



Phoenix Technologies Incorporated

High Performance Real-Time

3D Motion Capture Systems For Professionals

www.ptiphoenix.com

Scientific Advantages

Fully Automatic Calibration

By using the recently released VZAutoCal™, even a multi-tracker Visualeyez™ system is now fully automatically calibrated. No manual user calibration effort is required at all. Should any tracker gets bumped or moved during a capture, just wait for a second or two, and the system will recover the accurate calibration by itself!

Continuous Adaptive Calibration

VZAutoCal™ will also update the system calibration continuously if the user so chooses. It will make use of the data captured during a session and optimize the system calibration at intervals chosen by the user. The updating can be stopped at any time by the user if desired.

Reliable High Accuracy Data

Every individual Visualeyez™ tracker is factory-calibrated by instruments with 3D accuracies traceable to international standards. All data filters can be turned on or off. You can fully control the system and trust the data you get with absolute confidence.



Reliable Real-Time Operation

Visualeyez™ system can output the captured data within 0.5 milliseconds ($< 0.0005s$) from the time the marker light reaches the tracker. Since no marker identification problem will ever occur, the user can depend on receiving a correct marker's data within this timing for implementing autonomous real-time applications reliably.

Zero Wrong Data Probability

Wrong data is worse than no data. An optical marker can be partially occluded and yield inaccurate position data as a result. The larger a marker is the more likely it can be partially occluded, and the larger the introduced inaccuracy will be. Visualeyez™ system uses tiny LEDs as markers which are nearly impossible to occlude partially. Should partial occlusion ever occur, the introduced inaccuracy will still be very small. Hence there is practically zero probability of generating wrong data.

Setup Anyway You Like

Visualeyez™ systems do not require any illuminators to sense the marker positions. The trackers can face each other without causing any blinding problem. Hence they can be laid out and oriented in any way to capture the desired motions. For example, the chest motions can be captured directly even when a person is bending down by simply laying a tracker on the ground and pointing up at the chest area.

Huge Capture Space

Each Visualeyez™ system tracker can capture over a huge 190m² space. This is due to its exceedingly wide 90 degree angle operation. Therefore even a single- or two-tracker system is good enough for innumerable scientific applications.

Unique Multi-Rate Sampling

Sampling slow motions at high frequency would result in large amount of useless data, wasting storage space and any processing efforts. Visualeyez™ system allows different markers to be sampled at different frequencies to capture motions of very different speeds (e.g., the club head and the golfer's body) at about the same spatial resolution.





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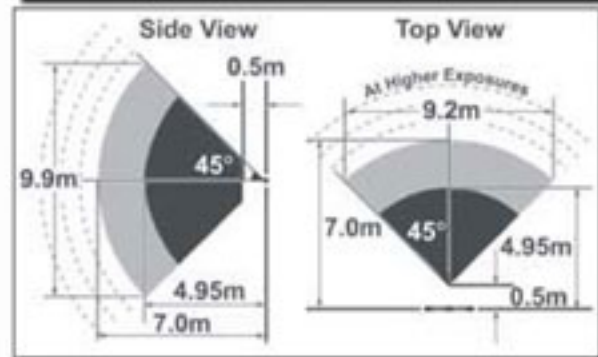
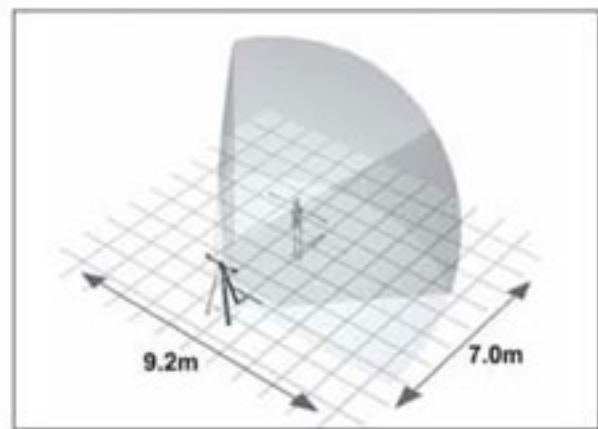
Scientific Advantages

Two-Way Synchronization with Other Equipment

The capture process of a Visualeyez™ system can be started and stopped by an external equipment (or device) in several ways. The system can also generate signals for triggering other equipment to operate synchronously.

Technical Specifications

Sensing Volume:	~ 190 m ³ of useful space, over 7m radius (at min. exposure)
Minimum Sensing Distance:	0.5 m
Position Resolution:	0.015 mm at 1.2m distance
Number of Markers:	512 max (no 'swapping' problems)
Number of Subjects:	512 maximum
Calibration:	Not required for an individual tracker Not required for multi-tracker systems either, if VZAutoCal™ is applied
Scalability:	Unlimited, 1-24 trackers tested
Accuracy (3D combined, nominal):	<0.5mm rms (H-series) 0.5-0.7mm rms (E-series) Calibration data range: 0.6-2.5m distance, +/-40° yaw, +/- 30° pitch
Operation Angle:	90° (+/- 45°) in both pitch and yaw; 107° diagonally
Sensing Rate:	4348 3D data points per second (single sampling) 4167 3D data points per second (double sampling)
Data Latency:	< 0.0005s at maximum sample rate
Computer Communication:	Serial RS232/RS422 (921.6kbps)
Mounting Orientation:	Any (no 'blinding' problems)
Ruggedness:	Can operate with up to 15G acceleration applied to the tracker (optional)
Tracker Bar Weight:	3 Kg



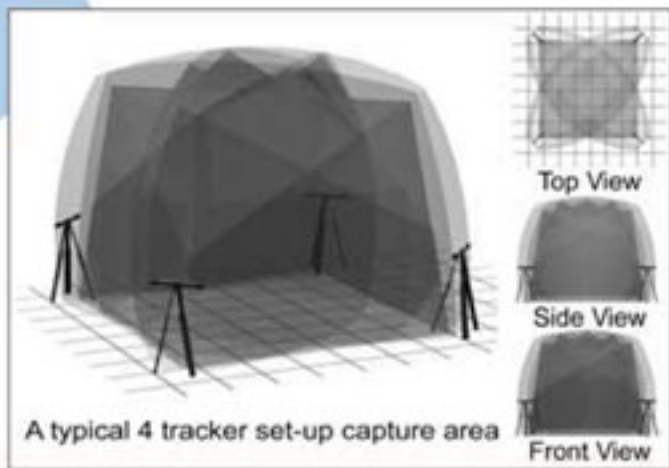
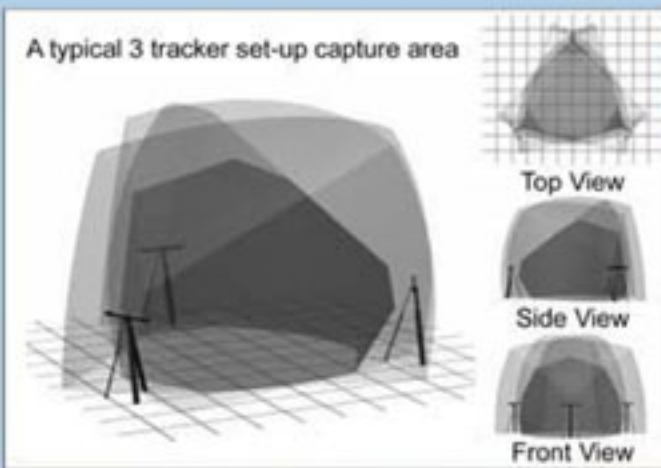
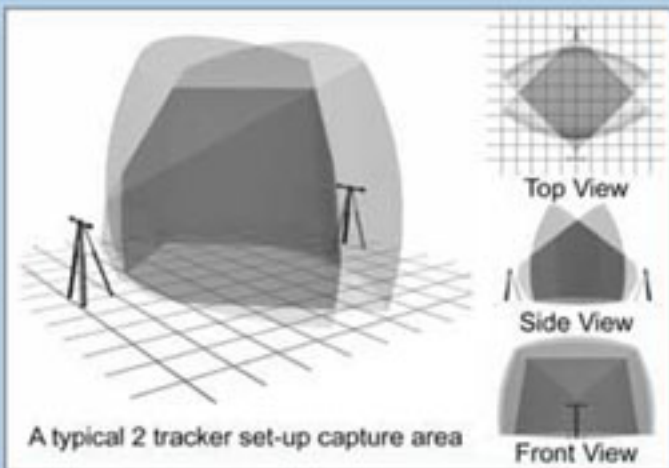
Single Tracker System

Consisting one single tracker, this simplest Visualeyez™ system is good for tracking 3D object motions with little rotational components (which are the main causes of occlusion). Example applications include walk studies, gait analysis, facial motion capture, machine vibration research, 3D digitization, etc.

Multi-Tracker System

For large range and/or complex motions with large rotation components, you may require a multi-tracker system to capture from different directions. An extra software, the VZAutoCal™, is now provided for operating such a system without requiring the user to do any manual calibration. VZAutoCal™ makes the multi-tracker system appear as if it were a more sophisticated single-tracker system. The advantages of a multi-tracker system include:

- Increased capture space
- Multi-directional capture of the markers to reduce occlusion and improve data quality
- Flexible capture space design as only one tracker needs to sense a marker to determine its 3D position



PTI Headquarters

4302 Norfolk Street, Burnaby, B.C.
Canada V5G 4J9
TEL: +1-604-321-3238
FAX: +1-604-321-3286
E-mail: info@ptiphoenix.com

PTI Asia Office

2F, No. 31, Lane 77, Xing-Ai Road
Neihu District, Taipei, Taiwan 114
Tel: +886-2-2793-6552
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Continuous Adaptive Calibration

VZAutoCal™ will also update the system calibration continuously if the user so chooses. It will make use of the data captured during a session and optimize the system calibration at intervals chosen by the user. The updating can be stopped at any time by the user if desired.

Easy Operation

It's very easy to operate a Visualeyez™ system for most motion capture applications:

1. Turn on the system.
2. Click on 'Auto Configure' (to connect the trackers to the computer).
3. Start 'Auto Detect Targets' (to identify which markers are being used).
4. Set desired capture frame rate and sampling period.
5. Press 'Record' to start motion capture. (The system will calibrate automatically!)

Highly Portable & Easy To Set Up

Lightweight yet rugged design makes a Visualeyez™ system the most portable motion capture system available. A 4-tracker system can be transported or checked in as baggage on flights by two people to anywhere, then set up and start to operate within about 30 minutes!

Scalable To Meet Capture Requirements

The size of a Visualeyez™ system, hence the capture area and complexity, can be easily scaled up or down to fit a specific motion capture application. A 1-tracker system is good enough for capturing 3D facial expressions and any other motions that do not contain much rotation. A 3-tracker system can capture full-body, facial and even finger motions all at the same time! A 4-tracker system is good for capturing any types of motions and multiple actors simultaneously. Even larger system can extend the capture area indefinitely.

Setup In Anyway You Like

Visualeyez™ systems do not require any illuminators to sense the marker positions. The trackers can face each other without causing any blinding problem. Hence they can be laid out and oriented in any way to capture the desired motions. For example, two people entangled in mid-air may be better captured with some trackers lying on the ground aiming upwards.

Huge Capture Space

Each Visualeyez™ system tracker can capture over a huge 3D space. This is due to its exceedingly wide (90 degrees) sensing angles. A 4-tracker system can be easily setup to yield almost 6m x 6m capture area.

High Accuracy & Resolution

Every individual Visualeyez™ tracker is factory-calibrated by instruments with 3D accuracies traceable to international standards. The resolution is so high that while capturing the full-body motions of a person at a distance, his facial expressions can be captured at the same time.



Dynasty Warriors 3 characters
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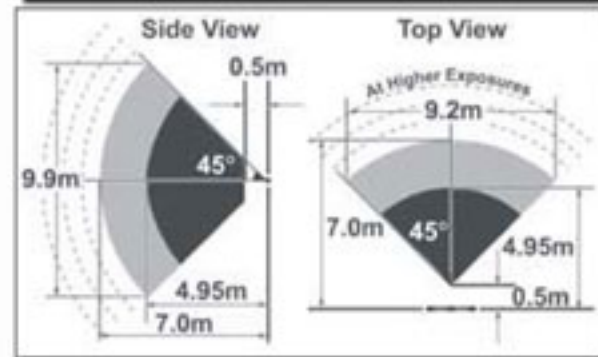
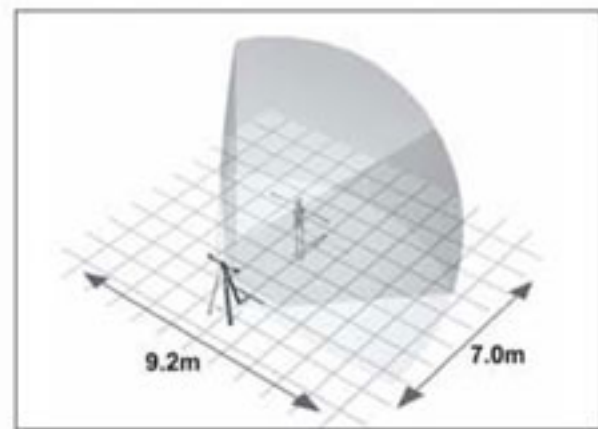
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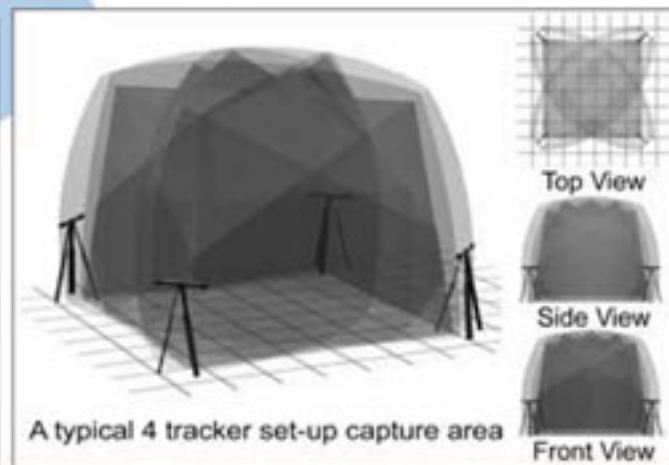
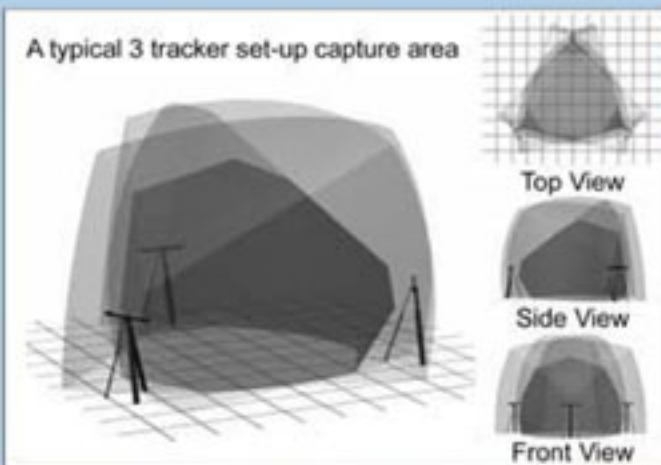
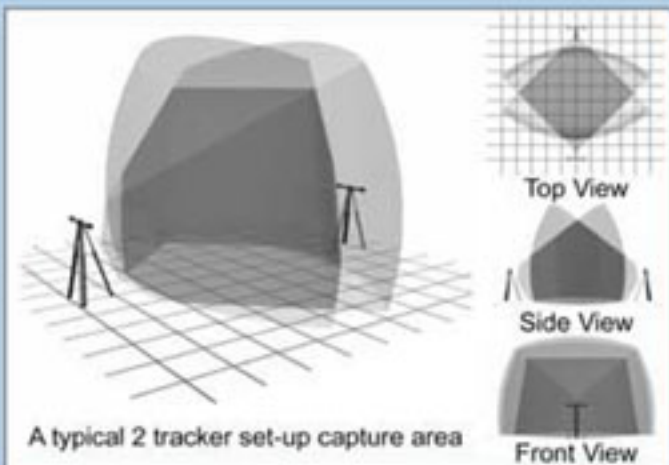
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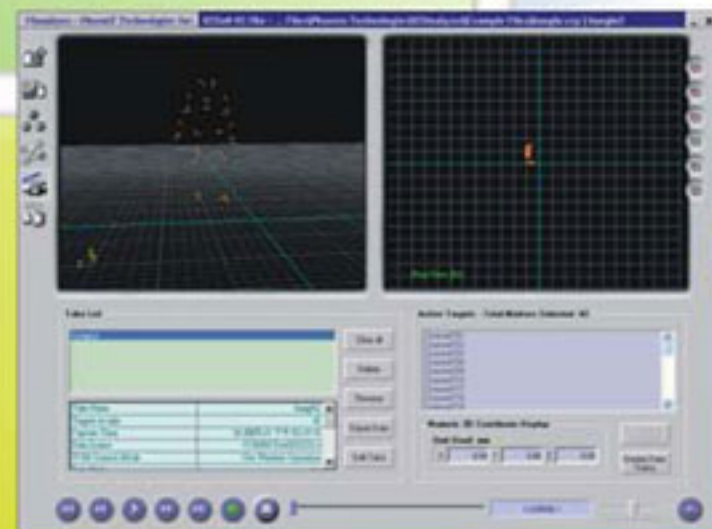
SOFTWARE

VZSoft™ Graphical User Interface

This is the very friendly user interface of every Visualeyez™ system. It allows you to control and setup the system to capture 3D motion data in the way you like. Then you can use it to view, edit, export or stream the captured data to many industry standard animation or scientific applications such as MotionBuilder, Maya, Softimage, 3D Max, Famous 3D, LabView, Matlab, Visual3D, Quest 3D, VRCO and VRPN.

VZSoft™ functions and controls:

- Auto or manual marker selection for capture
- Marker naming and labelling
- Random marker capture sequence editing
- Set sampling period and pattern to meet application needs
- Marker stick-figure definition and display
- Edit marker data
- Define Coordinate Reference Frame (Graphically or Scientifically)
- Display 3D marker positions in orthogonal and perspective views simultaneously
- Real-time data filtering and smoothing
- Auto repeat for repetitive captures
- Stream data to application software in real time or during playback
- Record, replay and convert data
- Digitize 3D objects with optional VZProbe™



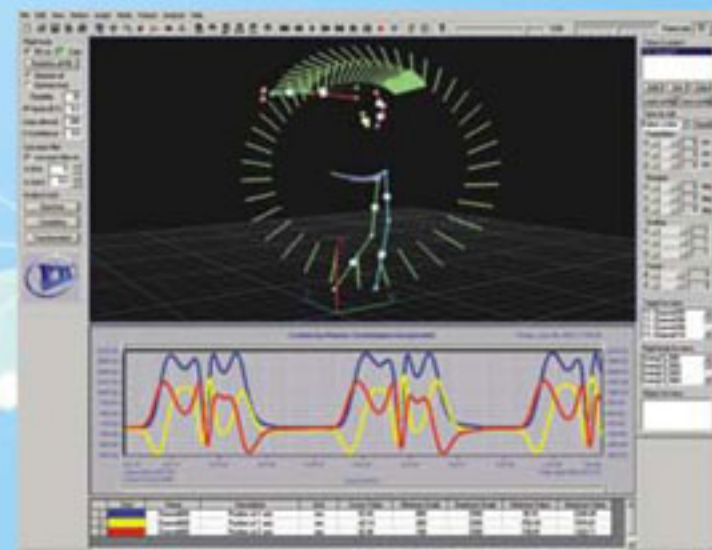
VZAutoCal™

VZAutoCal™ is for motion capture with a multi-tracker Visualeyez™ system (an 'MTS') without having to do any manual system calibration! Its basic functions are: 1. Transmit user commands (via the VZSoft™ GUI) to the trackers; 2. Gather the multiple data streams generated by the trackers and fuse them together; 3. Send the single fused data stream (as the MTS output) back to the VZSoft™. In order for VZAutoCal™ to fuse the data properly, the position and orientation of each slave tracker relative to the master tracker must be accurately determined. This process is called 'system calibration'. To date all other motion capture systems require this process to be carried out with manual labour work from the user in a separate calibration procedure done before a capture session. VZAutoCal™ not only performs this process automatically at the start of a capture session, but can also repeat the process periodically to keep the system calibration in the most accurate state continuously. Thus a capture session with a Visualeyez™ system is started simply with the actor(s) walking into the capture area. There is no need for the user to manually calibrate the system at all!



VZAnalyzer™

This toolbox provides functions for real-time or offline data processing, analysis and feedback purposes. Angles, rigid bodies (for occlusion compensation), etc. can be easily calculated. The motion tracing and graphing functions can plot a multitude of physical parameters of individual or groups of markers. Multiple takes from different motion capture projects can be analyzed together or compared for differences. Virtual markers can be defined based on physical markers to track motions of unreachable points of interest.





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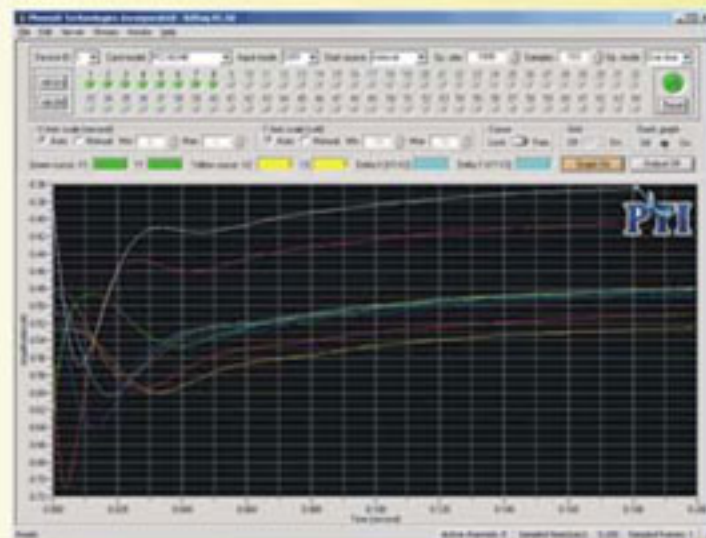
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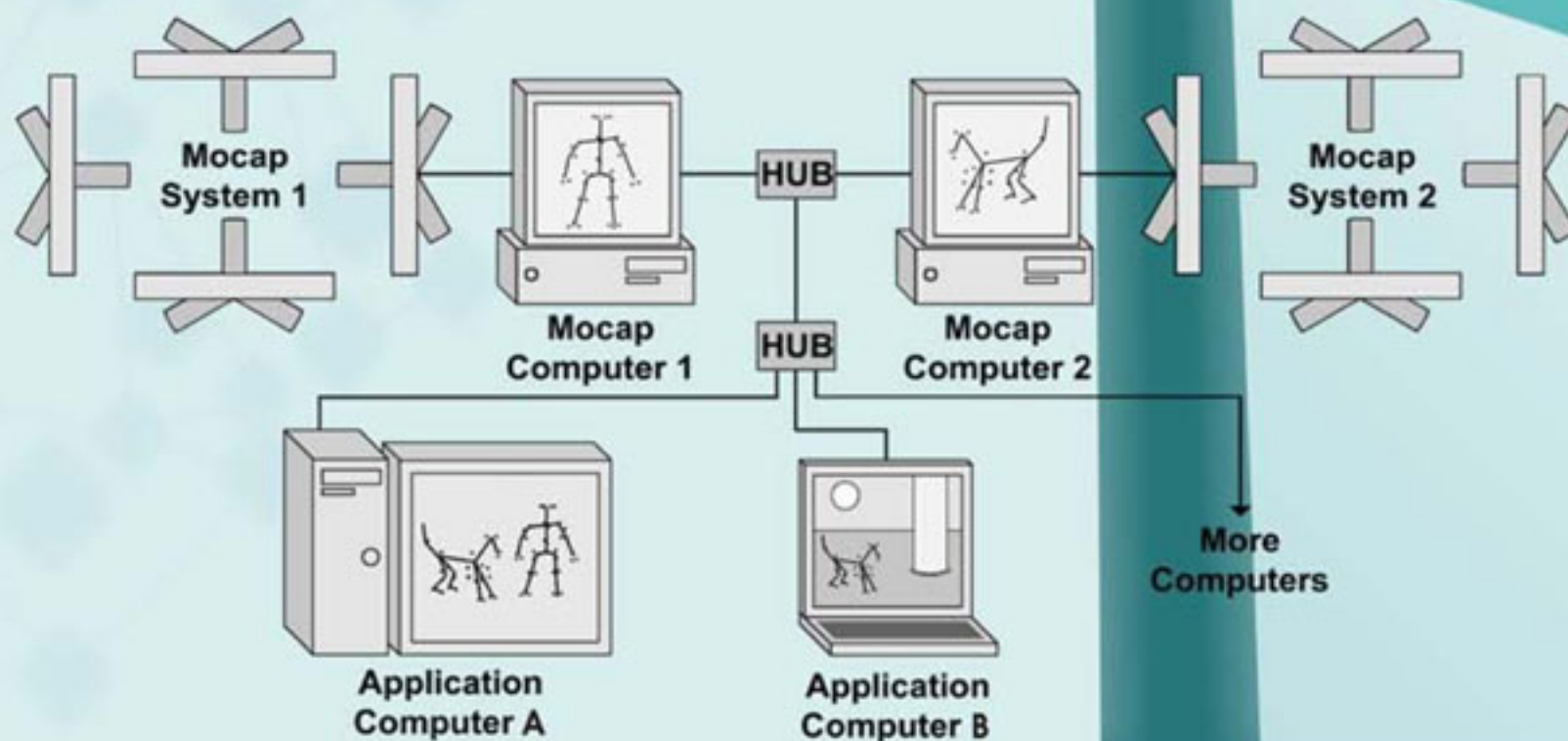
VZDaq™

This software allows the user to synchronize motion capture by a Visualeyze™ system with analog data acquisition by a wide range of National Instruments A/D cards. One application of VZDaq™ allows the user to read in up to 64 analog channel data and plots them during acquisition. The acquired analog data can be integrated with the captured motion data into one file, and be analyzed in VZAnalyzer™, LabView or Matlab for various applications. VZDaq™ can operate on a different computer from that of the motion capture host and send the acquired analog data via TCP/IP to merge with the motion data. This can reduce workload on the host computer and allow an independently developed analog data monitoring station to be integrated with the motion capture system without much effort.



HydraNet™

This optional data combination and dispatching subsystem allows data captured by one or more Visualeyze™ motion capture system(s) to be combined and/or streamed in real time to as many workstations as the user desires. Each workstation can pick and choose the data it needs for its own application. Thus complex motions can be captured by a number of smaller systems, and applications requiring high computing power can be accomplished by distributed parallel processing.



Plug-ins

Plug-ins are available for integrating a Visualeyze™ system with popular software for animation and scientific applications. The current line-up of plug-ins include:

- LabView
- MATLAB
- Visual3D
- VRCO
- VRPN
- Quest 3D
- MotionBuilder
- Maya
- 3D Studio Max
- Famous 3D
- Softimage

SDK Available

For innovative users, a software development kit (SDK) is available for developing user applications to utilize the motion data captured by a Visualeyze™ system in real-time or off-line.

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ACCESSORIES

Standard LED Markers

Special wide-angle high-power near-infrared LEDs are used as markers by a Visualeyze™ system. These are packaged in several ways for different purposes. The rubberized packages with Velcro bases are good for use with the VZSuit™ for multimedia motion capture applications. The flat-based packages are good for various scientific applications which often require them to be directly attached to the skin. Two major types of the LEDs are used. The 6-chip LEDs are good for general purpose large motion capture applications such as gait, walk, sports analysis and animation. The single-chip LEDs are good for closer fine motion capture applications such as fingers and/or facial expression captures and applications which demand the highest accuracy.



Target Control Module (TCM)

A target control module is required to control the firing of a standard LED marker. Three models of TCMs, namely TCM8 (also called 'MiniTCM'), TCM16 and TCM32, are now available for application conveniences. They can control up to 8, 16 and 32 markers respectively. If more markers are required, more TCMs can be applied in parallel. A TCM is programmed and controlled by the master tracker of the system. This is done via either a tether cable ('wired mode') or remotely by a radio transmitter-receiver pair ('wireless mode') depending on the user's choice.



MiniTCM and Multi-Rate Sampling

This small TCM can control up to eight markers (also called a 'TCM8'). It is good for applications such as tracking a small animal or prop, or operating a calibration wand for manually calibrating a multi-tracker system (see also VZAutoCal™ for fully automatic calibration). In addition, it possesses the unique Multi-Rate Sampling capability which allows a marker to be sampled at up to eight integer-multiple number of times of a marker controlled by either a TCM32 or TCM16. This means you can capture motions of very different speeds (such as in a golf swing) with nearly equal spatial details to facilitate motion analysis. No system or human resources need to be wasted collecting and processing massive useless data for the slow motions.



Wireless SIMarker™ & SI3Marker™

SIMarker™ is a completely wireless marker. SI3Marker™ is a modified version of the SIMarker™ with very short wires for controlling up to three LED markers with essentially the same set of electronics. These intelligent radio-controlled LED markers are each powered by a tiny rechargeable battery, and each 'marker' comes with a permanent distinct ID number for identification. They do not need to be controlled by a TCM. Each is small, lightweight and can be simply attached on a motion capture subject, yet the ID for each marker can be flawlessly tracked like a standard LED marker, allowing them to claim the best features of all optical motion capture system markers.





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Semi-Wireless SWMarker™

This latest small intelligent LED marker comes with a built-in ID for flawless marker identification too (similar to a SIMarker™). It is powered by a terminated wire-pair. The marker can be re-positioned along the wire-pair to facilitate attachment on a capture subject. One wire-pair can power up to ten SWMarkers™, and three wire-pairs can be powered by a single battery pack. This makes the SWMarker™ system almost wireless yet up to thirty can be powered by a single battery pack.



VZSuit™ For Capture Convenience

This two-piece stretchable motion capture suit is completely Velcro-compatible (except for the armpit areas). It allows for free unrestricted actor motions. The actor/ performer simply slips into the suit and is ready to begin motion capture. The top piece is zippered on the front for easy wearing. The suit may come complete with TCM(s) and standard LED markers (or SWMarkers™) strategically placed for optimal full-body motion capture if ordered. For applications which require unique marker placements, custom-designed suit may be ordered. The VZSuit™ is designed for wearing convenience, quick and easy arrangement of the LED markers for optimal capture performance and easy suit cleaning. Any wiring required can be covered with removable Velcro strips.



VZProbe™ Contact Digitizer

This is a stick-like device with 3 LEDs placed in a triangular pattern. By properly calibrating the device first, the Visualeyaz™ motion trackers can capture the device's tip position. VZProbe™ can be used to establish a coordinate reference frame or to digitize the shape and sizes of large objects by contact. By outfitting it with an appropriate tip, a VZProbe™ can even be used to digitize surfaces not in the line-of-sight of the trackers; e.g., the underside of a car or the inside of a cup.



Finger Motion Capture Gloves

Intricate fingers and hand motions can be captured with this advanced glove pair. Made with stretchable Velcro-compatible fabric on the back side and mesh material on the palm side for sensitive touch, this glove set allows tiny Velcro based markers to be easily attached to nearly anywhere required to minimize occlusion and allow the highly complex finger motions to be captured.



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