Efficiently illustrating metabolism

Metabolic illnesses are not rare. Because they can affect any organ in the human body, they are difficult to isolate. Doctors use single photon emission computed tomography (SPECT) to help them make a diagnosis. For the past ten years, Dr. Alexander Hans Vija (45) and his team in the U.S. have been working on algorithms, software and hardware solutions to optimize the images resulting from this type of examination. Now the researchers have developed an application that qualitatively improves SPECT analyses. Subsequent developments, such as IQ•SPECT, can reduce the dose of radiation or the time the diagnosis takes by three quarters.

“It’s a bit like the Nile Delta,” says Dr. Alexander Hans Vija to sum up. But he isn’t talking about the geographic characteristics of his home town of Evanston, one of Chicago’s northern suburbs. Instead, this senior scientist is referring to his research work at Siemens. Twelve years ago, the now 45-year-old scientist embraced the idea of improving the quality of the images of human organs that were created using SPECT. Today, thanks to his research, Siemens has created a number of products that have a wide range of functions — just like the widely branching Nile Delta.

Vija heads the research group for SPECT at Siemens Molecular Imaging, a subsidiary of Siemens AG. He came to Siemens in 2001 and dedicated his efforts to optimizing functional imaging methods. One of those methods is SPECT. His latest invention, Application Driven Optimization of Acquisition and Reconstruction of SPECT/PET Projection Data, ADORA for short, improves the quality and efficiency of SPECT examinations. This solution makes it possible to optimize data acquisition and processing. Compared with conventional tomography, ADORA may improve the image quality.

SPECT is used to generate a graphic representation of the metabolic processes in the body. This is accomplished through the use of “tracers.” These radioactively marked substances are injected into the patient’s bloodstream prior to the examination — usually via a vein in the arm. These substances then spread throughout the body and accumulate in the cells of the organ that is the subject of the examination. There they emit gamma rays. The detectors are special cameras that rotate around the patient and measure these rays. Many image layers are produced from this information. These image layers, taken from various angles, are then combined to create a 3D image. “In this way the rays provide the doctor with information from inside the body,” explains Vija. In these images the level of metabolic function is conveyed through the intensity of the color scale. One indicator of cancer cells is the increased metabolism they exhibit compared with healthy cells. Metabolism that is too low — due to heart disease, for example — is revealed by a lower color intensity as compared to healthy surrounding tissue. Depending on the clinical problem, the doctor can specify both the tracer and the SPECT imaging protocol. This involves a complex preparation process that takes many

variables into account. ADORA can potentially help the doctor to define the optimal protocol variation using only the existing data as a reference.

Vija and his team have now succeeded in optimizing this imaging technique. The main aim of their new ADORA application is to perfect the clinical results of a SPECT/CT examination by optimizing the entire imaging process rather than just individual components.

A rotatable gamma camera that can image the radionuclides in the body carries out a rapid preliminary scan. Then the ADORA software creates a customized camera diagram for the volume that is to be examined. In this diagram the projection angles and their individual dwell times can be specified. Previously the camera diagram was predefined and couldn't be optimally adjusted to each patient.

ADORA has already generated a number of subsequent projects. Using this software as a foundation, Vija and his team have developed various medical technology products. Based on these innovations Siemens introduced at the annual Nuclear Medicine society meeting in June 2013 a new hybrid imaging modality called xSPECT. Using for instance, the xSPECT Bone application, it is possible to make very high-resolution images specifically of bones; IQ•SPECT makes it possible to examine the flow of blood through the heart — in a quarter of the time that was previously required. More functions are planned. The goal here is to create higher-resolution images than those made previously. "But the fundamental function of ADORA is to better adapt the SPECT equipment to the specific illnesses of the patients and the requirements of subsequent treatments," says Vija.

He knows what he's talking about. Before he turned his attention to optimizing SPECT examinations with Siemens, he graduated from Giessen University (Germany) with a double major in mathematics and physics and then he went on to earn a doctorate in physics at the University of Washington in Seattle. Researching medical topics is a passion for Vija. He has written more than 20 published scientific papers. Moreover, in the twelve years that he has been working for Siemens he has registered a total of 79 inventions that have resulted in 29 individual patents and in 58 IPR families.

In his free time Vija, a father of two, enjoys leading an active life. He is not only a passionate skier but also an instrument-rated pilot. When he isn't up among the clouds, he enjoys traveling on the ground. "I want my children to get to know as much of the world as possible," he explains. However, he hasn't taken them to visit the Nile Delta yet.