Better MRI images generated more rapidly

Magnetic resonance imaging (MRI) is still a relatively new medical imaging technique. The first commercially available MRI devices were not developed until the mid-1980s. MRI images display the structures of organs and tissue. Inventions developed by Dr. Stephan Biber are now continually improving the image quality of MRI devices. These inventions make it easier to identify changes to tissue structures, while at the same time enabling ever shorter imaging times.

Unlike x-ray machines, MRI devices do not expose patients to ionizing radiation. Instead, magnetic resonance imaging exposes protons in the human body to a powerful magnetic field that causes them to oscillate at a high frequency. These oscillations are picked up by an antenna in the MRI device, whose computer programs then convert the signals into images. “The closer the antenna is to the part of the body for which an image is being recorded, the better will be the antenna’s reception,” Biber explains. “In addition to the technical issues involved, it’s important for the patient to feel comfortable during the procedure, despite the fact that the antennas are located very close to his or her body. That’s something I have to take into account as well.” Biber has been working for many years to improve MRI antennas, signal transmissions, and image processing programs.

MRI devices have several separate antennas that are combined to create a local coil that receives signals from inside the body. The trend in recent years has been to produce smaller and smaller antennas that deliver a stronger signal at more or less the same level of noise. The advantage here is that a higher resolution enables continual improvement of the quality of the diagnosis because it allows physicians to recognize smaller and smaller structures more reliably. The improved signal-to-noise ratio can also be used to shorten scanning and measuring times, and that makes it possible to examine more patients in the same period of time. “The smaller antennas also offer an additional benefit in that they’re more sensitive and focus more precisely on the area being examined,” says Biber. For example, one antenna unit placed above the forehead can deliver a signal from the prefrontal cortex. By contrast, the older local coils, which are larger and have only one antenna unit, deliver signals from all areas inside the head. The spatial allocation of signals to a specific area

inside the human body can be used in parallel imaging procedures in order to significantly shorten the image recording times.

However, the benefits offered by the small antennas also lead to several technical problems. For example, by their very nature, the more sensitive small antennas will more strongly pick up signals that are distorted by breathing processes and by the resulting movements in the chest and stomach area. However, Biber has developed a program that very effectively focuses antennas on a specific point before a scan in order to prevent distortions. The same invention, which is also a software solution aligned with MRI hardware and applications, enables signals to be compared after they are digitized but before the image is generated. This, in turn, allows the most important information to be filtered out.

As a result, local coils with a very large number of antenna units can also be used with MRI devices that are equipped with fewer reception channels. For example, an MRI device in the mid to upper-range price segment operates with a head coil that has 20 to 32 antenna units whose signals are picked up by 32 to 64 reception channels, while a less expensive unit has only 8 to 16 channels. However, thanks to Biber's program, such a unit can still work with the same head coil that the more expensive ones use. Plans call for this invention to be utilized in a new magnetic resonance imaging device that is currently being developed by Siemens in China.

"All of these inventions are actually computational techniques that compress and filter digital signals before images are generated from them," Biber explains. Biber is certainly a versatile inventor. He has helped to develop both hardware (such as coils) and software algorithms for image and signal processing. Biber is also a system architect who is responsible for ensuring that individual MRI components are developed in a manner that enables them to later work together perfectly as a complete system and be used in multiple products of a system family. When he's not inventing things, Biber spends time with his wife and two children. He also likes to "disappear" when he gets a chance — he's an avid diver and loves all aquatic sports.