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at the Ginzton Technology Center

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PUSHING *the* TECHNOLOGICAL ENVELOPE

at the Ginzton Technology Center

Stories about those who explore new scientific frontiers or push the envelope of technology have always been popular. Endeavors that go beyond conventional boundaries seem to spark our curiosity and compel us to wonder: What's next? Pushing hard on the technological envelope to explore what's next for Varian Medical Systems are the scientists and engineers at the Ginzton Technology Center.

By Lynn Yarris

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>
> — Kolleen T. Kennedy, M.S., vice president, Varian Oncology Systems

Headquartered in Mountain View, California, with a staff of about 45, the Ginzton Technology Center (GTC) is Varian’s central research and development organization. Although it officially came into existence in 1999 (when Varian Medical Systems was organized into three operations, including Oncology Systems and X-Ray Products), GTC has existed under different names since the 1960s, when it was known as the Varian Research Center.

New technologies, new capabilities

Although GTC’s mission entails problem solving and the incubation of start-up businesses, its main thrust has been the investigation and development of new or so-called “disruptive” technologies that will create significantly improved capabilities for Varian’s customers.

“One of our main jobs is to take as much risk as possible out of a new technology,” says GTC’s director, George Zdasiuk, Ph.D. “We investigate a promising idea and work with Oncology Systems’ marketing and engineering teams to assess whether it will one day result in a meaningful product or service.”

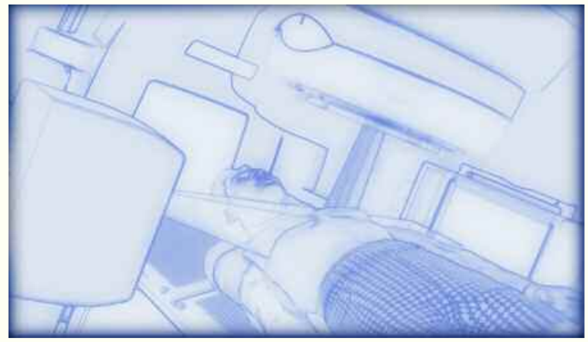
Zdasiuk, who holds his Ph.D. in applied physics from Stanford University, says the horizon for most of the technologies GTC investigates is three to five years.

“To go much further than that would be questionable in the current environment, given how fast technological changes occur,” he says. “We try to look as far into the future as we think we can see while still retaining the flexibility to respond to new breakthroughs and changes in technology.”

Zdasiuk says the line separating technologies ready to be made into products from those that are premature is not always solid. For this reason, the GTC staff will do a preliminary investigation into an idea and, if they judge it to have sufficient merit, they’ll seek the involvement of Varian’s marketing group.

Left, researchers Gary Virshup, Edward Seppi, Ph.D., and John Pavkovich, Ph.D., explore the future of radiation technology at Varian’s Ginzton Technology Center.

Above right, on the drawing board are advancements in linac onboard imaging systems.



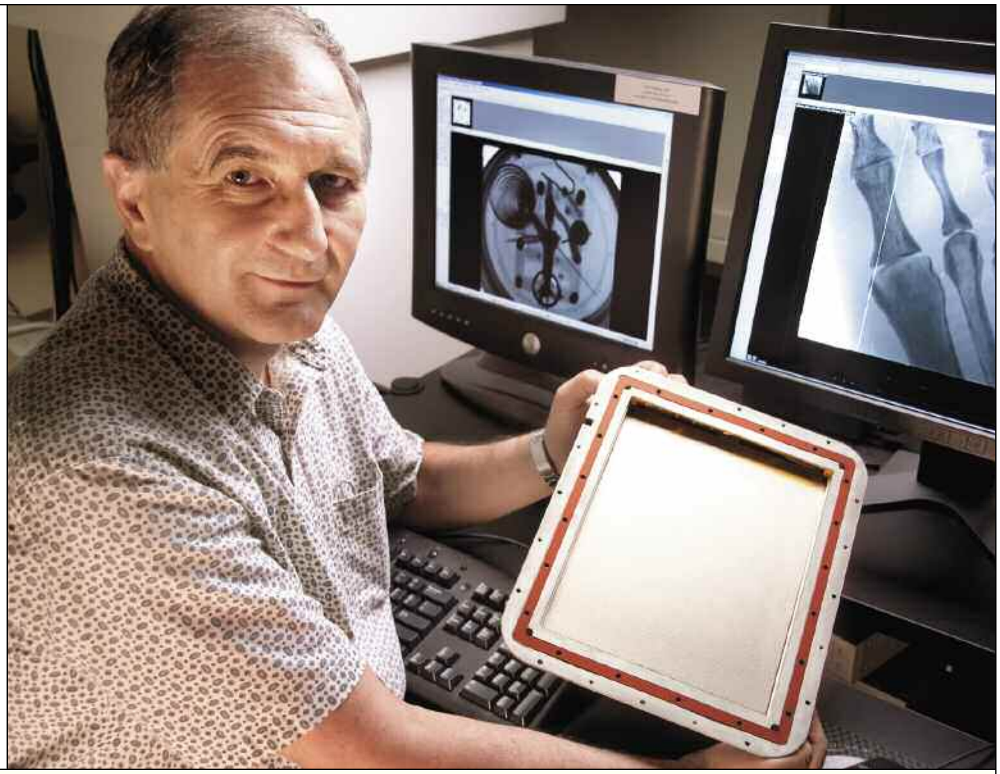
“Varian’s marketing and engineering departments stay closely connected to our clinical customers,” says Kolleen Kennedy, vice president of Oncology Systems, who oversees both marketing and engineering functions at Varian. “We work with our colleagues at the GTC to ensure that our complementary resources are focused on solving the most pressing clinical problems our customers face.”

Flat-panel imaging developments

Probably the best example of a seedling technology that GTC researchers helped nurture into the full bloom of a commercial product is the flat-panel X-ray imager.

It’s no exaggeration to say that flat-panel technology is revolutionizing the use of X-ray imaging both inside and outside the medical community. Technology specifically developed at GTC and elsewhere within Varian makes it possible to obtain both high-resolution radiographs and real-time X-ray movies from the same camera. It also gives X-ray imaging unprecedented portability, which is helping to substantially broaden the technology’s range of applications.

“We began working with researchers from Xerox’s Palo Alto Research Center (PARC) in the early 1990s to develop the early prototypes for flat-panel imagers based on amorphous silicon technology,” Zdasiuk says. “At that time, many thought this technology would be too expensive or not robust enough for radiation oncology. But, working with Varian’s engineering department, we were able to incorporate it into an FDA-cleared, amorphous silicon–based portal imaging product.” ›



R&D program manager George Zentai, Ph.D., demonstrates the prototype for a photo-conductor–based flat-panel imager in GTC's Advanced Development Lab.

Today, Varian's most advanced flat-panel imager is the PaxScan® 4030A detector, a 40- by 30-centimeter panel that can acquire high-resolution radiographs at more than 7 frames per second (FPS), or fluoroscopic images at up to 30 FPS. The market for the PaxScan displays is still growing, but GTC researchers are already at work on the next stage of development.

Varian currently deploys what is called an indirect approach to flat-panel imaging. Incoming X-ray photons are absorbed by a scintillator coating that converts them to visible light photons, which are then converted into an electrical signal in an amorphous silicon plate. The electrical signal is amplified, digitized, and finally transformed into an image by a computer. Researchers at GTC are now exploring the use of other coatings that would directly convert incoming X-ray photons into electrical signals.

"The main advantage of taking the indirect approach to flat-panel imaging is the potential to achieve higher resolution at a lower cost," says Zdasiuk.

The promise of cone-beam CT

Another major research effort under way at GTC is the development of cone-beam computed tomography (CT). In conventional fan-beam CT, a thin, flat X-ray beam is sent through a designated target within a patient's body from many different angles. This yields a series of projections that can be reconstructed by a computer into a single, high-resolution 2D image. In cone-beam CT, the "fan" beam is opened up (into a "cone") to cover a broad enough area so that an entire 3D-image data set can be obtained in a single scan.

"Cone-beam CT greatly speeds up the collection of data, especially when we think of the relatively slow gantry rotation speeds of radiation oncology accelerators and treatment simulators," says Zdasiuk. "A volume set that might take the better part of an hour to collect using fan-beam CT on a simulator can be acquired in about a minute with cone-beam CT.

Working closely with Varian Oncology Systems' worldwide engineering team, GTC researchers have been "feverishly at work" incorporating cone-beam CT technology into Varian's Acuity™ simulator, Zdasiuk says. This addition will give oncologists a new option of using the Acuity system to obtain high-resolution 3D anatomical images.

"Instead of having to physically move the patient and tie up a CT scanner, oncologists will be able to combine imaging modalities during treatment simulation," says Zdasiuk. "Giving Acuity a 3D CT capability also helps ensure that patient positioning is optimized for treatment."

Varian is looking to demonstrate a prototype of Acuity with cone-beam CT technology at this year's annual ASTRO meeting. The eventual plan is to incorporate cone-beam CT technology onto a Clinac® linear accelerator for kV-based onboard imaging. Onboard imaging would provide oncology teams with high-resolution images of both bony anatomy, for interfraction patient positioning, and soft tissues, for intrafraction motion management.

The Ginzton Technology Center was named for Edward L. Ginzton (1915–1998), one of the cofounders, with Russell and Sigurd Varian, of Varian Associates, the precursor to Varian Medical Systems.

It was, in large measure, Ginzton's advocacy that led to the development of the Clinac medical linear accelerator. Of that effort, Ginzton said, "This project shows the unique role that a research and development company such as ours—with a highly trained professional staff, closely related to a university environment, with creative and ingenious technical people—can play."

Ginzton advocated a strategy of attracting top-flight researchers and providing them with an environment where they could create without restriction—an approach that produced hundreds of innovations and awards. As the sole or joint holder of approximately 50 patents, Ginzton embodied the spirit of discovery that characterizes the mission of GTC today.

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IGRT enhancements

As part of the next step in Varian's initiative for image-guided radiation therapy (IGRT), GTC researchers are working to develop a new generation of motion-tracking technology for monitoring the target movement. GTC researchers helped develop the RPM™ respiratory gating system, which uses a reflective marker placed on the patient's chest, in combination with a video camera, to track patient motion during respiration.

"The idea first surfaced back in the early 1990s when we saw that the aerospace industry was using video technology to track deformations of aircraft during flight," says Zdasiuk. "We thought the technology might be useful for tracking patient and tumor motion during a treatment session."

GTC researchers are currently working on the use of tiny gold particles as marker seeds that would be implanted inside the patient around the site of a target tumor. Gold is biologically inert and provides a high contrast to X rays.

"Having internal markers makes real-time tracking practical," Zdasiuk says. "The technology will initially be applied to the prostate, but we expect it will be expanded to other tumor sites."

Biosynergy potential

Much further down the road as a product, but still of prime interest to GTC, is a biosynergy research effort. This work involves the use of radiation-activated chemical agents that can enhance the outcomes of radiation treatments, as well as the use of radiation to enhance therapies involving genes or cancer-killing chemical agents.

"The biosynergy research effort was established to fulfill Varian Medical Systems' commitment to capitalize on combining radiation with the latest advances in molecular medicine," says Robert Sutherland, Ph.D., president of Varian Biosynergy. The biosynergy research also brings into play the use of functional imaging techniques such as PET, SPECT, and MRI spectroscopy.

"Right now, we're focused on tracking soft tissue and dealing with anatomical distortion, but the future lies in biochemical markers and functional images to see where the cancer really is," Zdasiuk points out. "An important role for GTC is to develop the technology that will analyze images and extract information that oncologists can act upon."

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