FieldStrength

Publication for the Philips MRI Community

ISSUE 47 – 2012/3

Barrow Neurological Institute research strives to make clinical MR faster and better

New partnership between Barrow and Philips for using Ingenia 3.0T in research projects.

This article is part of FieldStrength issue 47
2012/3

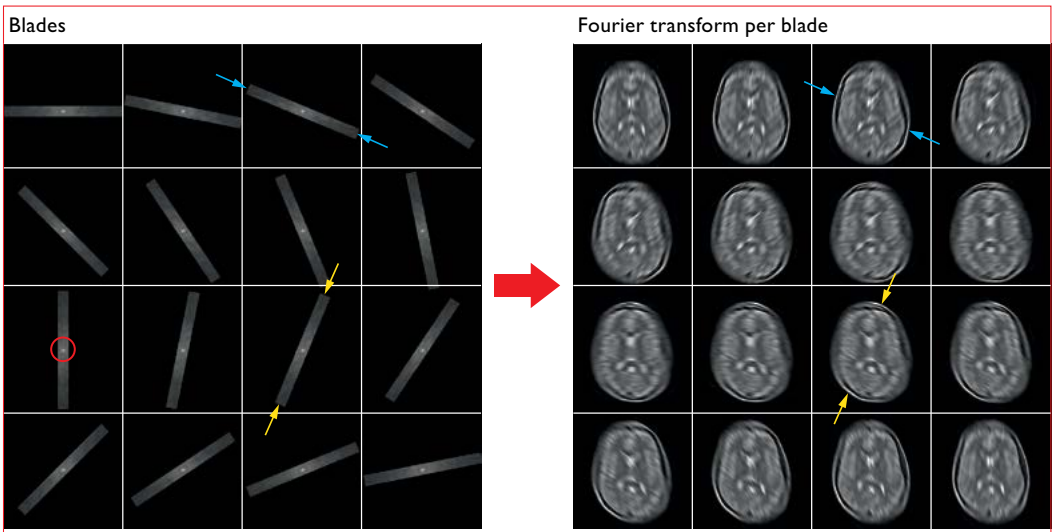
Jim Pipe, PhD, Director of Neuroimaging Research at Barrow Neurological Institute, researches MRI methods that may have a positive impact on patient care. He invented PROPELLER, a technique that eliminates patient movement artifacts. Before joining Barrow, he served on the faculty of the Department of Radiology at Wayne State University (Detroit). He holds a BSE and an MSEE in electrical engineering, and an MS and a PhD in bioengineering from the University of Michigan.

Barrow Neurological Institute research strives to make clinical MR faster and better

New partnership between Barrow and Philips focuses on advancing MR technology by using Ingenia 3.0T in research projects.

Barrow Neurological Institute is a center of neurological excellence contained within St. Joseph's Hospital and Medical Center (Phoenix, Arizona, USA). It recently acquired its first Philips MR system, an Ingenia 3.0T. The system comes with a five-year agreement between Philips and St. Joseph's to pursue research that will advance MR technology by accelerating MRI and improving image quality, for example, by reducing motion-related image disturbances.

"I think the big reason to have fast MR is because we can't afford long MR scan times anymore."

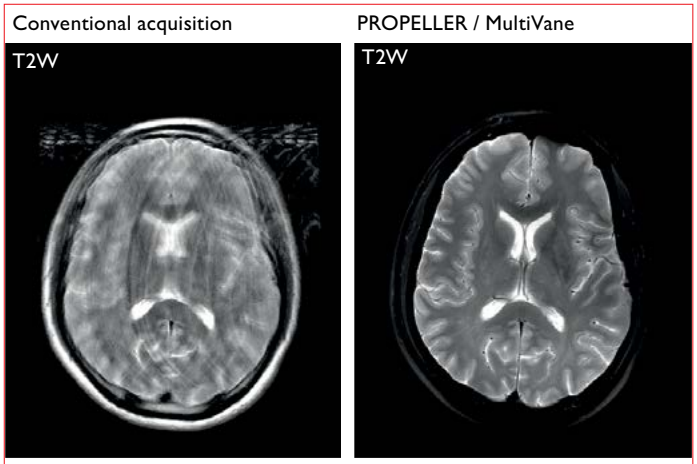


Principle of PROPELLER and MultiVane techniques
Conventional methods collect data along horizontal lines that fan all of k-space. PROPELLER and MultiVane data are collected as rotating blades. One echo train collects all data for one blade. The images obtained by Fourier transforming each blade illustrate that the low spatial frequencies are collected by each blade (red circle), while edge information corresponds to the orientation of the blade in high-frequency space (blue and yellow arrows). When combined all data produce a complete sharp image.

Barrow Neurological Institute plans to use the Ingenia to help reach the goal of "making clinical MR faster and better," according to Jim Pipe, PhD, director for neuroimaging research at the Institute. As the inventor of the PROPELLER (Periodically Rotated Overlapping ParallEL Lines with Enhanced Reconstruction) technique, which Philips applies in MultiVane, as well as chair of the 2012 International Society for Magnetic Resonance in Medicine (ISMRM) Meeting, Dr. Pipe is at the forefront of MR technology research, particularly in regards to fast sequences and motion correction.

Developing spiral MR for robust and fast clinical use

One aspect of Barrow's research is the development of spiral MR. "Spiral MR has been used in research for quite a while, but is not used clinically very much at all because it is not very robust," Pipe says. "However, it has the potential to make it possible to generate images with the same SNR, quality and content as normal images, but collected in less time and with reduced motion artifacts." He estimates that if technical hurdles are solved, spiral imaging could reduce neuro scan times – and ultimately exam times – by a factor of 2 to 3.



Motion reduction

Example images of a moving volunteer show PROPELLER / MultiVane techniques combined with motion correction reduce ghosting and mitigate blurring. Techniques like PROPELLER and MultiVane oversample the center of k-space by collecting data in groups. If in-plane motion occurs, it is evident in the low resolution frequencies from the center of k-space, and corrected in the individual data groups. The groups are then combined, resulting in sharper MR images.

"The desire to go faster should follow patients, because they want to get the exam over as quickly as they can, and it also fits well with the economics of healthcare, because we have to become more efficient with these expensive tools."

CONTINUE

Speed addresses both clinical and economic issues

Higher scan speed allows for faster imaging with less motion-related blurring, or higher resolution in the same scan time. In addition to the clinical benefits, Dr. Pipe sees an important economic benefit. "If we could change MR so that we could do five-minute exams that cost a couple hundred dollars, rather than 45-minute, thousand dollar exams, it would really change the paradigm of how we use MR," he says. "In the United States, for example, we spend roughly 20 billion dollars each year on MR. If we could even cut those 45-minute times in half, and then charge 60% of the current charge so we are still making more per hour, we can save billions of dollars in healthcare costs without compromising patient care quality at all."

Dr. Pipe acknowledges that not all exams will be as short as five minutes, and that such a change requires more than just technical advancement, but calls it the motivating factor. "When I give educational talks, I point out that we are not making fast images just because it is cool. I think the big reason to have fast MR is because we can't afford long MR scan times anymore."

He adds, "The desire to go faster should follow patients, because they want to get the exam over as quickly as they can, and it also fits well with the economics of healthcare, because we have to become more efficient with these expensive tools."

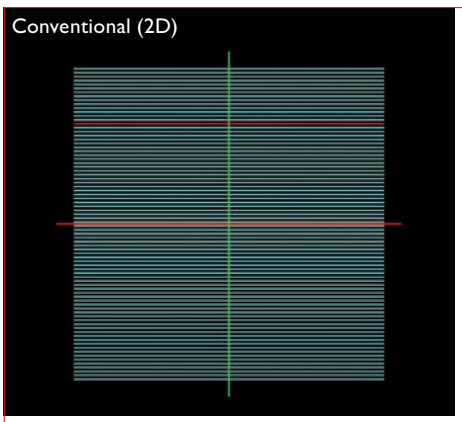
Additional areas of study include fMRI, MR angiography

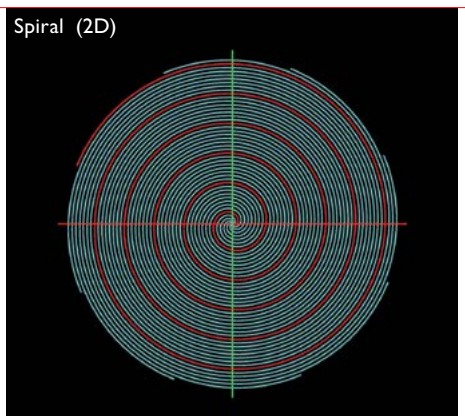
In addition to developing fast sequences, the Institute's Ingenia system will be used to further develop non-cartesian motion reduction techniques, such as MultiVane, and for a wide variety of research. Leslie Baxter, PhD, also of Barrow, will use Ingenia 3.0T for fMRI studies of deep brain stimulation and depression, pre-surgical planning, and other fMRI applications. Barrow also may use the scanner for research on various other topics, including cardiovascular imaging and Alzheimer's research, in cooperation with other Phoenix institutions including Mayo Clinic and Banner Health.

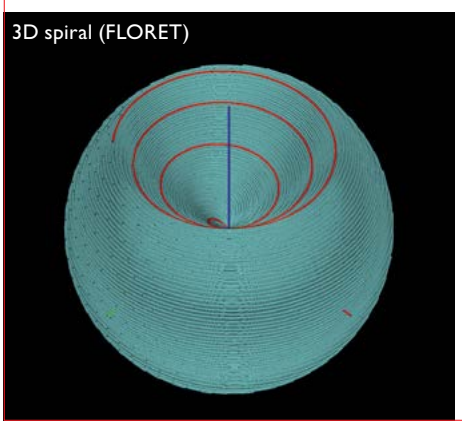
"The research changes all the time, but we are always interested in making clinical MRI really good, and we want to remove all the technical boundaries so that the only things limiting us are physics and physiology," Dr. Pipe summarizes.

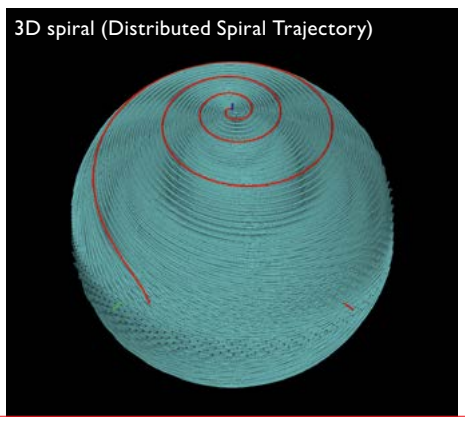
Although his scanning experience with Ingenia is still limited, Dr. Pipe is very positive about the system. "The neuro images are quite good," he says. "This is our first system with a 70 cm bore, which is fantastic from a patient point of view. Our early impressions of dStream are really good, and there is a lot of flexibility that will be very advantageous to us." But he reserves his highest praise for Philips personnel.

"My biggest incentive for working with Philips is the people. I have admired the work of a lot of folks within Philips for a long time, and I am thrilled to be able to work with them," he says. "The desire at Philips to challenge the status quo of MR is very exciting to me. I think we share a lot of the same vision and enthusiasm."







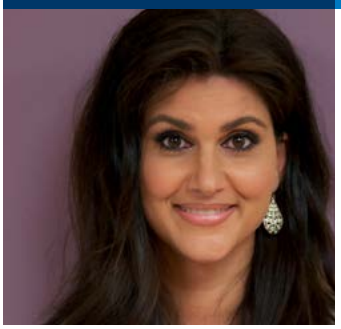


Spiral imaging

Spiral imaging has the potential to create images with the same quality as conventional methods, but in less time and with reduced motion artifacts. Spiral scanning measures more of the data in k-space each TR. If the technical barriers to making this technology truly robust can be solved, spiral imaging could improve nearly every type of MR scan.

Creative design of 3D spiral-based trajectories opens up the possibilities for improving more applications.

Learning to use Ingenia easier than expected for Barrow research technologist



Sharmeen Maze, RT,
Research MR Technologist at
Barrow Neurological Institute.

Sharmeen Maze shares her experiences with the site's first Philips MRI scanner

After receiving her training in MRI, Sharmeen Maze, RT (R) (MR), began working as an MRI Research Technologist at Barrow Neurological Institute nearly 10 years ago. A few months ago Barrow acquired its first Philips system, an Ingenia 3.0T. Maze notes that she was apprehensive about using a different manufacturer's system. "I was really hesitant about it," she says. "But it has been a good experience. The transition to Ingenia was easy."

Now, with a few months' scanning experience, she shares her observations on transitioning to Ingenia.

Image quality: "I'm working on a nationwide clinical study. Those exams have specific parameters to ensure that results from across the country are comparable. When I started using the Philips system, I was running the same scans as I had run on our older systems, but with the Philips parameters. I found the images were quite excellent."

Working with a voxel-based system: "I had heard that the Philips system was in voxels, and not matrix-based like I was used to. But it was surprisingly easy to learn."

"With the Philips system, you set the voxel size, and it remains fixed, which is quite nice because you always know what your in-plane resolution and voxel size is, without having to do calculations."

Understanding parameters: "I was kind of surprised by how many parameters there actually are that you can change and manipulate that we weren't able to even see on our other systems."

ExamCards: "There are a lot of parameters to go through. But it was quite easy once I got the hang of it. Once we had them created it was pretty easy to save them and to work on an ExamCard during the time I was scanning something else. I also used NetForum."

SmartExam: "In research, you have to be consistent, and everything has to be exactly the same for every scan because they are usually longitudinal studies. So the ease of being able to lock your protocols and set up the exams the same way is key."

Post-processing: "We don't do a lot of post-processing in our research. But from a clinical perspective, I noticed that there were a lot of things that we can do on the system. I work clinical MRI on the weekends, and there are certain functions that we aren't able to do on that non-Philips system, so there is a workstation for different types of processing. Whereas with Ingenia, it is all on the scanner, and you don't need a separate workstation."

Patient comfort: "I am doing an obesity study, and it has been a lot more comfortable for my patients. Because of the length of the table stroke, I can scan people head to toes without bringing them out and turning them around half way through the scan."

Short, and fewer, cables: "When patients are in a high magnetic field, and with the research we're doing, we don't want a lot of cables or extra cords along the patient that could potentially create a current."

MobiView: "MobiView is eye candy. It is an impressive image, and the detail is amazing for an approximately three-minute scan without a breath hold. It is also a great method for planning additional scans. For example, I can do a quick scan of the spine, and then set up all my other scans off of that, without doing several little localizers like we have had to do in the past. You get a nice image of the whole spine in one shot instead of three."

Gating instruments: "We have two units that look like cell phones. They have rechargeable batteries, and a short cable that you can attach to an EKG lead, the cardiac or respirator belts or peripheral gating, and you get a really great signal. I'm used to long cords that were plugged into an external device such as a patient would have at the bedside, and then a monitor in the control room so the tech could see the gating. If we had patients on anesthesia, we would have EKG leads, pulse oximeters and CO_2 monitors, and I'd have to be aware of all those cables and make sure they didn't get caught on anything."

Advice to other technologists: "It was a nice surprise how easy it was to transition to the Ingenia. The only thing I brushed up on was the names of the pulse sequences because they are different, and I still have a cheat sheet that tells me what they are in other vendors' language and Philips language."