TATRC Programs in Image-Guided Therapy

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The views expressed in this briefing are those of the author and do not reflect official policy or position of the Department of the Army, Department of Defense or the U.S. Government
TATRC: Our Community and its Needs

Tricare
(Active, Retired, Beneficiaries)

Healthcare
(Cancers, Circulatory Disease)

Soldier Performance
(Psychological/Physiological)

Prevention, Detection, Diagnosis and Treatment

Combat Casualty Care
“Boots on the ground”

Trauma Care
(PTSD/TBI, Bleeding, Amputations, Burns)
Conventional Technologies: Detection and Diagnosis

MRI/S
- Soft tissue
- Nondestructive
- Functional Imaging
- High Resolution
- Penetrates All Tissues
- Ferromagnetic interference
- Not Portable
- Limited to 3T for humans

CT/XRAY
- Bone
- Functional Imaging (PET)
- High Resolution
- Penetrates All Tissues
- Ionizing Radiation
- PET requires radiotracers
- CT can require contrast agents

Ultrasound
- Combination
- Nondestructive
- Highly Portable
- Functional Imaging
- Monitor Tissue Properties
- Images can be hard to acquire/interpret
- Sensitive to gas/bone
- Requires Skin Contact
- Poorer Spatial Resolution
Medical Imaging Technologies: Roadblocks for Trauma Care

In the Combat Support Hospital:

• One tool “to do it all”
• Ease of use
• Morbidity of combat-related injuries
• Portability, Maintainability, Reliability

Limitations of Imaging Techniques:

• What more can we do with current technologies using photons, particles and sound waves?
• Where are the standards and models? (acquisition-related, post-processing, instrumentalional,...TISSUE)
• How do we get a tool with sub-millimeter spatial resolution and deep-tissue penetration?
Optical Imaging:

Pathologies:

• Burn (Monstrey et al.)
• Wound (Singer et al.)
• Neuroimaging (Arenth et al.)
• Infection (Naumann et al.)
• Bone (Camacho et al.)

Limits of Current Studies:

• Tissue modeling in terms of photonic properties
• Developing a consensus amongst established researchers for image acquisition parameters and experimental conditions for each pathology

Efforts @ TATRC:

• Terahertz imaging of burn
• Hyperspectral imaging for detection and treatment of skin cancers
• SBIR/STTR topics
Neurotrauma: The Military Challenges

- Co-existence of TBI and PTSD; but no clear association

- Links of mTBI to other diseases such as PD (Bower 2003) and AD (Plassman 2000)

“We want to help you come all the way home” – BG Sutton 2009
Dr. Vannier of the University of Chicago is focused on developing acquisition and post-processing standards for DTI.

TATRC has worked with the DVBIC, Siemens and the American College of Radiology to develop new visualization software that uses an XIP format for image processing with anatomical data for a telemedicine application (Right: DTI/MRI/Anatomically co-registered image from a thumb tapping experiment).
Medical Imaging Technologies: Cancers
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<th>PORTABLE IMAGING AND IMAGE GUIDED THERAPIES</th>
<th>HIGH PERFORMANCE RADIOLOGY</th>
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<tr>
<td>Portable X-Ray</td>
<td>Higher sensitivity CT and PET designs</td>
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<tr>
<td>Ultrasound</td>
<td>Higher sensitivity MR Coils/instrumentation</td>
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<td>Portable EEG</td>
<td>Radiological and anatomical standards</td>
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<td>Advanced surgical camera</td>
<td>Better small molecule tracers</td>
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<th>ADVANCED SURGICAL CAMERA</th>
<th>COMPUTER ASSISTANCE IN DIAGNOSIS</th>
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<td>Incorporate new materials</td>
<td>Treatment planning and simulation</td>
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<tr>
<td>Algorithm development (post-processing)</td>
<td>(controls: patient movement, procedure to procedure, patient to patient)</td>
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<td>Spectral libraries based on anatomy/pathology</td>
<td>Development of open software platforms for image registration/segmentation</td>
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<td>Deep tissue models of targeted pathologies</td>
<td>Novel data visualization schemes/...</td>
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Questions:

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