

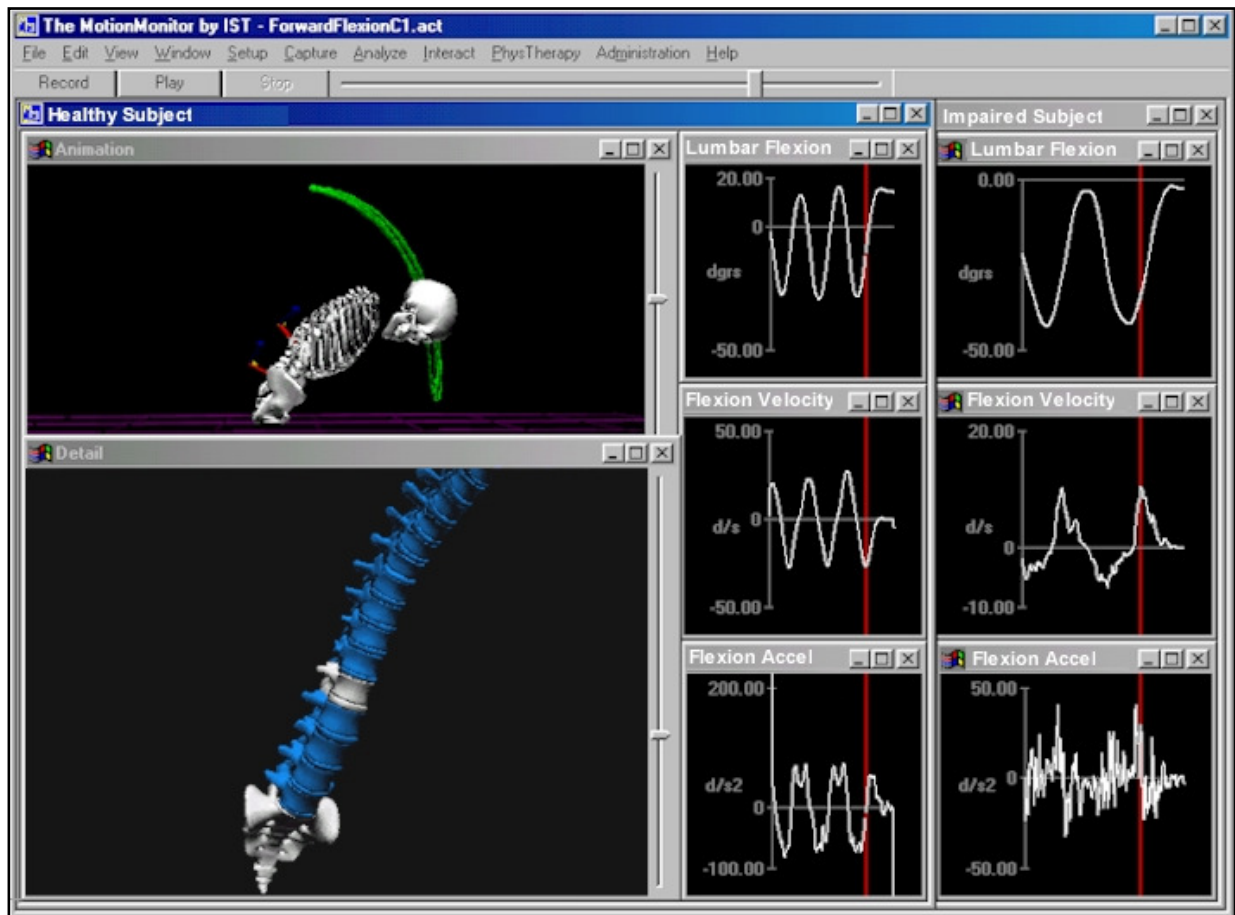


**The MotionMonitor** base unit shown here with Ascension magnetic trackers, Extended Range Transmitter and Bertec non-conductive forceplates.

*the most advanced data acquisition and analysis system in the market place offers precise measurement of human motion for applications in...*

## Spine Vertebrae Movement

- Digitize anatomical landmarks to define the dimensions of each vertebra in the segment.
- Analyze inter-vertebral movements or vertebral movements relative to a fixed segment.
- Use defined protocols, such as the ISB recommendations, to assign specific axes layouts and Euler angles sequences. Alternatively, use default axes for quick setup in a clinical setting.



Above is an image of a forward flexion activity for a healthy 26 year old athlete. The data on the right is from a 45 year old sedentary lawyer with back pain. In the detail spine animation, the vertebrae that appear in white have sensors attached to them. Here, sensors were assigned to T1, L1 and the sacrum for tracking these individual segments as well as the movement of their respective spinal columns. The graphs below display the degrees of lumbar flexion, flexion velocity and flexion acceleration. While the range of motion is similar for each, note the differences in the smoothness of velocity and acceleration.



...The Total Solution in Motion Capture®

The MotionMonitor™ is a trademark of Innovative Sports Training, Inc.

Real time **data** acquisition, analysis, and 3D visualization.  
Turnkey **hardware** solutions. Upgradeable as your needs change.  
Research Design & System Engineering **consultation**.

Innovative Sports Training, Inc. • 3711 North Ravenswood Avenue • Chicago, Illinois 60613 USA  
[www.innsport.com](http://www.innsport.com) Telephone: 773.244.6470 email: [support@innsport.com](mailto:support@innsport.com)

**The MotionMonitor** is a totally integrated 3D data collection system for use in clinical, biomechanical, neuro-control, and sports medicine applications involving the analysis of complex motion. Data from Ascension magnetic trackers, NDI Optotrak optical sensors, Polhemus Fastrak / Liberty, SR Research's EyeLink<sup>®</sup> II, Motion Analysis Corp & Qualisys passive video sensors, EMG, forceplates, video, and other analogue devices are collected by The MotionMonitor, fully synchronized, and presented in real time with state-of-the-art computer renderings and graphic displays. Data output includes all kinematic and kinetic data including joint forces and moments computed with either a top-down or bottom-up inverse dynamics model. Angle data is available as quaternions, cosine matrices, Euler angles, Grood & Suntay angles or projection angles. The user can specify the reference frame, rotation sequence, and axes layout in post-processing. User-defined data can be generated using standard math notation. Data can be reported in either the time or frequency domains and includes filtering functionality. Full body biomechanical computer renderings include stick figures, skeletons, and humanoids. Detail renderings include high resolution images of hand, foot, and spine as well as user-generated mesh files.



*The MotionMonitor supports real-time collection from all of the popular passive and active optical tracking*

**The MotionMonitor** support team offers a comprehensive package of services designed to meet the unique requirements of each client's research. Services include turn-key systems design, integration of existing client hardware, maintenance, warranty protection, training, and support following installation. Worldwide, IST has built a dedicated following among university researchers.

**Position Capture Technology by Motion Analysis Corporation** – passive optical three degree-of-freedom markers and 6 degree-of-freedom rigid bodies.

**Sampling Rate:** up to 2,000 Hz camera frame rate and up to 10,000Hz sensor frame rate, depending upon camera type and settings

**Resolution:** Up to 2352x1728, over 4 million pixels

**Position Capture Technology by Qualisys** - passive optical three degree-of-freedom markers and 6 degree-of-freedom rigid bodies.

**Sampling Rate:** up to 1,000 Hz depending upon camera type.

**Resolution:** 1 in 60,000 of field of view.

**Position Capture Technology by PhaseSpace**- active optical three degree-of-freedom markers and 6 degree-of-freedom rigid bodies.

**Sampling Rate:** up to 480 Hz.

**Resolution:** 3600 x 3600 for 12.4 megapixel.

**Position Capture Technology by Ascension Technology** - magnetic six degree-of-freedom sensors.

**Sampling Rate:** 30 to 144Hz for each of two to fourteen sensors.

**Range:** Extended Range Transmitter will measure 12 feet (3.7m) from transmitter for total range of 24 feet (7.3m). Standard range will measure three feet (91cm) from transmitter for total range of six feet (182cm).

**Position accuracy:** Extended Range Transmitter: up to 0.3 inches (7.5mm) / 0.5 degrees at a five-foot (1.5m) distance from transmitter and 0.6 inches (15mm) / 1.0 degrees at a ten-foot (3m) distance from transmitter. Standard Range Transmitter: up to 0.07 inches (1.8mm) / 0.5 degrees at 36 inch (91cm) distance from transmitter. MiniSensors: up to 0.07 inches (1.8mm) / 0.5 degrees at 12 inch (30cm) distance from transmitter.

**Resolution:** Extended Range Transmitter: 0.03 inch (0.75mm) / 0.1 degrees at five feet and 0.1 inch (2.5mm) / 0.2 degrees at ten feet (3m) from transmitter. Standard Range Transmitter: is 0.03 inch (0.75mm) / 0.1 degrees at 36 inch (91cm) distance. Mini Sensors: is 0.02 inch (0.5mm) / 0.1 degrees at 12 inch (30cm) distance from transmitter.

**Position Capture Technology by Northern Digital** - active optical three degree-of-freedom markers.

**Sampling Rate:** up to 4,600 Hz divided by the number of markers.

**Range:** 34 degree field of view offers 2.6 x 3.5m space at 6m separation from the camera

**Position accuracy:** Up to 0.1mm RMS at 2.25m from sensor. 0.45 to 0.9mm RMS at typical operating distances.

**Resolution:** 0.01mm at 2.25m from camera.

**Position Capture Technology by Polhemus** – magnetic six degree-of-freedom sensors

**Sampling Rate:** Fastrak: 120Hz divided by the number of sensors (maximum 4) to be tracked; Liberty: 120Hz or 240Hz with four, eight, twelve, or sixteen sensors.

**Range:** Specifications below for Fastrak and Liberty at 36 inches (90cm), reasonable results up to 72 inches (180cm)

**Position accuracy:** Fastrak and Liberty: 0.03 inches (0.08cm) and 0.15 degrees RMS

**Resolution:** Fastrak: 0.0002 inches (0.0005cm) and 0.025 degrees; Liberty: 0.00015 inches (0.0004cm) and 0.0012 degrees

**Analogue Data:** 16 channels of A/D data collected on Measurement Computing's PCIM 1602-16 bit PCI board. Sampling rates up to 150kHz multiplexed. System will support up to four units for a total of 64 channels. Includes software for processing of forceplate and EMG data.

**A/D Interface Panel:** Sixteen A/D BNC connectors, four D/A BNC connectors, one DB25 male digital I/O connector, one DB25 female with jumpers for internal connection of Noraxon and Delsys EMG or Bertec Forceplate amplifiers. Connection from panel to Measurement Computing's PCI A/D card.

**Event markers** for event identification, motor control experiments and externalization of system timing pulses include LED's, Light Relays, FSR's and hand held event markers.

**Computer:** Pentium 4 Processor 2.8 GHz or faster with 2 GByte of RAM, 320 GB hard drive or larger, CD/DVD-RW, 19-inch LCD monitor, wireless keyboard and mouse, and Windows XP Professional operating system.

**Video Capture:** 30 fps, up to three cameras.

**Enclosure:** Desk top chassis or Shock mounted enclosure on casters suitable for shipping; 23 x 23 x 23 inches (58.4 x 58.4 x 58.4 cm).