

## Joint Base San Antonio (JBSA), Fort Sam Houston; Rehabilitation Sciences Research Lab

Located at JBSA-Fort Sam Houston, TX, the U.S. Army Medical Center of Excellence (MEDCoE) is home to the #13 ranked physical therapy program in the nation – the US Army-Baylor University Doctoral of Physical Therapy Program.

### **The Rehabilitation Sciences Research Lab (RSR)**

The 1,500 square foot research space in Willis Hall is conveniently located close to key clinical facilities on the joint base, including Brooke Army Medical Center (BAMC), the Center for the Intrepid (CFI), Wilford Hall Ambulatory Surgical Center, and the Soldier's in Training Clinic (SIT). The extensive resources of the RSR's include the following:

#### *Biomechanical Motion Analysis*

- Instrumented Walkway with two Optima BMS400600 High Frequency 6-channel AMTI (Advanced Medical Technologies Inc., Watertown, MA) force plates embedded in the center of a 10m walkway. Individual strain gage force plates have a maximum capacity of 17,800N, COP accuracy of less than 0.5mm, and sensitivity of 0.04  $\mu\text{V/V-N}$ .
- Fully Instrumented Bertec Split Belt Treadmill (Bertec, Columbus, OH) with a full overhead support structure and harness and two 1.5m x 0.5m independent 6-channel force measuring walking/running belts. Each belt has a maximum load of 10,700N, speed range of 0-24kph, acceleration range of 0-25m/s<sup>2</sup>, and can inclined/decline to 15 degrees.
- VICON 3D Motion Capture System consisting of 10 Vantage V5 cameras (Vicon Motion Systems LTD, Oxford, UK). Fully integrated with both the instrumented walkway and treadmill, the system can sample at 420fps at a resolution of 5 megapixels with a maximum speed of 1,200fps in high-speed mode.
- VICON Lock+ Synchronization System (Vicon Motion Systems LTD, Oxford, UK) with 64-channel connectivity and 16-bit A/D conversion. The unit provides Gigaset synchronization for all Vicon equipment, broadcast sync input including Vertical Interval Timecode (VITC) from an external video source, Longitudinal Interval Time Code (LITC) input, 3-pin mini-DIN socket for video electronics standards association (VESA) sync input and output, remote control input stop/start for third-party trigger devices, and eight standard programmable phono sockets for external device synchronization using General Purpose Output (GPO) signals.
- Bertec Portable Essentials Dual-Balance force platform with Bertec Balance Advantage Software (Bertec, Columbus, OH). The system performs and assesses numerous standard balance assessment protocols (mCTSIB, LOS, RWS, US, WBS, etc.) and includes the upgraded COBALT balance assessment for screening, assessment, and treatment of high-end athletes.
- Hawkin Dynamics HD (Hawkin Dynamics, Inc., Westbrook, ME) functional assessment system with two 4060-05 Portable 6-channel Bertec force plates (Bertec, Columbus, OH) synchronized through a Hawkin Wireless Box. The system provides real-time feedback and immediate reports of numerous competitive athletics functional assessments such as the Countermovement Jump, Squat Jump, Drop Jump, Isometric Test, Multi Rebound, and CMJ Rebound. The 6-channel force plates sample at 1,000Hz, have a max load of 21,500N, and resolution of less than 0.4N.
- Two 8-sensor APDM (APDM Corporation, Portland, OR) wearable sensor motion analysis systems. Each Opal Monitor has a sensor suite consisting of a triaxial accelerometer, gyroscope, and magnetometer. All sensors operate on a 32-50Hz bandwidth with a 12-16-bit resolution, and a sampling rate of 20-200Hz. The accelerometer has an adjustable range of  $\pm 16g$  or  $\pm 200g$ , the gyroscope has a fixed range of  $\pm 2000$  deg/sec, and the

magnetometer a fixed range of  $\pm 8$  gauss. Data between sensors are synchronized via accompanying software and may be logged independently by the sensors or streamed directly to a PC. Analysis may be performed via accompanying software or exported to 3rd party software packages for analysis.

- SWAY Balance System (SWAY Medical, Tulsa, OK) application offers on-field and clinical assessment of balance and cognitive symptoms related to mild traumatic brain injuries that can be performed on a mobile device (smart phone, tablet, etc.).
- HUDL High Speed video (Agile Sports Technologies, Inc., Lincoln, NE) performance analysis application able to capture, replay and analyze functional movements in super slow motion (up to 240fps).
- Shimmer3 Inertial Measurement Unit (IMU) (Shimmer Sensing, Dublin, IE) 14 sensor Consensus bundle. 24MHz MSP430 CPU, dual-mode accelerometer (ultra-low noise or wide range), Bluetooth capable, and integrated motion processor for onboard 3D orientation estimation.
- ActiGraph GT9X Link (ActiGraph, LLC., Pensacola, FL) wearable activity monitors. The wearable inertial measurement units feature triaxial accelerometers, gyroscopes, and magnetometers, and include hardware signal filters and high-resolution LCD displays with optional real-time feedback.

#### *MSK Ultrasound Imaging*

- Supersonic Imagine Aixpolarer Ultrasound (Diagnostx, LLD, Tampa, FL) Elastography System with proprietary ShearWave technology. Device features include Power Angio, Pulse Wave doppler, panoramic imaging, contrast imaging and speckle reduction.
- 4 x Sonosite M Turbo (Fujifilm Sonosite, Inc., Bothell, WA) ultra-compact portable ultrasound machines. Devices features M-Mode, PW Doppler, SCW doppler, Tissue harmonic imaging, speckle reduction, spatial compounding, DICOM 3.1, Auto IMD, needle recognition, live dual mode, and Auto optimization.
- 10 x GE VSCAN Air (General Electric, Co., Chicago, IL) fully portable handheld wireless ultrasound imagers. Devices have curved and linear probes for both deep (2-5 MHz; 24cm) and shallow (3-12 MHz; 8 cm) scanning, feature both B and Color Flow modes, and synch wirelessly with standard smart devices running the intuitive user interface application.

#### *Muscle Function*

- HUMAC Normal Dynamometer (Computer Sports Medicine, Inc., Stoughton, MA) with attachments to perform shoulder, elbow, wrist, hip, knee, ankle, and back isolated motions. Continuous passive motion, isokinetic, isometric, isotonic, and zero gravity modes. Velocity range of 1/16 to 500deg/sec and max torque of 678Nm. Includes HUMAC E-Stim Software Module with associated Digitimer Electrical Stimulator (Digitimer Ltd., Welwyn Garden City, UK) and PowerLab 16/35 EMG data acquisition system (AD Instruments Inc., Colorado Springs, CO).
- Noraxon Telemetry wireless EMG system (Noraxon USA, Scottsdale, AZ). Sixteen-channel TELEmyo DTS EMG with myoMUSCLE Master Software.
- Myoton digital palpation (Myoton AS, Tallinn, ES) soft tissue assessment device.
- Commander Echo Algometer (JTECH Medical Industries, Inc., Midvale, UT) tissue pressure sensor.

#### *Neuroimaging*

- NIRSport2 mobile functional near-infrared spectroscopy (fNIRS) system (NIRx Medical Technologies, LLC, Glen Head, NY). Sixteen high powered dual LEDs 32mW max illumination and high performance SiPD detectors with down to 33 pW sensitivity. Ultra-fast source and detector specific signal optimization. Aurora fNIRS recording software with real-time HbO and Hb concentration change visualization in multiple display modes.

### *Software*

- MATLAB (MathWorks, Inc., Natick, MA)
- LabVIEW (National Instruments, Austin, TX)
- Visual 3D (C-Motion, Inc., Boyds, MD)
- Vicon Nexus (Vicon Motion Systems LTD, Oxford, UK)
- Superlab Pro 6 (Cedrus Corp., San Pedro, CA)
- NetForce (Advanced Medical Technologies Inc., Watertown, MA)
- ProCalc (Vicon Motion Systems LTD, Oxford, UK)
- SPSS (SPSS Inc., Chicago, IL)

### **The Clinical Simulation Labs**

Three adjacent laboratories spaces provide a combined 4,000 square open plan floor space for clinic simulation activities. Includes all standard physical therapy rehabilitation modalities and functional training equipment including treadmills, a dynamic unweighting system, and modality machines. Incorporated in the space is a 1,000 square foot performance training area with full body strength and condition equipment. The simulation space can also be configured for semi-private consultation or a dynamic overground obstacle negotiation course.

### **Research Population**

Joint Base San Antonio (JBSA) is home to Military Medical Training for all branches of the armed forces as well as Air Force Basic Training and Air Force Special Operations Training. Our researchers have ready access to a wide range of Army, Air Force, Marine, Navy and Coast Guard tactical athletes training in highly demanding occupational specialties such as Army Combat Medics, Navy Corpsmen, and Air Force Pararescue Jumpers. The 30,000 Soldiers, 35,000 Airmen, thousands of Trainees from other services trained annually, along with the tens of thousands of Active-Duty personnel providing support and instruction offer a unique opportunity to explore musculoskeletal, neurologic, and psychosocial conditions affecting both this population and the wider public. Also located at JBSA is the Military's premiere medical center, Brooke Army Medical Center (BAMC), a Level 1 Trauma Center with world class Amputee, Burn, and Limb-Salvage units, serving over 240,000 military healthcare beneficiaries in the greater San Antonio region.

### **Allied Health Graduate Program Collaborations**

Army-Baylor DPT researchers benefit from close collaboration with faculty and students of both on- and off-site Army-Baylor Allied Health Graduate Programs including:

- Division 1 Sports Physical Therapy Doctor of Science Fellowship, United States Military Academy, West Point, NY
- Orthopaedic Manual Physical Therapy Doctor of Science Fellowship, JBSA, TX
- Master's Program in Nutrition, JBSA, TX
- Doctor of Science in Occupational Therapy, JBSA, TX
- Occupational Therapy Doctoral Program, JBSA, TX