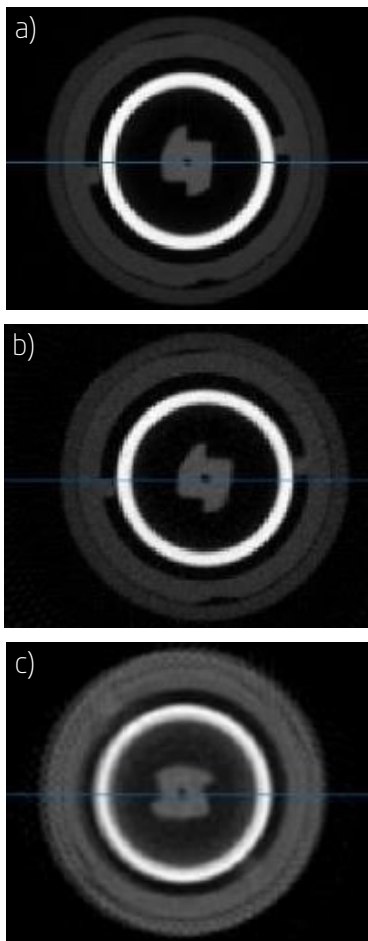


## Optimizing X-ray imaging for fast data acquisition

Novo Nordisk entered a collaboration with the 3D Imaging Centre at DTU through LINX, a project funded by the Innovation Foundation in Denmark. The goal of the project was to image an insulin injection pen during operation using X-ray Computed Tomography (CT) to visualise the movement of its internal parts. To follow the fast movements of small parts within the pen, it was necessary to perform the CT scans as fast as possible. In this part of the project, the measurement speed and quality were studied by tuning different acquisition parameters using an in-house X-ray CT setup, and by modifying the image reconstruction.



A 3D volume of the insulin pen showing the location of reconstructed slices in the following figures.



Reconstructed 2D slices with different amounts of projections: a) 1571, b) 150, c) 78 using SIRT reconstruction. All slices are from measurements with an integration time of 500 ms.

### Challenge

An insulin injection pen consists of many small moving parts which can be visualised by X-ray micro CT. In order to operate at a high speed, both the acquisition parameters and the reconstruction need to be optimised. This can be done by varying e.g. how many individual X-ray images are taken while the object is rotated ("number of projections") and by how long the detector is illuminated by the X-ray beam ("integration time"). However, when using few projections and the common reconstruction method based on a "filtered back projection", the quality of the reconstructed slices is usually negatively affected by stripes in the images. Using e.g. the "Simultaneous Iterative Reconstruction Technique" (SIRT) instead - a reconstruction algorithm method for correcting artifacts, such as stripes originating from from few projections - the resolution and contrast of the reconstructed data from CT scans with limited amounts of projections can be optimised.

### Collaboration

This collaboration was part of the LINX project, in which researchers at leading Danish universities collaborate with scientists in industry to solve industry relevant problems using advanced neutron and X-ray techniques.

### Results

Measurements were performed using a Nikon XT H 225 X-ray tomography setup. It was shown that a longer integration time and a higher number of projections resulted in a better quality of the reconstructed CT slices. While a filtered back projection-based reconstruction resulted in a good image quality from 1571 to 150 projections, the use of SIRT reconstruction could lower the number of projections to 78, which increases the scanning speed even more. For this reconstruction approach, an open reconstruction framework (*Astra toolbox*) was used and optimized accordingly.

### Perspectives

Though the number of projections was considerably reduced, more powerful X-ray facilities are required to record the fast movements within the insulin pen in real time. These were performed at a later stage of this project at the European Synchrotron Radiation Facility (ESRF) in France.

### Imaging Industry Portal

The Imaging Industry Portal is a part of the 3D Imaging Centre at DTU and assists companies in using and implementing 3D Imaging in research, development and production. The portal offers research-based 3D Imaging services and provides companies with the latest equipment and the most advanced knowledge within 3D Imaging and data analysis. The Imaging Industry Portal works as a gateway to ESS and MAX IV, as well as other large scale facilities.

[www.imaging.dtu.dk/Industry-Portal](http://www.imaging.dtu.dk/Industry-Portal)

### DTU 3D Imaging Centre

