Advancing Neurosurgery......
through Space Technology

ISS Conference, Denver, July 2013
iMRI and Robotics
International Adoption: Image-guided Surgery
International Adoption of iMRI

55 IMRIS sites worldwide
Where the robot entered my brain.

“Tara Nickerson, the first person to have brain surgery performed by a robot. The machine is called neuroArm, and it was created by Dr. Ginette Sutherland. Her team and students from the University of Calgary’s Faculty of Medicine. It allows surgeons to operate with unprecedented precision and confidence. Now that neuroArm has removed the tumor from my brain, it will go on to help many other people like me around the world.”

For research and innovation that is changing our world, look to the U of C. Come, learn and be inspired. Visit us at ucalgary.ca
Perseverance
Information Age Surgery

- Discovery of X-rays
- Stereotaxy
- Cerebral Angiography
- Electrocautery
- Radioisotope Imaging
- CT Imaging
- Osmotic Diuresis
- Surgical Microscope
- Intraop CT
- Intraop MRI
- Endovascular Coils
- Intraop MRI
- MRI
- PUMA 200
- Minerva
- NeuRobot
- SpineAssist
- NeurMote
- Evolution 1
- neuroArm
1.5T = 986
3.0T = 594
1580
n > 9000 worldwide (IMRIS)
Patient-specific Anatomy

During Surgery
Current Limitations

Pre-Surgical  Post-Surgical

2.3 z 10.0
Collaboration
Beyond Our Reach?
Tool Exchange
Can touch be translated electronically?
<table>
<thead>
<tr>
<th></th>
<th>Nano17 Stainless Steel</th>
<th>Nano17 Titanium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resolution</td>
<td>0.318 gram-force</td>
<td>0.149 gram-force</td>
</tr>
<tr>
<td>Max Threshold</td>
<td>12 N</td>
<td>8 N</td>
</tr>
<tr>
<td>Weight</td>
<td>9.07 g</td>
<td>10.1 g</td>
</tr>
<tr>
<td>Diameter</td>
<td>17 mm</td>
<td>17 mm</td>
</tr>
<tr>
<td>Height</td>
<td>15 mm</td>
<td>15 mm</td>
</tr>
<tr>
<td>Torque Overload</td>
<td>±1.6 Nm</td>
<td>±1.0 Nm</td>
</tr>
</tbody>
</table>

**Force Sensors**

- **Nano17 Stainless Steel**
  - Diameter: 17 mm
  - Height: 15 mm
- **Nano17 Titanium**
  - Diameter: 17 mm
  - Height: 15 mm

![Diagram of force sensors](image)
Quantifying Surgery
Astrocytoma Grade II
Astrocytoma Grade II
Disseminated Medulloblastoma

April 6 DI

MR T1 Gd

May 1 iMRI

MR T1 Gd
Steady hands
Image-Guided Robotics

T2 TSE @ 3T

Control Scan

neuroArm in bore with biopsy probe
Solution...

Live Man’s Switch
Image Guided Robotic Surgery
Surgical Performance/Haptics Laboratory
Customizing Robotics with 3D Printing
Training and Education
Virtual Reality and Robotics
Looking Forward
“Nothing is certain and everything changes”