. **Validation metrics**
4. **Common terminology & methodology for validation procedures**

- **ID sources of uncertainty**
- **Quality assurance**
- **Improved clinical translation & clinical Trials**

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IGI Technology Clouds

IGI Track	Assessm't Objectives	Validation Data sets	Validation Metrics	CDE	Common Methodology	QA	Regulatory Requirement s / Guidelines	Algorithm & Code
IG-Bx/Sx	•Accuracy •Precision •Reproduc'ty •Specificity • Etc.		•TRE •TE •FPE •Sx Margin •Etc.					
IGT	•Registration •IG & Tx delivery •Etc.							
IGRT	•Registration •IG & Tx delivery							
IGDD	•Toxicity •Biodist •Specificity •PK/PD							

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Initial Projects & Task Groups

3D C-Arm

Siewerdsen (Hopkins)
Fahrig (Stanford)
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US-guided Surgery

Vosburgh (Harvard)
Boctor (JHU)
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Robot-assisted Biopsy

Cleary (Children's, DC)
Stoianovici (Hopkins)
Peters (Robarts Inst.)
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Focused Ultrasound

Chopra (UTS)
Schlesinger (UVA)
Stafford (MD Anderson)
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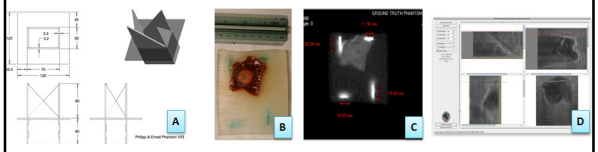
Products: TG Reports + Open Tools

3D US-Guided Surgery: Validation Phantom



Multi-modality Ground-Truth Phantom. (A) Phantom model. The physiological phantom is embedded between the triangular blades. (B) Gross pathology slice showing liver with RF ablation region and triangle-blade sections in the surrounding gelatin. (C) CT reconstruction slice corresponding to gross pathology cut. (D) 3D-B-mode reconstruction with fiducials triangle and plane intersections visible.

Boctor (Hopkins)

Future Task Groups

- **IG Radiation Therapy**
- **Optical IG-surgery**
- **IG Drug Delivery**

Goals of TAIGI Work Group:

1. Establish Task Groups through AAPM
2. Establish the IGI Technology Cloud
   - Explore Grand Challenges in IGI
3. Develop an open science framework for IGI

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