Visual3D™
A powerful software package for visualizing and analyzing biomechanical data

Visual3D is an advanced analysis package for managing and reporting optical 3-D data. Visual3D, together with Qualisys Motion Capture System, provide an advanced and affordable solution for biomechanical analysis. Visual3D has been tested in scientific and clinical labs worldwide and is the preferred solution for rigorous and accurate 3-D motion analysis. Visual3D was designed and developed by C-Motion, Inc, one of Qualisys’ global, strategic partners for the development and marketing of clinical and research applications. Qualisys Motion Capture Systems are now offered together with the Visual3D software.
**INPUT DATA**
Visual3D’s standard input file is in the C3D format (http://www.c3d.org). Visual3D reads and writes C3D files created on any common computer platform (PC, VAX, SGI, MAC). Tab-delimited ASCII files and Matlab’s files can be imported, exported and converted into C3D files.

**MODEL BUILDER**
The core of Visual3D is the Model Builder, a flexible biomechanical modeling tool that can be used to define an unrestricted number of rigid segments and link them together. The Visual3D biomechanical model defines each joint to have six degrees of freedom. The generalized six degrees of freedom modeling technique allows for the analysis of virtually any human, animal or mechanical movement (including assistive technologies).

**TRACKING**
Visual3D uses an optimal method for tracking each segment of the model. The pose (position and orientation) of each segment is determined by 3 or more non-collinear points attached to the segment.

**AUTOMATIC LABELING AND EVENT DETECTION**
Visual3D analyzes multiple movement cycles both within and across trials. Visual3D automatically determines common events related to gait analysis such as heel strike, mid-stance and foot-off during gait.

**SCRIPTING AND WORKFLOW**
Visual3D has a modest scripting language that permits the automated processing of data. Using scripts, custom data processing (that is not available through the graphical user interface) has been implemented for selected customers. The most recent version of Visual3D is also capable of executing user-defined exe files and user-defined dll’s. This provides the user with the ability to generate custom analyses while also taking advantage of the data visualization and reporting capabilities of Visual3D.

**VISUALIZATION**
The visualization of motion data can be shown as skeletons, mannequins or user-defined animations. Ground reaction forces from force plates can be shown as vector arrows and EMG signals can also be visualized. The presentation of synchronized video is also possible within Visual3D.
REPORTING
Visual3D provides straightforward reports that are used to produce and interpret movement sequences, including a standard analysis report that can be generated with a minimum of input using automated processing scripts. At the same time, advanced users will be able to access a more flexible analysis tool for less common applications (including unique patient populations) in order to customize the report format.

REAL-TIME
Qualisys Track Manager tracks objects automatically in real-time and 2D, 3D and 6D camera information is displayed allowing instant confirmation of accurate data acquisition. Captured data is easily streamed, in real-time, from QTM into Visual3D. In Visual3D you can then view and analyze data in real time, create real-time moving charts, and trigger events off of threshold exceptions or signals. A real-time pipeline* is provided which enables the creation of kinematics and inverse dynamics results, in real-time. One benefit is that you can create a model, and see the data applied to a model, in real-time and thus verify a meaningful data capture on the spot, rather than finding errors in post processing and having to redo (i.e. reschedule) a trial.
* Requires V3D Professional

SAVE AND EXPORT
In addition to the C3D format, C-Motion has designed a proprietary format called the CMO format. This format contains an entire movement analysis including multiple movement trials (e.g. multiple C3D files), a static calibration trial, biomechanical model description, reports and the relational information of the trials. For the convenience of some users C-Motion has provided the ability to export tab-delimited ascii files and matlab mat files. Animations can also be exported as AVI, BMP or SVG files.

GAIT ANALYSIS
Visual3D needs at least three markers for each body segment to determine its motion. Regardless of this, Visual3D is very flexible. In fact, any Gait Analysis model (marker configuration) can be used with Visual3D. This is accomplished by defining “virtual” markers for body segments with less than three markers attached to them. An advantage with this method is that all assumptions made by different Gait models are clearly visible to the user as virtual markers.

Users can define their own marker configurations (a one-time task) or use some of the following implemented marker setups for gait analysis:

- Visual3D 6 Degrees of Freedom Model
- Helen Hayes marker configuration
- Skin Marker configuration

Heel strike and toe off can be set by using the event processing function for automatic gait event detection.
APPLIcATIONS
Visual3D provides maximum flexibility in managing, analyzing, and reporting motion data collected by the Qualisys Motion Capture System. Visual3D has evolved from being a clinical research tool into the most powerful and practical solution for many industries and researchers in fields, such as:

- Clinical Motion Analysis (including Gait Analysis)
- Human Factors Engineering and Ergonomics
- Neuroscience
- Sports motion analysis
- Entertainment motion modelling
- Animal motion studies
- Psychology studies

FEATURES
- Support for 3-D Kinematic and Kinetic Analysis (Inverse Dynamics)
- Flexible Model Builder for creating 6DOF segmented models for human, animal or mechanical movement
- Push-button automation of the signal processing, analysis and reporting process
- Pipeline processing of scripts
- Automatic and manual event detection
- Plug-in architecture and SDK to extend functionality
- Real time plug-in for streaming data
- Generates clinical reports
- Works with optical motion capture systems, force platforms and EMG
- Clinically proven and reliable
- Synchronized video
- Virtual markers, objects and segments
- Optimal tracking and support for marker clusters
- 3D Digitizing Pointer
- Matlab processing
- Uses industry standard C3D files
- Works with data from multiple systems simultaneously
- Custom filters or complex transformations
- Custom analyses
- Custom marker sets

VISUAL3D VERSIONS
Visual3D is available in two forms - Standard Edition and a Professional version. Additional functionality in Visual3D Professional are:

- CMO Library - Data management enhancements to permit you to access all the data in all your CMO files (your trials, metrics, reports, parameters, etc) for use in more complex analysis, reporting, and developing application centric data stores.
- Real-Time Biofeedback and Analysis - Processes, graph, and analyze data as well as collecting data in real-time. Create real-time moving charts, trigger events, and analysis. A real-time analysis pipeline is also available for use.
- Induced Acceleration - Lets you determine which muscles are the source or contributing to lower body movement. Some forward dynamics are involved with this analysis.
- Caltester Software - Verifies the spatial synchronization of your motion capture systems and force platforms. The CalTester should be used before each motion capture session to validate laboratory settings.