

SOMATOM Sensation 64 – The World's Fastest CT Scanner

Siemens has always been a trendsetter in the computed tomography industry and its SOMATOM Sensation 64 is yet another example of this technology leadership. With its unprecedented image quality, detail and speed, the scanner establishes a new benchmark for diagnostic excellence.

By Tim Schröder



Superlatives should be applied judiciously. But there's no denying the fact that Siemens Medical Solutions' recently introduced SOMATOM Sensation 64 is the world's fastest CT scanner, achieving a spatial resolution of 0.4 millimeters and delivering diagnostic image quality that up until now was not thought possible. Moreover, this technology now enables physicians to visualize structures such as the inside of stents or smallest arterial deposits. Experts say this technology provides an optimal basis for even more accurate diagnostic examinations. However, applications for SOMATOM Sensation 64 extend far beyond the realm of cardiac diagnostics, since image quality is also a decisive factor in the early detection of tumors. Professor Werner Bautz, Head of the Department of Radiology at the University of Erlangen-Nuremberg and one of the specialists who have tested SOMATOM Sensation 64, is convinced that in this area the system offers considerable advantages. "In my experience no system to date has provided such detailed images using a 3D dataset. For example, in virtual colonoscopy, the entire colon can be viewed from all angles and in any dimension desired. It is possible, for example, to digitally open up the colon and virtually roll it out, thus allowing for contiguous tissue evaluation."

Dr. Mohammad Naraghi, Head of Business Development at Siemens Medical Solutions, puts it this way: "The image quality obtainable up until now wasn't good enough to allow for visualization of pathological changes such as early-stage tumors and vascular deposits, particularly in moving organs such as the heart and intestine. Images of these organs are often distorted by movements that occur while they are being scanned. Thus, the faster the scan, the sharper the image." Which is of course perfectly logical. The superb image quality delivered by SOMATOM Sensation 64 is also helpful in diagnosing lung cancer, where the main concern is early detection of pulmonary nodes, which change in shape and size over time. The new Siemens CT scanner allows for the visualization of far smaller pathological changes than was previously the case. This



PROFESSOR WERNER BAUTZ finds the image quality and speed of SOMATOM Sensation 64 to be highly advantageous.

also means that scanning can be performed at much shorter intervals, thus giving metastases less time to develop.

64 Slices Make the Difference

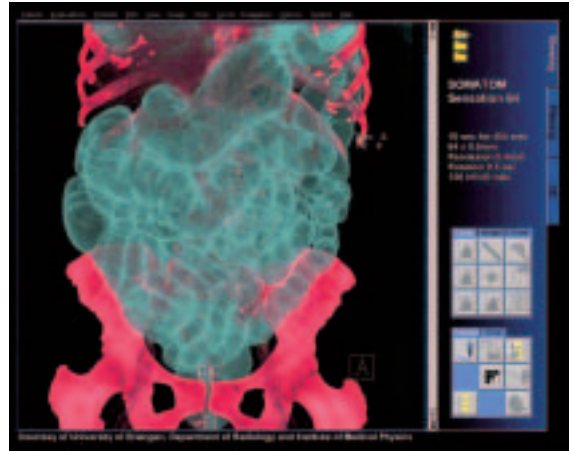
The outstanding quality of the images delivered by SOMATOM Sensation 64 is attributable to a series of innovations and new technologies, foremost among them being the STRATON X-ray tube and a special ceramic material that efficaciously converts X-rays into light signals. The heart of every CT system is constituted by the X-ray tube and detector that face each other in the circular gantry that revolves around the patient. The

»Never before have I seen such an excellent detail resolution.«

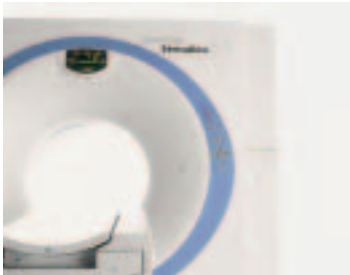
Professor Werner Bautz, Head of the Institute of Diagnostic Radiology, University of Erlangen-Nuremberg, Germany.



THE TEMPORAL resolution of 83 milliseconds delivered by the system enables it to capture razor-sharp images of even the smaller coronary side branches.



INVESTIGATION of a 45.5 cm colonic segment with 0.4 millimeter resolution and an examination time of 10 seconds.



THE OUTSTANDING imaging performance of SOMATOM Sensation 64 makes it *the* state-of-the-art CT scanner.

resolution provided by the CT scanner is determined by the number and width of the slices that are created during each rotation around the patient. A one-slice CT scanner creates one image per rotation, making imaging of the entire body a time consuming process. The SOMATOM Sensation 64 detector, however, is divided into 32 slices, known as rows, which means that a great many more tomographic images are produced per rotation. The main concern of the Siemens developers was to increase the number of rows above 16 while at the same time optimizing image resolution.

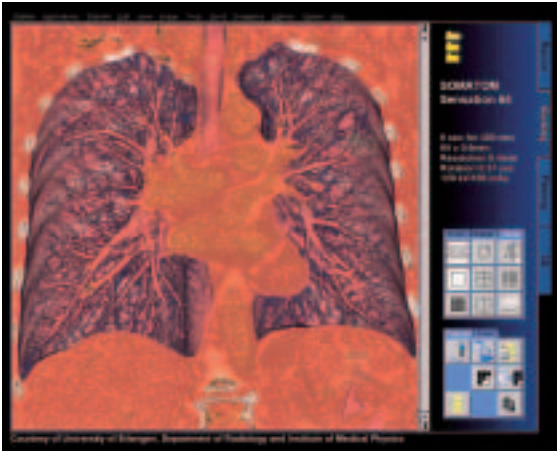
This was achieved via Siemens' unique z-Sharp Technology utilizing STRATON, Double z-sampling and the 64-channel Ultra Fast Ceramic (UFC) detector. The unique STRATON X-ray tube utilizes an electron beam that is accurately and rapidly deflected, creating two precise focal spots alternating 4 640 times per second. This doubles the X-ray projections reaching each detector element. The two overlapping projections result in an over-sampling in the z-direction, known as Double z-Sampling. The resulting measurements interleave half a detector slice width, doubling the scan information without a corresponding increase in dose. Siemens' proprietary, high-speed UFC detector enables a virtually simul-

taneous readout of two projections for each detector element, doubles the amount of slices acquired per rotation – 64 instead of 32 – and allows for a mean resolution of 0.4 millimeters, instead of 0.6 millimeters. According to Professor Willi A. Kalender of the University of Erlangen-Nuremberg, the great advantage of this technology lies in the fact that "images of superb quality can be obtained without increasing the X-ray dose."

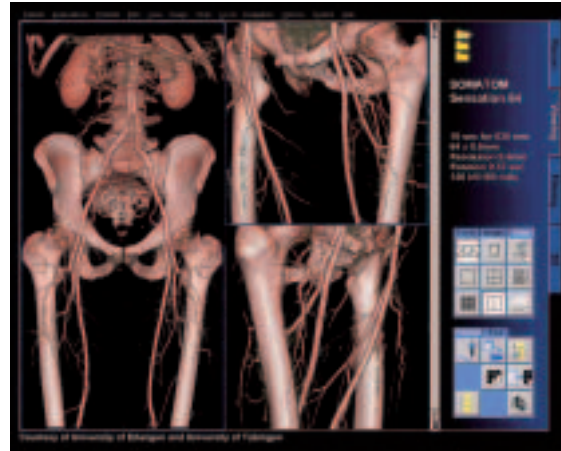
Examination Times Shortened by Innovative Technology

The excellent image quality delivered by the system is also attributable to the unusually high speed of its gantry, which in the SOMATOM Sensation Cardiac 64 rotates around the patient every 0.33 seconds, thus allowing for a temporal resolution of 83 milliseconds. This unprecedented CT scan velocity produces razor-sharp, highly detailed 3D images of the beating heart, even in patients with a high heart rate. The system can image the entire human heart in nine seconds flat.

In order to make the gantry rotate at such a rapid speed, it was first necessary to decrease the size and weight of the X-ray tube. To do this, the Siemens developers completely re-



INVESTIGATION of a 40 cm thoracic segment with 0.4 millimeter resolution and an examination time of 6 seconds.



THE ISOTROPIC resolution of 0.4 millimeters allows for detailed imaging of the smallest vessels.

designed the previous-generation tube. When large amounts of X-rays are generated within a brief space of time, the X-ray tube heats up very quickly. The X-ray generating anode in conventional X-ray tubes is surrounded by a vacuum and is not cooled directly, with the result that the heat generated dissipates only gradually and waiting periods between scans are needed in order to prevent the unit from overheating. Siemens' STRATON tube has a much more streamlined design. The anode is placed in a cooling medium at the periphery of the housing, and thus thermal build-up is dissipated immediately. This direct cooling enables a much more compact anode, thus reducing tube size and allowing for rapid gantry rotation.

Ultra Fast Ceramic (UFC) – Made by Siemens

A CT system can also be slowed down by its detector, particularly the ceramic component that converts X-ray quanta into light. Thus scientists have tried to develop ceramic materials that have good X-ray absorption properties as well as the capacity to react quickly to X-ray dose fluctuations. The ceramic material that was developed by Siemens Medical Solutions in Forchheim in collaboration with Siemens Corporate Technology in

Munich responds to such fluctuations in milliseconds.

This is an important attribute when the X-rays pass through soft tissue, which is more permeable to X-rays, and bone, which is less permeable.

CT scans display this transition as an area of dark-light contrast. The sharpness of the image is directly determined by the detector material, since all such materials have an afterglow, making them more fluorescent than is desirable. In order to obtain images that clearly differentiate between bone and soft tissue, afterglow time must be kept to a minimum. The afterglow in Siemens' ultrafast ceramic dissipates approximately 400 times faster than in the yttrium gadolinium oxide that has been used in CT systems of other vendors for many years. Although Siemens has been integrating this high-tech material into its CT systems since 1996, its full potential has only now been realized with the introduction of SOMATOM Sensation 64 and its extremely rapid rotation cycles. The advanced 64 channel electronics and UFC detector used in the unique z-Sharp system constitute the most advanced CT technology available on the market today. This is yet another example of Siemens Medical Solutions' technology leadership.

»Images of superb quality can be obtained without increasing the X-ray dose.«

Professor Willi A. Kalender, Head of the Department of Medical Physics, University of Erlangen-Nuremberg, Germany.

Author: Tim Schröder is a biologist, freelance journalist and former editor at Berliner Zeitung. He is a regular contributor to scientific journals such as Spektrum der Wissenschaft, Max Planck Forschung and Fraunhofer Magazin.