CBI is a full service engineering company that provides medical device design and testing, industrial/process engineering services for medical manufacturing, laboratory automation design, integration and engineering V&V.

CBI provides outsourcing and standalone project services to the life sciences community. Such services include projects that require regulatory compliant solutions in a cost effective and timely manner by using "off-the-shelf" as well as custom design solutions.

CBI's experiences range from requirements gathering and design documentation to the integration of automated equipment used in the medical manufacturing environment. We are well suited to provide complete solutions to any project.

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Robot Patient Positioner

When you need precision patient positioning

www.bioinstruments.net/cp-100

CBI

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As the need for specialized surgeries increases, so does the need for more advanced patient positioning technology. Current positioning systems are limited to only three or four axes. Consequently, specialized precision positioning is somewhat limited. However, positioning technology in the industrial sector has produced high-payload and high-precision 6-axis robot systems. Cicero Bioinstrumentation, Inc. (CBI) has therefore designed a positioning system that utilizes this technology for the medical world by creating the CP-100.

The CP-100 system is a robotic precision patient positioner that can be used in radiotherapy, orthopedic surgery and neurosurgery applications for adult and pediatric patients. Large-load versions of the CP-100 can also be used in veterinary positioning applications.

The CP-100 has been designed to work with MedTec's immobilization products and couchtops to allow for a common and standard approach to patient handling.

The CP-100 system can be provided as a base system with a robot positioner, or with an image tracking system that can be implemented in image guided and gating applications.

The CP-100 is typically used as a below-floor mount system that uses a rotating platform. This allows for a low profile for the positioning arm, yet allow for 6 degrees of freedom in positioning.

The CP-100 with an adult
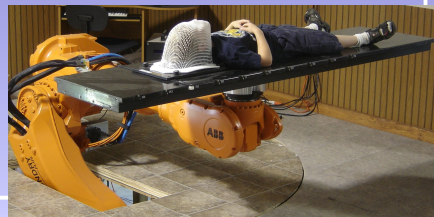
CP-100 with a child

MedTec couchtop and thermoplastic immobilization device for pediatrics

The Vicon Motion Tracking System is used with reflective passive markers and the Vicon iQ software package to provide patient position feedback.

The cameras have a 1.3 million-pixel digital CMOS sensor (1280 x 1024 pixels) that operates at 484fps (frames per second full frame) with up to 10,000fps when the frames are windowed.

Vicon iQ runs on a Windows platform, and can be installed on an Intel/ VME rack. Communications with this system is TCP/IP based.

The cameras are usually mounted to the walls of the treatment room, but can also be mounted on the ceiling or on mobile stands.

Markers are placed on the patient or mask, depending on the application. The system can be configured to provide a digital output for gating if respiration monitoring is desired.
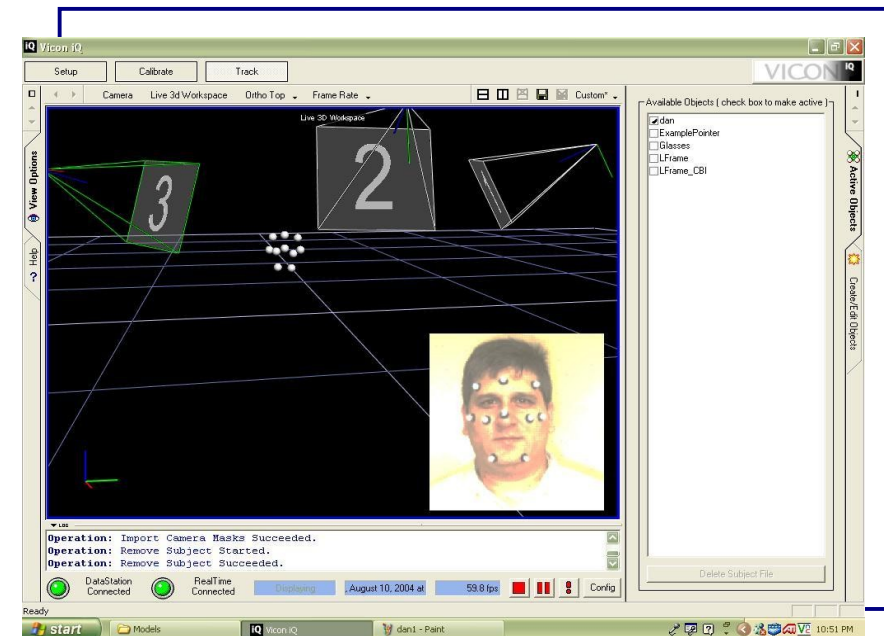

Vicon motion tracking camera

Motion tracking markers

Vicon iQ Software Screen Demonstrating the Markers

Vicon camera set-up with cameras on tri-pods

Position View

Current Postion

Status

Motion/Comm Control

The CP-100 provides a high-level user interface/control system called Positioner Control Interface, or PCI. PCI provides a Windows based PC system with a single user interface screen, keyboard, and mouse.

In CP-100 configurations the vision tracking system can be added as a separate PC controls system, or as additional software on the PCI PC. In this configuration a second monitor is added so that the user can use the iQ software and the PCI software together.

The PCI can also be configured to accept commands over a LAN via XML.

The PCI's main screen has 4 main areas of control:

Position View

The Position View panel provides a 3D graphical representation of the CP-100 as it moves. A user can use a mouse drag to rotate the view to change the zoom and direction of the CP-100 in the view.

Current Position

The Current Position Panel provides a digital readout of the CP-100's tool plate. This readout provides X, Y and Z position with respect to a configured reference coordinate system, as well as the rotation around each axis. This display can be configured for different display units.

Status

The Status panel provides information about the various subsystems of the CP-100, including patient alarm and E-Stop.
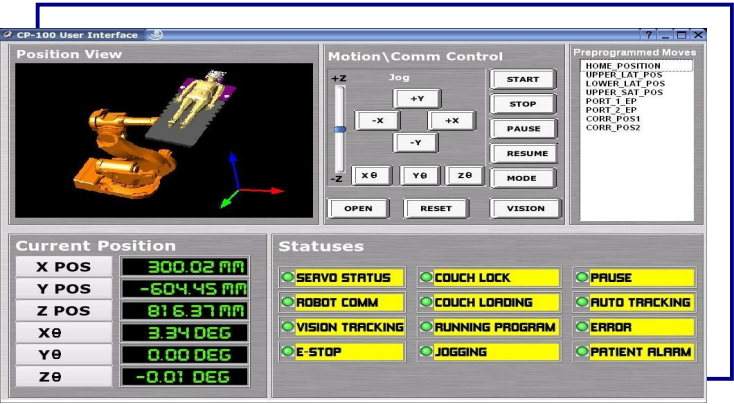
Motion/Comm Control

This panel allows either manual jogging/positioning of the CP-100, or the Start/Stop/Pause of an automatic positioning program, which is selected from the Preprogrammed Move list.

The CP-100 is a postioniong system that incorporates an ABB robotic arm, MedTec couchtops and patient immobilization devices, and a control workstation with one or two display interfaces.

The CP-100 can be configured to use a Vicon motion tracking system for patient alignment and image guided applications.

The software used to control the CP-100 directly is called the Positioner Control Interface (PCI). PCI is able to provide basic control over the robot motion and positioning, and it can also interface with the Vicon Motion System software Vicon iQ. PCI also allows for external system interfacing through the use of an Ethernet XML protocol.
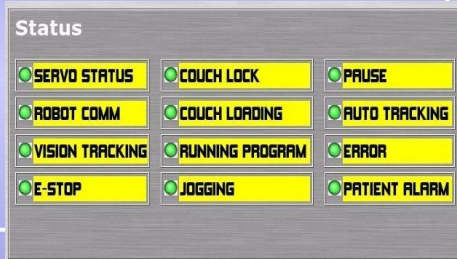

PCI Main Software Screen
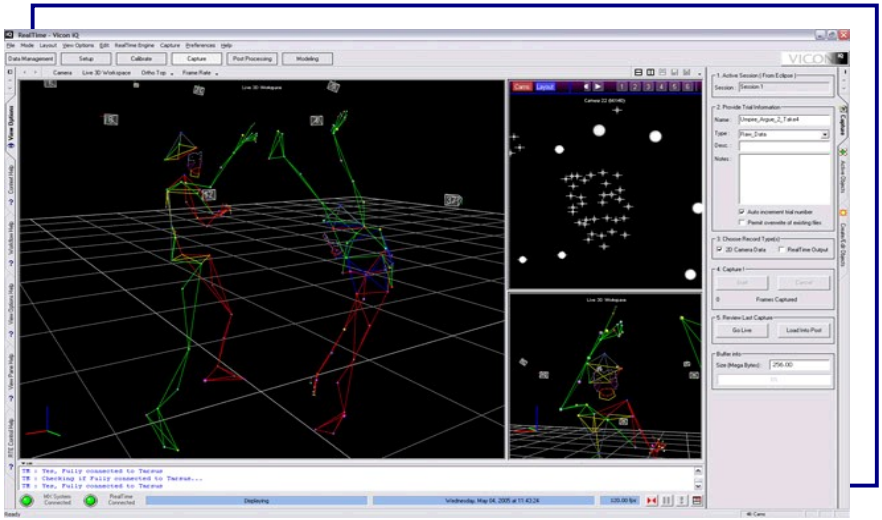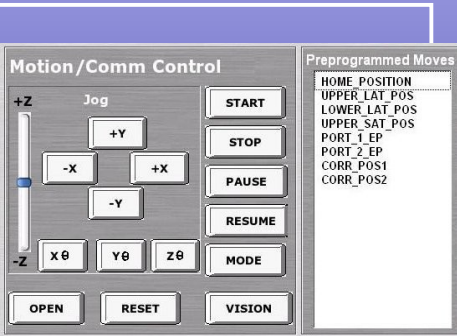

Vicon iQ Software Screen
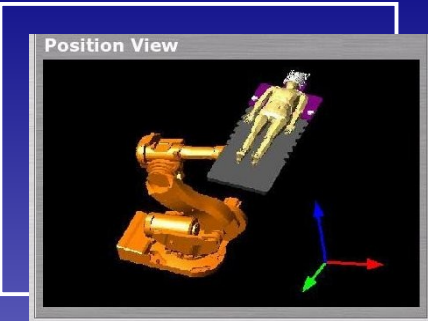
MedTec

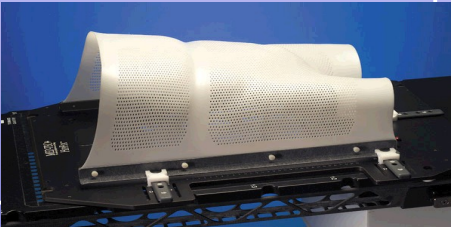**MedTec carbon fiber couchtop**

A MedTec couchtop is used in the CP-100 system. This couchtop is a standard, carbon fiber couch with the exception of two special modifications.

The first modification is the unit's direct-mount capabilities. This feature allows the couchtop to mount directly to the robot. The second modification is a removable mount. The removable mount allows for the use of different size couchtops on the same robotic structure.

MedTec IMRT reinforced thermoplastic mask

The MedTec couchtop has patented indexing "notches" – or indents – along the length of the couch/tabletop. The indexes are as follows: H1-head 1, H2-head 2, H3-head 3, 0, F1-foot 1, etc. This allows for the placement of MedTec fixation devices.

MedTec HipFix- A thermoplastic immobilization device for the hip and pelvis

Another MedTec component used in the CP-100 is IMRT reinforced thermoplastics. These thermoplastics are made for support of the head and neck, as well as torso and lower extremities. This provides support and immobilization of the patient to allow for precision treatment. The immobilization device is not restricted to thermoplastics. The MedTec Vac-Lok vacuum bag system will also work on the CP-100.


MedTec Vac-Lok system

CP-100 Robot

The CP-100 utilizes a Kuka or ABB industrial six-axis robotic arm to manipulate a MedTec couch top or a treatment chair. Advanced positioning algorithms in the ABB IRC5 controller allow the treatment target to be manipulated around a fixed-beam center point.

Robot options can include a resolver-based servo control for more reliable control in radiation environments (versus encoder based control). The position of the patient is repeatable to 0.2mm.

The CP-100 can be configured from a family of robots. Each robot is rated for different loads limits, including oversized loads.
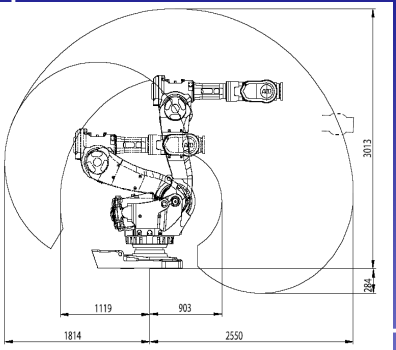
CP-100 ABB robotic arm without the couchtop demonstrating range of motion.

Floor

The CP-100 typically uses a below-floor mount with a rotating platform that is attached to the lower part of the robot and is level with the floor. The CP-100 can also be configured with a floor-mounted robot with a raised platform.
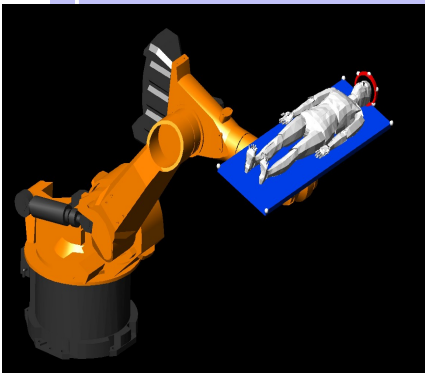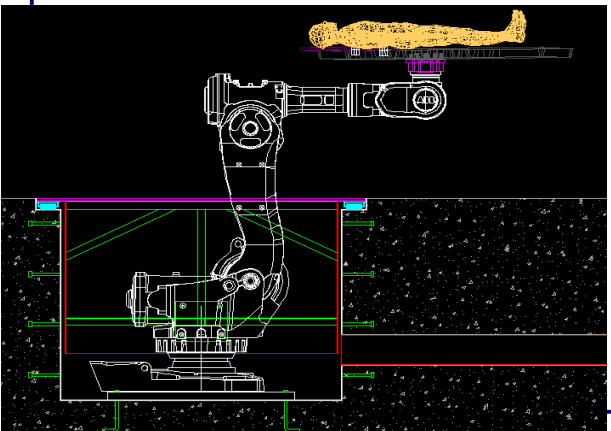

Kuka based CP-100 System

Diagram of below-floor mounting