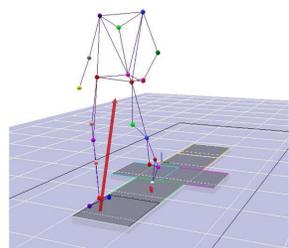
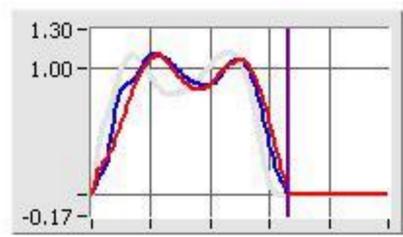
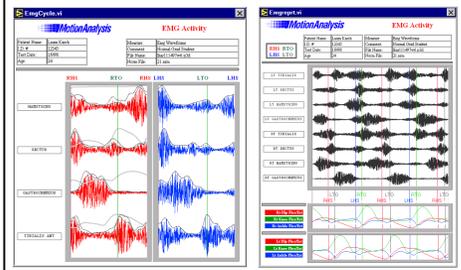


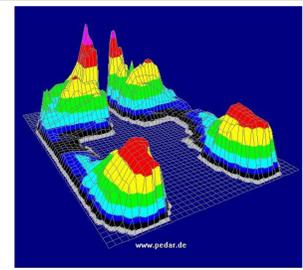
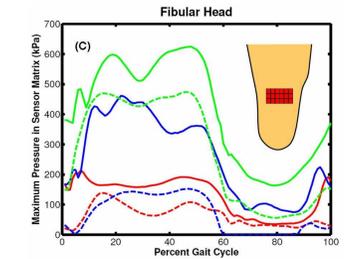
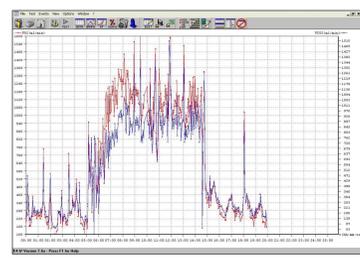
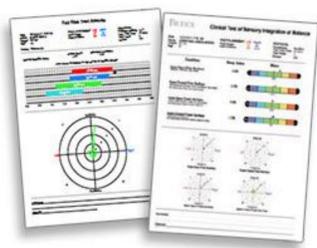
# The Jesse Brown VA Medical Center - Motion Analysis Research Laboratory: A Tool for Studying Human Movement and Evaluating Prosthetic and Orthotic Performance

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**Introduction:** The Jesse Brown VA Medical Center - Motion Analysis Research Laboratory (JBVAMC-MARL) is a state-of-the-art human movement research laboratory designed specifically for making measurements necessary for quantifying human movements. JBVAMC-MARL is used to increase understanding of normal gait, and to compare and evaluate the gaits of persons who walk with prostheses and orthoses, which we hope will lead to improved design of these devices. All of the measurement systems in JBVAMC-MARL are integrated with each other to allow for the synchronized collection of data in order to provide a comprehensive overview of the particular human movement activity. JBVAMC-MARL contains eight major equipment components, described briefly below:

Equipment	Function	Sample Data
 <p><b>Digital Motion Capture System</b> (Motion Analysis Corporation)</p>	JBVAMC-MARL is equipped with an 12-camera Digital Real-Time motion measurement system capable of sampling at 300 Hz at full resolution (12MP) and windowed resolutions at higher frame rates. The cameras track the positions of reflective markers that are placed on anatomical landmarks of the legs, pelvis, and upper body. The marker positions are used to define a rigid link-segment model of the body in the computer, from which instantaneous positions and orientations of body segments can be determined.	
 <p><b>Biomechanics Force Platforms</b> (Advanced Medical Technology, Inc.)</p>	Six force platforms are embedded flush with the floor in the center of a 10M walkway in the laboratory. The force platforms are placed end-to-end to enable capture of a full stride of gait at the fastest speeds of walking. Two of the platforms are turned crossways to facilitate study of crutch ambulation or study standing balance. The force platforms measure three force components and three moments. This information can be used in conjunction with the kinematic data to calculate joint moments and forces.	
 <p><b>16-Channel Wireless EMG</b> (Delsys, Inc.)</p>	The 16-channel EMG plus tri-axial Accelerometer system permits muscle activity and 3D accelerations to be measured noninvasively from electrodes placed on the surface of the skin. The system is completely wireless; synchronous data (EMG and 3D accelerations) is acquired through small, light-weight electrodes worn by the subject and transmitted via Wi-Fi to a receiver that interfaces with the computer. The data is used to identify compensatory strategies that are utilized by persons with pathologic gait.	
 <p><b>Digital Video Subsystem</b> (Sony, Panasonic, Videonics)</p>	The digital video subsystem consists of two digital camcorders, a DVD recorder, a monitor, and a video mixing board. The system is used to record simultaneous coronal and sagittal plane views of research subjects and merge the images into a single display. This provides a succinct video record of JBVAMC-MARL experiments that can assist with the interpretation of the acquired quantitative data and aid understanding.	

Equipment	Function	Sample Data
 <p><b>Pedar Insole Pressure System</b> (Novel Electronics, Inc.)</p>	The <i>pedar</i> system measures in-shoe dynamic pressures between the foot and the shoe or the foot and device (prosthetic or orthotic). The insoles connect to conforming, elastic sensors that cover the whole plantar surface of the foot. The system is wireless and can be synced with the Motion Analysis System for gait analysis. The <i>pedar</i> system allows us to measure peak and mean pressures, contact area, and pressure time integrals for the whole foot or for specific regions of the foot.	
 <p><b>Pliance In-Socket Pressure System</b> (Novel Electronics, Inc.)</p>	The <i>pliance</i> system measures in-socket dynamic pressures between the residual limb and the prosthetic socket in persons with amputations. The pressure elements contain high-tech elastomers that conform to socket contours. The sensors are available in various sizes, sensor configurations and pressure ranges. The system is wireless and can be synced with the Motion Analysis System for gait analysis. The <i>pliance</i> system allows us to measure peak and mean pressures, contact area, and pressure time integrals.	
 <p><b>Energy Expenditure System</b> (Cosmed USA, Inc.)</p>	The Cosmed system is a portable system for pulmonary gas exchange analysis on a breath by breath basis. This system allows us to evaluate the energy expended during activities such as walking and to assess the effect of different prosthetic and orthotic interventions. The system is wireless and can be used in almost any environment. The system allows us to measure heart rate, oxygen consumption and carbon dioxide production, as well as to calculate energy cost.	
 <p><b>Biodex Balance System SD</b> (Biodex Medical Systems, Inc.)</p>	The Biodex Balance System SD is used to evaluate dynamic balance and fall risk. The system is used to assess a subject's neuromuscular control by quantifying their ability to maintain dynamic single or double leg postural stability on either a static or unstable surface. The system allows us to measure a subject's ability to maintain their center of balance, their ability to move and control their body center of mass, and their ability to remain upright and balanced on unstable surfaces.	

**Conclusions:** JBVAMC-MARL is a powerful resource that permits researchers to quantify human movement by providing researchers, and ultimately clinicians, with a more complete knowledge and a better understanding of the mechanical interactions that occur between humans and prosthetic/orthotic systems. This knowledge contributes to improved fitting and the manufacturing processes for these systems, and potentially helps individuals using these devices to lead an improved quality of life.

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