**Raptor-4 Specifications**

**CAMERA**
- Frame size (pixels): 4.06 megapixels
- Resolution: 2352 x 1728
- Frame rate at full resolution: 200 fps
- Frame rate at partial scan: up to 10,000 fps
- Shutter type: Electronic rolling shutter
- Standard lens: 18-55mm zoom
- Camera power supply: HCP-8
- Camera connectors: Ethernet, Sync in/out
- Camera cabling: Standard Cat5E, power over Ethernet
- Camera body dimensions: 147mm wide x 92mm deep x 189mm high
- Camera weight, including ringlight: 5.2 lbs. (2.36 kg)
- Number of camera mount points: 4
- Power consumption: 50 watts
- Outdoor capability: Yes, with some limitations

**RINGLIGHT**
- Strobe Type: Near Infrared (750 nm)
- Strobe electronics: Integrated, software reprogrammable
- LEDs: 323
- Adjustable Illumination: Yes

**ENVIRONMENTAL**
- Temperature, Operating: 10° to 35°C, (50° to 95°F)
- Temperature, Storage: -40° to 65°C (-40° to 149°F)
- Relative Humidity: 20% to 80% (non-condensing)

**SYSTEM CONNECTIVITY**
- Plug and play compatibility: Yes
- System connectivity: Gigabit Ethernet
- Custom control interface: Yes
- Master camera indicator: Yes
- Camera number indicator: Yes
- Integrated camera display panel: 200 bi-color LED array
- Insight auto-focus: Yes
- Communication status indicators: Yes
- Maximum number of cameras: Unlimited
- Multiple camera types in system: Yes
- Genlock to external video source: Yes
- Synchronize to external signal: Yes
- IP addressable: Yes
- IP reconfigurable: Yes
- External A/D sync and clock: Yes
Cortex

Cortex is Motion Analysis’ software for handling all phases of motion capture within a single program – initial setup, calibration, tracking and post processing. A single, integrated application accelerates learning the system and improves productivity.

Cortex is the industry’s first mocap tracking software tailored to both a 32-bit and a 64-bit operating system for use with high-throughput multi-processor environments. It is built on Microsoft’s .NET Framework. The .NET framework maximizes programming productivity, which translates into more features delivered to our customers.

Cortex has undockable windows so that the operator can control which windows are open at once and where they can be positioned, even if they are moved onto a second monitor. Cortex’s internal plug-in architecture has been simplified through templates, making it easier for third party developers to create plug-ins to Cortex using free Microsoft Visual Studio express versions. Existing external software programs and plug-ins that use the MAC exclusive simultaneous-connection SDK2 environment will run without changes under Cortex.

Multiple Tracking Objects (MTO)

In both real-time and post-processing, Multiple Tracking Objects allows our customers to separate the capture into separate MarkerSets and edit each data set separately. Each MarkerSet has its own marker names, linkages, template and optional skeleton definition. With a simple tab selection you highlight and select the particular marker set as seen below with the separate DaveBody and DaveFace MarkerSets:

MTO Details:
- Post process data with multiple objects (templates, equipment)
- Simplified system set up
- Multiple simultaneous Skeleton engine support
- Fully backwards compatible with legacy data
- Simplified data packaging and transfer
**3D Display Options**
The Cortex 3D workspace is invaluable to the user because it provides a way to efficiently see whether the coordinate data appear correct. Users now have the ability to specify the number of figures to show before and after the current displayed frame, and show the trajectory of any marker. Also within this workspace you can view force and velocity vectors, camera positions, and body center of mass.

**Presentation Graphs**
Presentation Graphs allow one or multiple pages with tabs, one or more graphs per page and complete scaling and formatting control to optimize graph readability. Any data known to Cortex can be graphed via simple variable selector interface or scripts that retrieve and display the data.

**Collada 3D Viewer**
The Collada 3D Viewer allows our customers to play high resolution animations (collada open source standard for model rendering) within Cortex or SONIC. The animated figure can be displayed with markers as well as with joint velocity and ground reaction force vectors. The figures can be displayed in real-time or during Post Processing, and played back in sync with Presentation graphs. With Cortex you can also use collada files to generate custom scenes with floors, backgrounds and furniture of your choice.

**DV Reference**
Motion Analysis offers a software solution for digital video capture, DV Reference. DV Reference is embedded in Cortex and allows the synchronized capture and playback of reference video data from stationary and moving DV cameras. The software enables you to collect color or monochrome video from multiple cameras that is time matched to the motion capture data. This software requires DV cameras (contact MAC for compatible models) or High Speed Basler digital video cameras.

DV Reference also offers a function to overlay the reference color video images with stick figures, markers, vectors and other model information. Following a simple calibration procedure, the color reference video camera view becomes a background to the 3D View. The 3D Show Video checkbox will dim the floor and snap the 3D viewpoint to the reference video viewpoint. If you want to move the color or studio camera, you can put six markers on the color camera and view the real or virtual scene.
BioFeedTrak

BioFeedTrak is a general purpose scripting program for designing and implementing biofeedback programs that can enable clinicians and patients to receive instantaneous audio feedback to kinematic movements.

BioFeedTrak is able to give real-time feedback in the form of sounds based on whether or not kinematic or kinetic variables fall within certain bounds during the performance of any type of physical task that is predefined by the user. Kinematic variables include position, velocity and acceleration of individual markers (up to 45 markers) placed on key anatomical points of interest. Included angle between three markers as well as the angle of inclination of a segment defined by two markers can be used to provide feedback. Kinetic data include horizontal and vertical forces, moment about the vertical axis, as well as the coordinates of the center of pressure with respect to the forceplates.

The program works in conjunction with a Motion Analysis system. The user sets up the variables to be monitored, determines the starting and ending parameters for each variable to be assessed, chooses the volume and frequency of the audio feedback, and starts the Real-Time system. The patient and clinician are able to work side by side to retrain areas of the body that need further optimization.
Motion Analysis offers a software solution for digital video capture, DV Reference. DV Reference is embedded in Cortex and allows the synchronized capture and playback of reference video data from either a stationary or moving DV camera. The software enables you to collect color or monochrome video from multiple cameras that is time matched to the motion capture data. This software requires a DV camera with a firewire connection, or High Speed Basler digital video cameras.

DV Reference also offers a function which enables you to overlay the reference color video images with stick figures, markers, vectors and other model information. Following a simple calibration procedure, the color reference video camera view becomes a background to the 3D View. The 3D Show Video checkbox will dim the floor and snap the 3D viewpoint to the reference video viewpoint. If you want to move the color or studio camera, you can put six markers on the color camera and view the real or virtual scene.

The video images provided by DV Reference give visual confirmation of the motion capture data and offer an effective display of information that everyone can follow.
Kestrel Digital RealTime System

Motion Analysis offers a second small format solution for those who desire a faster frame rate and higher resolution: The Kestrel Digital RealTime System. The Kestrel is a small, compact camera capable of 300 fps with a sensor resolution of 2048 x 1088 pixels (2.2 million). The Kestrel Digital RealTime System consists of Kestrel digital cameras and Cortex software.

Kestrel Features
- 1-300 Hz selectable frame rates at full resolution
- 600 Hz at windowed resolution
- Electronic shutter
- Real-time data streaming
- Separate iris and focus settings independent of ring-light
- Strobed ringlight with camera body heat sink
- Five body mount points on camera for variable positioning
- Software controlled adjustable light output

Kestrel Digital Camera
The Kestrel Digital Cameras provide today’s motion capture technicians with a tool that assures reliable and accurate data. With digital technology there is no degradation of the signal over distance, less noise, and no resampling of data on another piece of electronics. The Kestrel Digital Camera signal is sent directly to the tracking computer via an Ethernet connection. The signal processing is embedded in the camera. This streamlined system of motion capture from camera to computer means less hardware and easier maintenance. The FPGA (field programmable field array) built into the Kestrel is software and firmware upgradeable via the Internet - moving of the cameras is not necessary.

Cortex Software
Cortex software captures complex motion with extreme accuracy. Real-time capabilities allow our customers to see capture results at the same instant as the subject is performing a specific task.

Cortex has a revolutionary way of handling motion capture data. File management is controlled by a single capture (.cap) file, whereby all files associated with a capture are referenced in a single location. This process simplifies file loading and saving, allowing the user to only manage a single file rather than separate project files and multiple data files. When transferring data, Cortex will package all files associated with a given capture. The file structure can be specified by users to best fit their needs.

Post processing data this clean is minimal, if at all, and Sky Scripting can be used to quickly process results and do batch processing.

System Includes
- Kestrel cameras and cables
- Camera carrying case
- Power hub
- Gigabit Ethernet switch
- Calibration frame and wand set
- Tripods or wall mounts
- Cable to synchronize for analog data collection
- Cortex software (2 licenses)
- Marker kit
Motion Composer

Motion Composer is a software for collating, integrating and presenting interactive motion capture data. Embedded within Cortex, Motion Composer is able to continuously update information without exiting to a stand-alone software package, creating a seamless workflow. Users are able to create a user defined, graphical and interactive report comprising: Motion capture data, forceplate data, EMG data, kinetics and kinematics, documents, color video and live web content.

Features

- Cortex plugin for presentation authoring
- Presentation tree/property controls for managing presentation resources
- Slide creation tools for laying out presentation slides
- Presentation loading/saving to presentation file format (XML)
- Presentation 'Pack-and-Go' for one-click packaging of viewer and data into a single file
- Freely redistributable viewer for presentation sharing
- New data views to support presentation views

Motion Composer Includes

Motion Composer
Presentation authoring plug-in for Cortex. Author presentations seamlessly from your Cortex session.

Motion View
Presentation player. Package and share presentations easily with this interactive viewer. Suitable for burning to a CD, emailing, or web distribution.

New Data Views
New graph, document and multimedia views. Perfect for presentation data.

Plug-in Kit
For advanced users, Visual Basic project templates for creating custom plug-in views.

RTF editor pane for rtf/text create/import/view/edit
HTML editor pane for HTML/media import/view/edit
2D graph pane for graphical information view/analysis
The Raptor series of motion capture systems allow our customers to use the system *outdoors as well as indoors* without changing any of the hardware or software on the system. Motion Analysis has developed an exclusive new proprietary image processing software which is embedded in the Raptor cameras. The Raptor cameras have twenty times the processing power of our previous generations of cameras to accomplish all of the required image processing computations. This new, exclusive software addresses the various challenges of working outdoors in direct sunlight as well as indoor environments where reflections and lighting conditions can also affect a capture, while maintaining extreme accuracy and real-time capabilities.

**Raptor-4 Digital RealTime System**

The Raptor-4 Digital RealTime System consists of Raptor-4 digital cameras and Cortex software, which captures complex motion with extreme accuracy. Real-time capabilities allow our customers to see capture results at the same instant as the subject is performing a specific task. With Calcium software, our customers can solve directly to a character skeleton - a feature that is unmatched by any other motion capture company. Real-time previzualization is a reality with our systems. Post processing data this clean is minimal, if at all, and Sky Scripting can be used to quickly process results and do batch processing.

**Raptor-4 Digital Camera**

The Raptor-4 Digital Camera has a larger sensor area than standard video cameras. The corresponding use of a high quality 35mm lens allows for the sweet spot of the lens to map over this larger image sensor area, resulting in greater lens and system accuracy. The Raptor-4 automatically measures focus and adjusts brightness for optimal performance. As with other MAC digital cameras, the Raptor-4 is field upgradeable via email, compatible with other MAC digital cameras and supported with Cortex software.

The Raptor-4 operates up to 200 fps at a full resolution of 2352 x 1728 pixels, and up to 10,000 fps at reduced resolutions. The Raptor-4 Digital Cameras provide today’s motion capture technicians with a tool that assures reliable and accurate data. With digital technology there is no degradation of the signal over distance, less noise, and no resampling of data on another piece of electronics.

**Excellence Does Not Equal Number of Pixels**

Savvy consumers understand that the excellence of any camera is not measured by the number of pixels alone. Other factors such as sensor size, pixel size, optics, depth of focus, quality of the ring light and other mechanics all contribute to a motion capture camera’s effectiveness. The Raptor series of cameras have consistently out-performed other motion capture cameras in accuracy and latency tests, and are the only motion capture cameras to perform flawlessly outdoors at high frame rates. Broadcast tracking applications require precision to 1/100th of a degree - only the Motion Analysis Raptor systems can meet this requirement.
With superior on-board processing, better lens distortion modeling and more powerful ringlights, the Raptor-4 has a greater depth of field than our competitor’s cameras. A smaller f-stop can be used and have a wider field of view, allowing for a greater depth of field - this translates to fewer cameras needed in the capture volume. Our cameras are also in focus throughout the entire volume and can equally see markers close and far away. The Raptor-4 can see 12mm markers 85 feet away and 10 feet away - both in full focus. This translates to fewer cameras needed to cover the capture area.

**Insight Focusing**

Having precisely focused cameras is a critical requirement to collecting accurate motion data. Motion Analysis introduces Insight Focusing, which allows a single user to precisely focus an entire system of cameras in a matter of minutes. The camera’s LED board serves as a real-time visual indicator providing instant feedback.

**High Power Ringlight**

New for the Raptor-4 is a high-power ringlight for greater light coverage. The new shape is in proportion to the sensor, in a way that round or square ringlights are not. The LED’s are more powerful, brighter, deliver more even coverage, a wider field of coverage and the ability to see a marker from a further distance than our previous ringlights. Each LED is individually oriented for optimized coverage.

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**Raptor-4 Includes**

- Raptor-4 cameras, zoom lens, HPRL
- Camera carrying cases
- Power hub(s)
- Gigabit switch(s)
- Choice of tripods or wall mounts
- Marker kit
- Calibration frame and wand set
- Cortex software

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**Raptor-4 Features**

- Indoor and outdoor capture without changing any of the hardware or software
- Grayscale centroid or grayscale edge (user selectable) for every marker at all frame rates
- 1-200 Hz selectable frame rates at full resolution
- Up to 10,000 Hz at partial resolution
- Portable - up to 8 cameras in two suitcases
- Built-in zoom provides more visual options for ease of set-up
- Separate zoom, iris and focus settings independent of ringlight
- High power, near IR ringlights (HPRL)
- LED display panel for camera identification and status
- 323 LED’s for brighter and better light uniformity
- Strobbed ringlight with camera body heat sink
- Four body mount points on camera
- Software controlled adjustable light output
- SDK provided at customer’s request
Skeleton Builder

A skeleton is a hierarchically connected set of bones with translation and rotation data. Each bone has a "parent" and potentially any number of "children". One special bone has no parent and is usually referred to as the "root" of the skeleton. Skeleton Builder, as the name implies, is a tool that allows you to construct a skeleton by creating bones and arranging them in a hierarchy. Each bone is defined by the motion of three markers used to construct its rotation data.

Skeleton Builder skeletons are relatively simple, direct and fast calculations of segments (bones) that are defined and calculated from one marker center to another. The markers can be real or virtual (calculated) and are typically from one virtual joint center to a second virtual joint center. A 3D local coordinate system is defined with three markers: origin, bone (Y) axis, and XY plane. The advantage of Skeleton Builder skeletons is that they compute very quickly and they represent the method of how most biomechanical models have been computed for many years.

Advantages

- Entire specification done in Cortex and stored in .prj files
- You can make changes to the setup and see results immediately in the any viewing package attached to the Cortex SDK
- Good for tracking props
- Easy to create rotational and transitional offsets
- Easy to track individual rotation channels, such as for a hinge
- Extremely fast calculations - they are directly generated
- Entire specification is done in Cortex
- Good for tracking props
# Osprey Specifications

## CAMERA
- **Frame size (pixels):** .3 megapixels
- **Resolution:** 640 x 480
- **Frame rate at full resolution:** 250 fps
- **Shutter type:** Global Shutter
- **Standard lens:** 4-12mm zoom
- **Camera power supply:** HCP-8
- **Camera connectors:** Ethernet, Sync in/out
- **Camera cabling:** Standard Cat5E, power over ethernet
- **Camera body dimensions:** 51mm wide x 50mm deep x 80mm high
- **Camera weight, including ringlight:** 13.4 oz. (0.38 kg)
- **Number of camera mount points:** 5
- **Power consumption:** 20 watts

## RINGLIGHT
- **Strobe Type:** Near Infrared (750 nm)
- **Strobe electronics:** Integrated, software reprogrammable
- **LEDs:** 53
- **Adjustable Illumination:** Yes

## ENVIRONMENTAL
- **Temperature, Operating:** 10° to 35°C, (50° to 95°F)
- **Temperature, Storage:** -40° to 65°C (-40° to 149°F)
- **Relative Humidity:** 20% to 80% (non-condensing)

## SYSTEM CONNECTIVITY
- **Plug and play compatibility:** Yes
- **System connectivity:** Gigabit Ethernet
- **Custom control interface:** Yes
- **Master camera indicator:** No
- **Camera number indicator:** No
- **Integrated camera display panel:** No
- **Insight auto-focus:** No
- **Communication status indicators:** Yes
- **Maximum number of cameras:** Unlimited
- **Multiple camera types in system:** Yes
- **Genlock to external video source:** Yes
- **Synchronize to external signal:** Yes
- **IP addressable:** Yes
- **IP reconfigurable:** Yes
- **External A/D sync and clock:** Yes