

From left to right: Valentin Prevost (Canon Medical Systems Corporation), Bei Zhang (Canon Medical Systems Europe), Prof. Tourdias (Bordeaux University Hospital), Prof. Dousset (Bordeaux University Hospital), Bruno Triaire and Nobuyasu Ichinose (Canon Medical Systems Corporation).



VISIONS spoke with Prof. Dousset and Prof. Tourdias, from the Bordeaux University, France.

Deep Learning Reconstruction in Magnetic Resonance Imaging

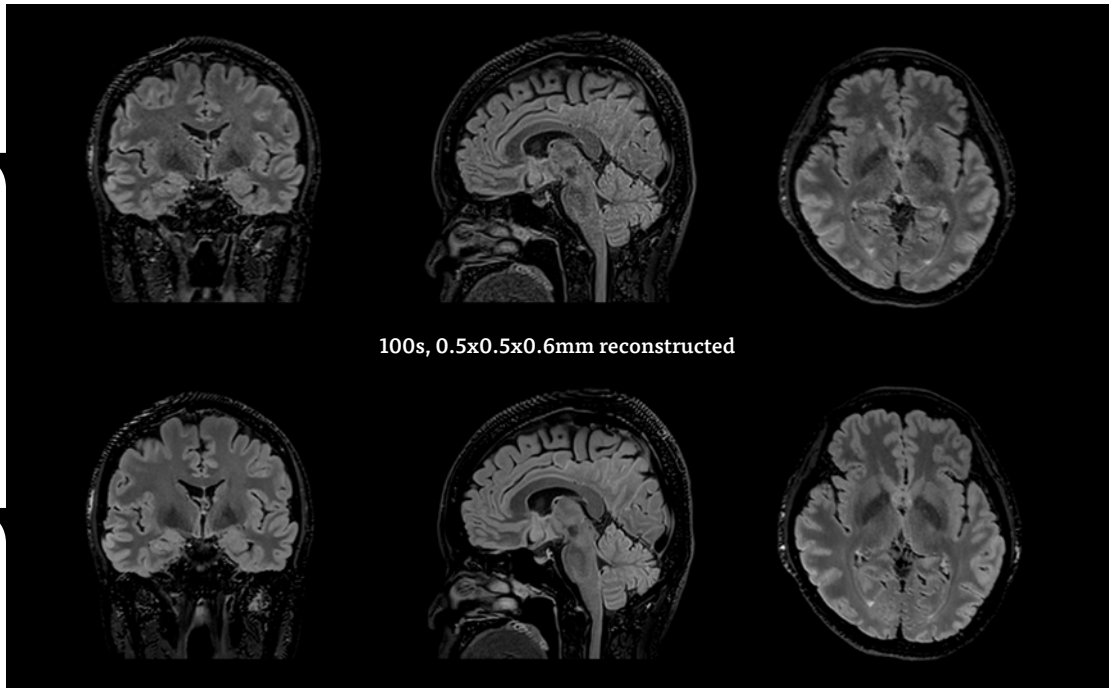
Artificial intelligence continues to expand the possibilities brought by medical imaging and advance healthcare. In particular Deep Learning Reconstruction (DLR) used in combination with Magnetic Resonance Imaging has the potential to help diagnose diseases earlier, faster and better. In France, Bordeaux University is working with Canon Medical's DLR solution to fulfill these promises and take the best out of the technology in numerous applications in research and clinical practise.

DLR has the ability to improve image quality by eliminating noise. Removing noise from images with DLR increases signal to noise ratio, helping to obtain ultra high-resolution images. Based on the experience from Bordeaux University, this has provided the opportunity to see anatomy previously not possible on 3T systems.

Applications in research and clinical work

With the help of Canon Medical, the future has already started at the Bio Imaging Institute (French: IBIO[1]), an unique structure that serves as an interface between the clinical work performed at Bordeaux hospital and the research done at Bordeaux University.

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3D FLAIR Original image.

3D FLAIR with DLR.

IBIO started integrating Canon Medical's DLR solution in November 2017. The workload progressively increased during the first six months, to find the optimal parameters and fine-tune the "denoising". The team has been using the system routinely for about a year now and is working on validating the tool scientifically.

Prof. Thomas Tourdias, Radiologist at Bordeaux University, uses DLR in almost all his research projects. "DLR helps to remove noise and obtain better image quality, which assists us to collect more information to answer research questions. Removing noise also helps us to reach a very high resolution that we previously couldn't achieve, which is very helpful for specific research areas," he said.

DLR can be implemented in a myriad of clinical scenarios, for example to help expedite workflow. "In our daily routine, we are challenged with a growing number of requests and the difficult task of examining all these patients. So probably the major clinical application for DLR is going to help us work faster. Many more patients could undergo examinations when we decrease the acquisition time," Prof. Tourdias explained.

DLR is easily integrated into the image reconstruction chain. Radiologists only have to plug in the option to improve the image quality. Switching to this new routine is effortless and brings real benefits, according to Prof. Vincent Dousset, Head of the diagnostic and therapeutic Neuro Radiology department at Bordeaux University Hospital.

"The first advantage is that we can achieve high resolution images with-



"Removing noise also helps us to reach a very high resolution that we previously couldn't achieve."

Prof. Thomas Tourdias, Radiologist at Bordeaux University and Hospital, Practitioner at Bordeaux University Hospital. Also member of INSERM Unit U1215 Pathophysiology of neural plasticity" at the Magendie Neurocentre.



"With DLR we can achieve both high resolution images without losing time or signal and reduce the image acquisition time."

Prof. Vincent Dousset, Head of the diagnostic and therapeutic Neuro Radiology department at Bordeaux University Hospital.

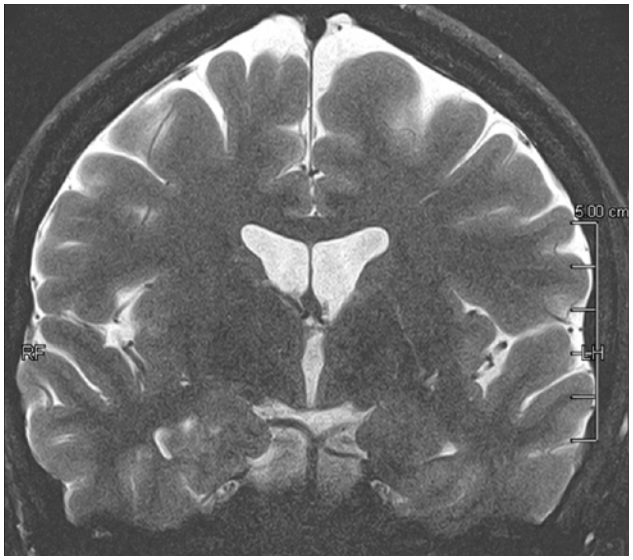
out losing time or signal. The second advantage is the reduction of image acquisition time, as we care less about the signal quality because the noise can be eleminated following the scan," Prof. Dousset said.

DLR is more than just a new tool, it's a major change in medical imaging history, Prof. Dousset believes. "Because the DLR will allow us to correct afterwards what couldn't be corrected at the outset, the first application is that we no longer have to improve the signal or the spatial resolution. This is revolutionary in medical imaging history. This is the main advantage I think: the image "denoising" technique."

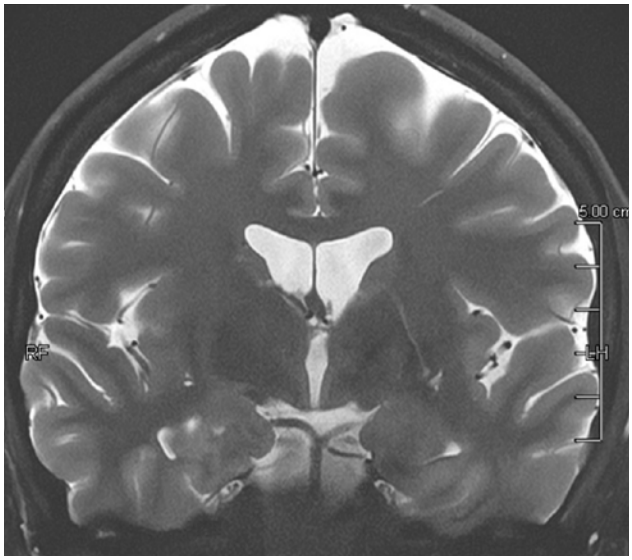
In particular DLR has an important clinical impact in anatomical regions that require a very high resolution, for example parts of the hippocampus and the claustrum.

"The DLR brings a spatial resolution that I have never seen before in neurologic imaging. I recently pointed out a brain area, for example the claustrum, that is almost invisible on standard MRI images even with very high resolution or high field devices. However, thanks to the DLR we could highlight this kind of brain anatomy. So, indeed, there is a considerable advantage to using this technique." Prof. Dousset said.

Prof. Tourdias worked at 7T to visualise extremely fine structures of the hippocampus while at Stanford. With DLR, he can now do this task with a 3T. "When we compared the images we realized that by pushing the 3T machine and processing with DLR that we were able to achieve a similar result to what we could achieve with 7T. I think this is the main surprise of the technology." he said.



Original Coronal T2w image.



Coronal T2w image with DLR.

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Bordeaux University Hospital.

Mutual benefits

The synergy between the hospital and Canon Medical creates opportunities to find solutions for the patient, also in areas that had never been explored before. Working with Canon Medical enables physicians at IBIO to work with the most advanced technology on the company's latest MRI scanner for on-going clinical research, but benefits spread beyond the institute, Prof. Tourdias explained.

"There is an interest in transferring the technology back to the manufacturer, and we hope that the results of this research will quickly spread to the industry. And then it's interesting to put together research projects. So, there are multiple facets to our collaboration," he said.

The strong cooperation between Canon Medical and the medical team at IBIO has also placed the institute among the top, most competitive imaging centres in Europe.

"Canon Medical's collaboration with Bordeaux University helps us position ourselves internationally among the important European academic teams who work with major medical imaging manufacturers. This is a huge benefit," Prof. Dousset said.

Canon Medical's cooperation was essential in installing and becoming familiar with the system and more generally with AI. With Canon Medical's clinical scientists involved all through the process and visiting regularly, the medical team was able to find the optimal settings and make the most of DLR.

"There were a lot of questions about DLR's relevance and benefits, and the different technical parameters that it features. We proceeded to analyse a lot of images, so that we could make choices that had been transcribed by Canon Medical. The manufacturer's contribution was very significant to DLR's development at our site," Prof. Dousset said.

Innovating hand in hand with Canon Medical benefits not only the patient, but also the next generation of radiologists. "It's very important to integrate the industry in education, to prepare students for their future professions," he concluded. //

Reference

[1] *The Bio Imaging Institute (French: IBIO) project was initiated ten years ago to be the interface between Bordeaux Hospital and Bordeaux University. The building hosts research on both animals and humans, with a particular focus on MR imaging, but there are also on-going projects in X-Ray and optical imaging. The IBIO welcomes several academic teams from Bordeaux University and the French National Centre for Scientific Research (French: CNRS), who work on MRI biologic imaging development and neuroscience studies, as well as industrial teams, such as the Canon team for MR work.*