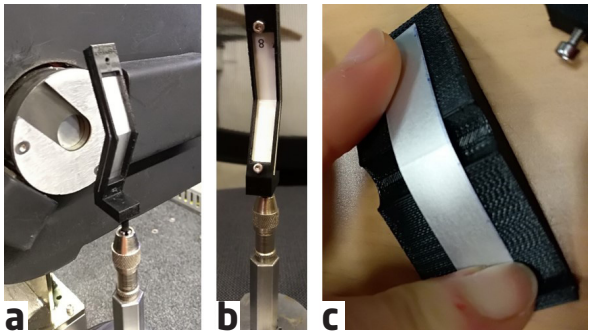
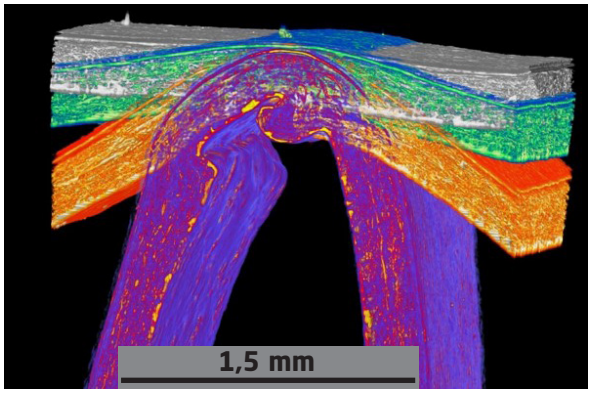
# Folding of packaging materials

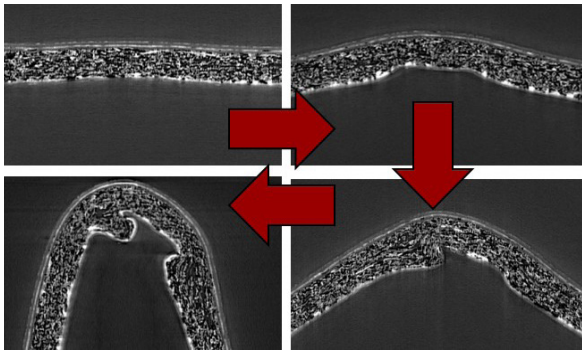
Tetra Pak is the world´s leading food processing and packaging solutions company.To predict and control the behavior of the materials which are used for packaging, Tetra Pak is committed to modelling and simulation using digital 3D models. To obtain reliable virtual models, it is important to know the exact geometry of the end products, but also the geometrical changes the products undergo during production. In this project, we have developed a method to fold and analyze the packaging materials in different angles,  such that the geometry of packaging materials can be studied at different folding angles.




*Photographs of the designed holder (a, b) and support tool (c) to fold, but not overbend the sample 45°.*




*3D rendering of the sample at different folding angles.*



*Slices virtually cutting the sample at different folding angles.*

## Challenge

In order to study how the different layers of the packaging material react when they are folded at different angles, a set of holders and support tools were developed. The holders allow the same position of the material to be studied using X-ray micro computed tomography when folding at 0° , 45°, 90° and 180°. To prevent the material from overbending, and to allow for geometrical flexibility during folding, support tools were fabricated for 45° and 90° folding angles, as shown on the pictures on the left.

## Collaboration

Through the collaboration between Tetra Pak and the 3D Imaging Center at DTU, the material was characterized using micro X-ray computed tomography scans and in-house developed analysis tools. 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

During production of packaging material, crease lines are made on the paper board before lamination of additional layers. These crease lines facilitate folding the material into a packages. The different crease lines are mainly oriented along or across the production direction.  In this project, the same material was studied while looking at two differently oriented crease lines. Furthermore, two different folding directions were studied: folding the inside of the packaging material inwards, or folding the outside of the packaging material outwards. In total, this enabled us to study four different folding series with four folding angles for each series. To process and visualize the acquired data, a stitching method, allowing for sideways stitching and aligning the samples, was developed. By that, the individually acquired, but overlapping, tomograms with a pixel size of 4.2 µm could be merged.

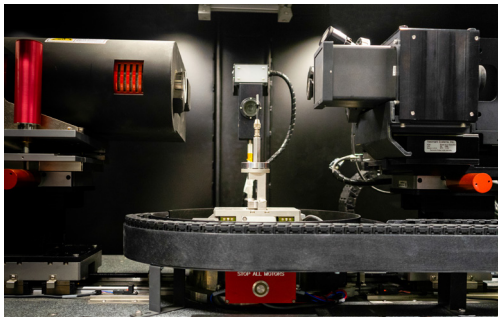
## Perspectives

The purpose of this project is to obtain geometric input for modelling and simulation processes. Therefore, the acquired data is going to be used for further analysis to deduce information on how the layered material behaves when being folded at different angles.

## Imaging Industry Portal

The Imaging Industry Portal is a part of the 3D Imaging Center 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/english/Industry-Portal



## DTU 3D Imaging Center