GE Healthcare

Customer Testimonial

Universitätsklinikum Jena Hospital Accelerates CT Workflow in Time-Sensitive ER

This is Universitätsklinikum Jena's independent experience with deep learning image reconstruction.

Universitätsklinikum Jena (UKJ) is a 200-year-old academic research facility in Germany where scientists and physicians from more than 25 nations are involved in biomedical and patient-related clinical research. Providing state-of-the-art medical care for the hospital's 26 clinical centers and 25 institutes which treat 53,000 inpatients and 275,000 outpatients per year requires keeping up with technological advances that improve diagnostic accuracy and confidence.

Over the past decade radiology exams have increased in numbers and their role in clinical diagnostics has grown. But more scans also mean more image data is being produced for every patient examined and all that data ultimately has to be handled by physicians. As a result, identifying intelligent methods that can keep the workload manageable, particularly in the emergency room (ER) setting, while also prioritizing diagnostic confidence and decision-making remain high on the list.

In time-sensitive clinical settings like the ER where trauma teams need fast, accurate and reliable data for treatment decisions, UKJ is now relying on a new artificial intelligence (AI)-based CT image reconstruction algorithm from GE Healthcare to produce TrueFidelity CT Images. This deep learning iterative reconstruction (DLIR) approach is one of the first of its kind available on the market today.

Professor Ulf Teichgräber

MU Dr. Ioannis Diamantis

Felix V. Güttler

This is Universitätsklinikum Jena's independent experience with deep learning image reconstruction.

Keeping pace with the ER workflow

“Speed, accuracy and reliability of CT imaging is critical for improving confidence in diagnosis and selecting appropriate treatment in the ER.” explains Prof. Dr. Ulf Teichgräber, Head of Radiology at UKJ. “With the advanced technology of deep learning, trauma teams at UKJ are experiencing higher quality imaging with fast reconstruction throughput.”

The UKJ team made the decision to implement TrueFidelity CT Images broadly, throughout their clinical routines after the initial evaluation. Impressed by the image quality and robustness of the reconstruction results, they moved forward with clinical application training and then adopted the deep learning algorithm on the ER scanner knowing it would significantly improve image quality and maintain clinical relevance of reconstruction times for the time-sensitive clinical settings of their trauma and stroke teams, as well as their other clinical colleagues.

Additionally, the UKJ team predicted deep learning image reconstruction technology would also improve workflow by removing the need to use specific kernels (algorithms), such as a lung algorithm for performing pneumonia scans. This saves time and makes it easier for the radiologist to provide instructions on how to perform the examination. Today the UKJ ER CT scanner with TrueFidelity CT Images has the ability to reconstruct any examination that is needed without the help of a special kernel, with no penalty to reconstruction times, all of which provide significant benefits.

"Deep learning image reconstruction makes it much easier for me as the doctor because I don't need to wait even two minutes for a technologist to perform reconstruction with a specific kernel once an examination is completed," explained Dr. Ioannis Diamantis, leading CT radiologist at UKJ. "Now once I have the thin slice images I can immediately begin to concentrate on the pathology and do everything as I need to on my AW server with a standard kernel. I don't have to take time to explain to my technologist where the pathology is located and what I need for the case because I can do all of that myself. It is something any radiologist can do."

Workflow benefits resulting from the clearer images produced by advanced TrueFidelity CT Images are ultimately translating into more confident diagnoses. "Deep learning allows for superior image quality by further improving signal-to-noise ratio (SNR) compared with iterative reconstruction. This means clinical colleagues working in critical ER scenarios might receive a more confident diagnosis from the radiologist and this allows clinicians to make more confident treatment decisions," explains Felix Güttler, Commercial and Technical Director, Department of Radiology at UKJ. "Also for patients with high BMI, we receive faster diagnosis with higher confidence." added Dr. Diamantis.

Trauma image quality improves diagnostic confidence

For trauma patients and those with a high BMI, traditionally it has been challenging to position these individuals in the exact position needed in order to produce the highest quality image outcome. In contrast, the UKJ teams have found that with TrueFidelity CT Images, they are able to scan patients with high confidence without increasing radiation dose or requiring perfect positioning.

"One advantage of using TrueFidelity CT imaging in the ER environment is the dedicated training the algorithm received for motion artifact reduction in brain scanning," explains Mr. Güttler. "It is a critical improvement to have in the ER environment, for example with stroke, because it allows our radiologists to conduct a more confident assessment of a pathology in the artifact-affected region."

Currently UKJ has TrueFidelity in routine use on both Revolution CT scanners for almost every given clinical situation and anatomical region. According to Prof. Dr. Ulf Teichgräber, Head of the Department of Radiology, "For more than 90 percent of what we are doing we are using the advanced deep learning approach because, in our experience, it has outperformed existing iterative reconstruction techniques in almost every scenario."

TrueFidelity™ - Polytrauma whole Body – IQ Improvement

TrueFidelity 2 mm

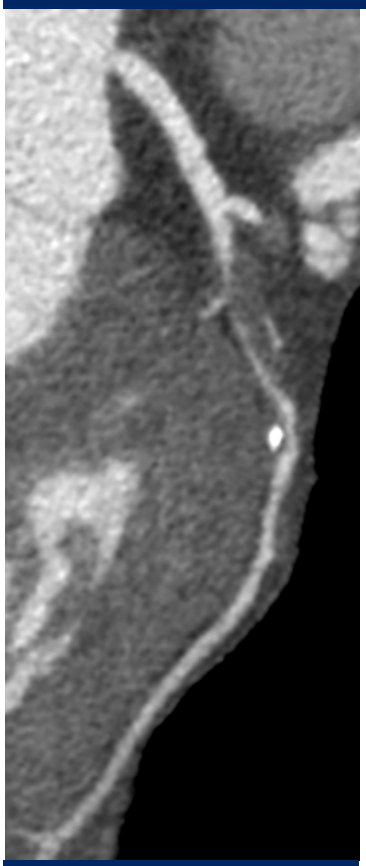
This is Universitätsklinikum Jena's independent experience with deep learning image reconstruction.

Demonstrating cardiac pathology with 3D reconstruction

TrueFidelity CT Images when applied to advanced 3D reconstruction also produce better 3D model depictions of what the findings look like for UKJ trauma teams. **According to Dr. Diamantis, "We have updated all of the protocols in our system with deep learning image reconstruction and use 3D reconstruction primarily with our cardiac imaging to demonstrate to the surgeon where the pathology is located. In the end, we have to be able to show where the problem is at and TrueFidelity CT Images are easier to read. I perform 3D demonstrations live over my AW server and they look perfect."**

The team is now considering the potential for how this technology might improve imaging quality for in-stent views given how much the lower noise improves their ability to see pathology more clearly.

TrueFidelity™ - CCTA Occlusion RCA & Stenosis of LAD / LCX



LAD

LAD

VR Tree

This is Universitätsklinikum Jena's independent experience with deep learning image reconstruction.

Reducing radiation dose for recurrent follow-up scans

While the TrueFidelity technology was not primarily designed to deliver low-dose CT protocols, the UKJ team found it provides substantial clinical benefits in this area.

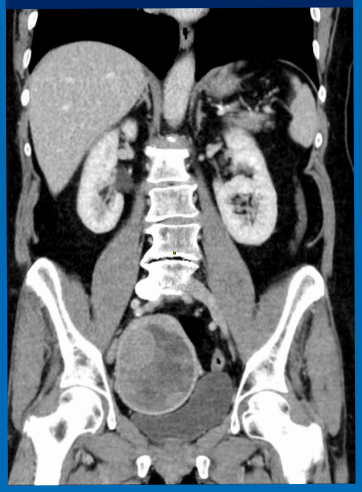
"In our oncology patients who undergo four follow-up CT scans per year we wanted to compare the examinations from the same scanner but with different reconstruction methods in order to observe what would happen with dose reduction," said Dr. Diamantis. "We believed we would see reductions in dose of up to 50 percent. And we did."

In high BMI patients the UKJ researchers were able to achieve a 50 percent dose reduction using deep learning technology and still produce the same image quality compared to previous Model Based Iterative Reconstruction techniques.

Maintaining Image Quality while reducing dose through mA and kV

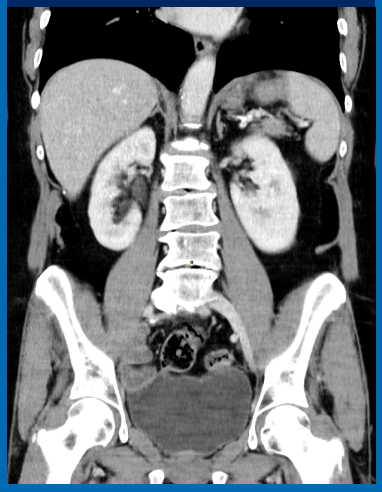
Portal Venous Phase

Prior exam - October 2018



4 mm
ASiR-V 50%
CTDIvol 7.77 mGy

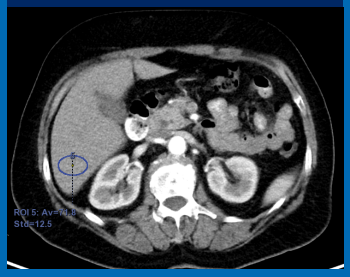
Follow up – June 2019



4 mm
TrueFidelity
CTDIvol 3.44 mGy

Arterial Phase

Prior exam - October 2018



ASiR-V 50%
120 kV | 192 mA | NI 27
CTDIvol 7.11 mGy

Follow up - June 2019

TrueFidelity
100 kV | 160 mA | NI 32
CTDIvol 3.39 mGy

This is Universitätsklinikum Jena's independent experience with deep learning image reconstruction.

Ground truth training with FBP makes a difference

Training the deep learning network on filtered-back projection (FBP) data with ground truth imaging was a significant point of confidence for the team at UKJ, including their physics experts and radiologists.

"It was important for us that the algorithm was trained on ground truth FBP data versus iteratively reconstructed data that already makes the resulting images look a certain way." said Felix Güttler.
“We were frequently discussing the pitfalls if the algorithm was trained by iterative reconstruction images because of potential information loss.”

By contrast, the team's point of view regarding the development and training of TrueFidelity using ground truth FBP as the gold standard is one of reassurance. They know this process does not take away relevant information.

Future of DLIR in the trauma setting

Prof. Teichgräber, Mr. Güttler, Dr. Diamantis, and their fellow radiologists and clinical colleagues believe TrueFidelity imaging increases the importance of CT as well as marks a new era in reconstruction techniques for CT.

"For us, it is the first experience using an AI-based solution in a broad clinical setting versus just focusing on one specific problem," said Mr. Güttler. "So, it is our opinion that deep learning image reconstruction clearly outperforms existing iterative reconstruction methods."

"We are waiting for the next step with image reconstruction and what comes next," commented Dr. Diamantis. "Deep learning image reconstruction is where we would like to concentrate and we're looking forward to being able to get even more information and data."

“One thing to emphasize with implementing TrueFidelity on our CT scanners was that there is nothing to lose," said Mr. Güttler. "Throughout the entire evaluation phase and all our planning for how to implement and use deep learning image reconstruction, it was always clear that we could also use existing model based iterative reconstruction methods, too. In other words, we felt nothing could go wrong by moving ahead."

"We could not have implemented the deep learning approach this successfully without the invaluable support and training we received from GE Healthcare during the initial trial period because it was exactly what we needed to make it work for all of our colleagues," said Felix Güttler. "We received additional application support after the evaluation phase and during the implementation phase which helped guide us on how best to introduce and install this technology in the clinical setting."

"I recently had a couple of site visits and I told them to just take the thin slices and begin using and working with them, and to develop protocols with TrueFidelity for CT angiography or other anatomical regions so they can begin working with the technology," said Dr. Diamantis. "This helps overcome any fears of not yet having special kernels for every clinical scenario because now you don't need them. It is not complicated and the quality is higher."

TrueFidelity™ - Whole Spine Scan @ High IQ / Low Noise

TrueFidelity VR

TrueFidelity
STD E1

This is Universitätsklinikum Jena's independent experience with deep learning image reconstruction.

References

Interview with UKJ's Felix Güttler and Ioannis Diamantis, M.D. on 9/11/2019

UKJ https://www.uniklinikum-jena.de/en/University+Hospital.html Accessed 9/12/2019

JB74999XX