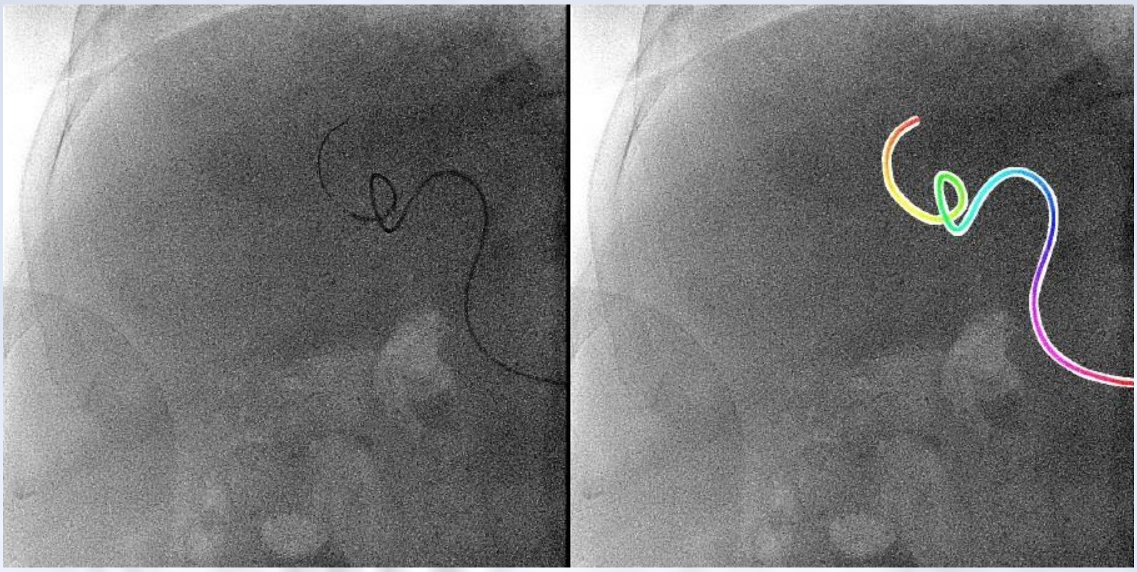

in the past. The new approach uses convolutional neural networks, which is a relatively novel technology, and requires a GPU for the computer issue.

A challenge is that **fluoroscopic images are very noisy** and the **instruments being looked for are very thin**. Using the deep learning approach allows them to segment the instruments with high accuracy. The strength of these deep learning approaches is that they themselves learn the features from example images.

When using deep learning, there are many parameters that can be set in training and it can be a challenge to find the right settings that give an acceptable working result. For the training data, they use a lot of data augmentation. They have 100 sequences more or less with x-ray images, with annotations in a few frames, and then they transform these images to generate extra training data.

Although they have all the components they need, Theo thinks **a much larger training dataset would be of benefit**, with a wider range, different systems and different applications. He gives the example that even with lots of training data, if you have non-fluoroscopic images with more contrast, the detection fails.

Theo tells us about the next steps for this work:

"This is the last step of a complete approach for guidance in TACE. TACE is a liver procedure that is endovascular. What you previously did was build a 3D model from the vessels, from a 3D image, and align that with the fluoroscopy, providing a roadmap which was live updated based on the motion of the instrument. Up to now, we used minimally segmented guide wires, and this is the final step, so we are currently integrating all steps. That should give us a system that gives a live roadmap during TACE procedures and also allows the physician to see in 3D where his instrument is."