



Medical technology: Precise control and alignment of electron beam technology using Embedded PCs, EtherCAT and stepper motor system

Innovative radiation therapy uses flexible PC-based control platform

Modern automation technology is playing an increasingly important role in the effective treatment of cancer. IntraOperative Electron Radiation Therapy (IOERT), which was developed in the U.S. by IntraOp Medical, has achieved excellent treatment results in practice and is now being used in hospitals around the world. This technology delivers a direct, highly concentrated and precise dose of radiation with electron beams during cancer surgery, immediately after the tumor is removed.



Mobetron® is a mobile linear accelerator for IOERT and is used globally for treating different types of cancers.



The CX5020 Embedded PC with directly connected I/O terminals is extremely compact in design and requires only a small amount of space in the control cabinet.

With corporate headquarters located in Sunnyvale, California, IntraOp Medical has developed a fully mobile, electronic linear accelerator for IOERT called the Mobetron®. This radiation machine is currently being used in clinics and hospitals in North America, Europe and Asia to treat various cancer cases. Mobetron® allows the tumor bed to be radiated precisely with concentrated electrons and any remaining cancerous cells to be killed off. In most cases this eliminates or at least reduces the need for post-operative, external radiation therapy. "In addition to better survival rates, shorter treatment cycles and fewer side effects, Mobetron® also helps to drive down the cost of cancer therapy," explains Andy Merrill, VP of Engineering and Operations, IntraOp Medical.

Embedded PCs control electron radiation treatment

IntraOp Medical uses the PC-based control platform from Beckhoff to automate its 2nd generation mobile linear accelerator. "Incorporating the open PC control solution allowed us to meet our key strategic requirements in terms of electrical engineering. The CX5020 Embedded PC is a compact, high-performance and flexible controller," says Shura Kretchetov, Physicist, IntraOp Medical. All control functions are run using the TwinCAT PLC and TwinCAT NC PTP automation software. It controls all the automated functions of Mobetron® including the small linear accelerator that is used to deliver electron beams directly to the affected areas.

"We use the enhanced processing power of the CX5020 to continuously integrate new functions in the controller, such as treatment planning tools or remote diagnostics," explains Shura Kretchetov. The EtherCAT Terminals are connected

directly to the CX while additional EtherCAT nodes use the EK1100 EtherCAT couplers to distribute additional I/Os across the system.

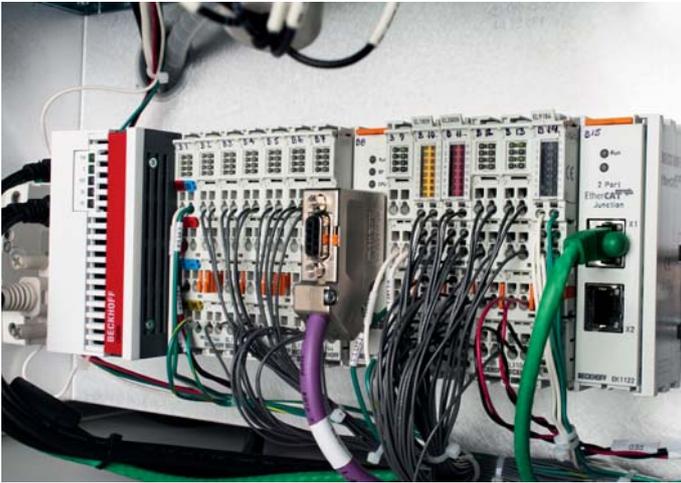
"The PC and EtherCAT-based control platform enables very fast control processes in the low microsecond range, which has a direct positive impact on the performance of the Mobetron® systems in the field," explains Shura Kretchetov. All system and process data gathered by the Mobetron® can be processed quickly and efficiently as the tumor cells are being irradiated.

Complex drive-technology solution

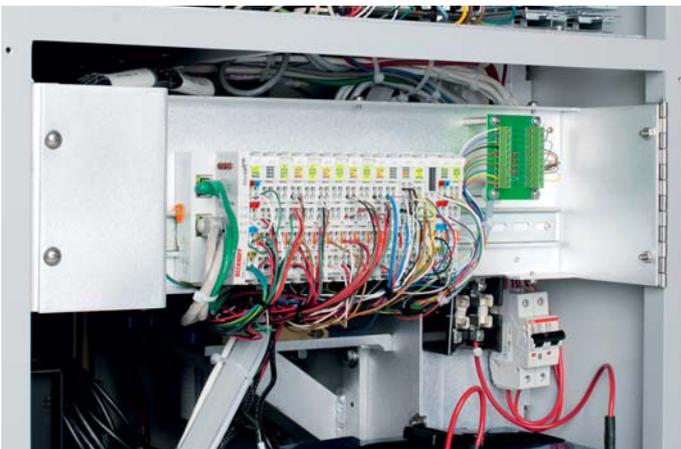
Ensuring space-saving motion control technology on the Mobetron®, IntraOp Medical uses Beckhoff's EL7031 and EL7041 stepper motor control terminals paired with AS1060 series stepper motors for an extremely compact stepper system that doesn't require separate amplifiers. The stepper motor control terminals ensure precise control and alignment of the electron beam. "Naturally, ensuring precise control of machine movement and the treatment process is critical to the health and safety of patients and PC- and EtherCAT-based control help us implement that security," explains Andy Merrill.

Flexible device connectivity via wide array of interfaces

In addition to easily integrating essentially any device with an Ethernet connection, IntraOp Medical utilizes EtherCAT Terminals to establish connectivity to other communication protocols, such as PROFIBUS or serial protocols. The EL6731 slave terminal enables full integration of PROFIBUS devices in the EtherCAT



The control system of the Mobetron®, comprising a CX5020 Embedded PC, TwinCAT automation software and the connected EtherCAT I/O modules, is highly efficient and flexible. It controls all automated functions of Mobetron® including the linear accelerator that is used to deliver electron beams directly to the affected areas.



IntraOp Medical uses Beckhoff's EL7031 and EL7041 stepper motor control terminals paired with AS1060 series stepper motors for precise alignment of the electron beam.

network without requiring the addition of PCI cards. Similarly, the EL6021 serial interface terminal enables simple connection of devices with RS422 or RS485 interfaces.

"By integrating Beckhoff's control technology we've opened up our machine architecture, allowing us to go from a simple PLC controller to a powerful and open PC-based control platform, thereby affording us excellent flexibility," says Andy Merrill. With the integration of the PC-based control platform, the Mobetron® IOERT systems can be monitored and controlled with greater ease and precision, something that is hugely significant in terms of the high safety standards in cancer therapy. "The PC control solution means we can establish much better monitoring and control of various components on our machines while at the same time it helps us optimize our remote diagnostics and system efficiency," adds Andy Merrill.

Significant also is the much shorter engineering time thanks to the PC-based control platform. "Compared with first generation machines, which were equipped with a conventional PLC, use of PC-based control allows us to save around 36 hours of engineering and installation time per machine, enabling us to ship twice as many machines per month," says Shura Kretchetov. He continues on to say: "All in all, since integrating Beckhoff's control technology, our Mobetron® cancer treatment system has become easier to manufacture, troubleshoot, and maintain; I can conservatively estimate that we have easily reduced our overall controls costs by 20 %."

Encouraged by these excellent results, IntraOp Medical is continuing to successfully move forward with its goal of, on one hand creating more flexible, efficient, and cost-effective IOERT machines, and on the other hand bringing new machines for other medical applications to market. "In the future, we want to create a universal system that is open to all different types of medical applications such as cosmetic surgery, burn victim treatment, fighting infections and viruses, to name just a few," explains Andy Evans. We are focusing on specialized and customized "Ready for Use" solutions to ensure that we remain at the forefront of the highly competitive medical technology market."

Further Information:

www.intraopmedical.com

www.beckhoffautomation.com