

# Visualising texture through X-ray CT analysis

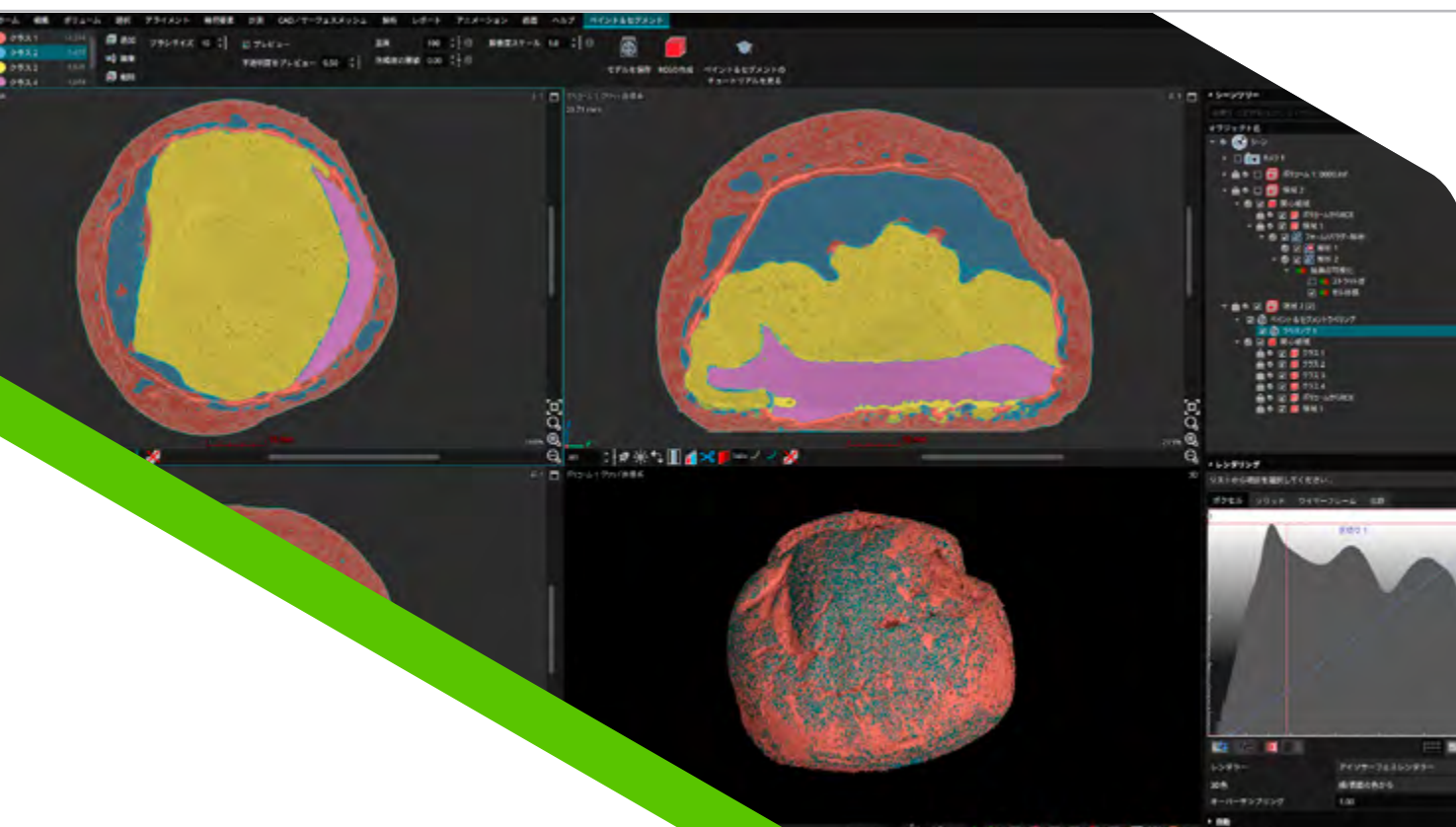
## What lies beyond the taste pursued by Tsukishima Food Industries

Fluffy cream puffs, crispy croissants—‘texture’ is essential to the deliciousness of food. There is a company striving to scientifically unravel its true nature.

Tsukishima Food Industries Co., Ltd., a B2B food ingredients manufacturer that has been producing processed oil and fat products such as margarine and cream for over 50 years since its founding in 1960, was one of the first in the food industry to introduce industrial X-ray CT equipment in 2010.

By scanning the entire food item, including its interior, and analysing its structure using specialised software, the company has succeeded in visualising and quantifying differences in texture and structure that could not be identified through conventional taste testing (sensory evaluation) or physical property assessment.

This technology brings a new dimension to decision-making in texture design. We spoke to the research team about the story behind its introduction and the company’s vision of ‘going beyond deliciousness’.



## The catalyst for adoption:

### A 'macro perspective' enabled by non-destructive testing

At the company's research institute, food is evaluated and analysed using approximately 50 types of analytical methods for product quality control and development. Mr Mizobe, a technical expert, had been keeping an eye on X-ray CT as a new analytical tool for over ten years.

Until then, the only way to observe the interior of food was to cut it open. However, with soft foods such as bread and cream puffs, the internal structure collapses the moment they are cut. Furthermore, whilst an electron microscope can reveal fine (microscopic) structures, there was a challenge in understanding how those specific features relate to the overall properties of the food (such as texture or fluffiness).

Against this backdrop, Mr Mizobe had been searching for many years for 'technology capable of capturing the overall structure (macro) non-destructively and quantifying its characteristics'. However, conventional X-ray CT systems required protective shielding to block the X-rays, which increased their weight, and the limitations of the equipment's structure meant there were restrictions on the size of samples that could be imaged, which proved to be a major obstacle to adoption.

"The turning point came three years ago, when Shimadzu Corporation brought us a leaflet," recalls Mr Mizobe. "The weight and price were about a tenth of the equipment we had previously considered. Moreover, the size of the samples that could be imaged had increased tenfold."

### Strong confidence in innovative evaluation techniques

When he actually scanned a sample using the demonstration unit, Mr Mizobe says he was astonished by its speed and clarity.

"I had expected it would take between three and six minutes to capture (scan) with high precision, but I was able to obtain a very clear image in just about two minutes. I felt strongly that this would allow us to explain differences in texture, so I submitted a budget request to my manager, and the decision to adopt it was made immediately with the comment, 'This is definitely worth using!'"

Another factor that drove the decision to adopt the system was Hexagon's 'VGSTUDIO MAX' software, which enables the three-dimensional visualisation and analysis of scanned data. This made advanced analysis possible that had previously been impossible by visual inspection alone, and it is said to have been the deciding factor in the adoption.



Shimadzu Corporation's XSeeker X-ray CT system: a desktop-sized device that makes it easy to scan food samples

### The persuasive power and objective proof conveyed by 'a single photograph'

Mr Fukuda from the institute emphasises the importance of 'visual appeal' in modern analysis.

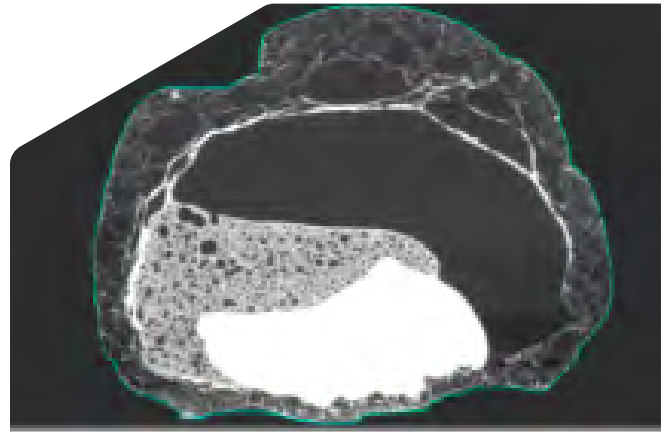
"X-ray CT images possess a persuasive power akin to a single photograph telling a story. They are perfectly suited to the needs of today's era, where visuals are highly valued."

As a concrete example of the results achieved through compelling images backed by numerical data, Mr Sugawara cites an episode from a development project.

"During development aimed at bringing a prototype closer to the target product (benchmark item), although sensory evaluation suggested it was 'close', we lacked the decisive evidence to convince the client. So, we showed them data from CT analysis of the internal cavity structure and quantified volume measurements. The client was surprised, exclaiming, 'You can see this much!'; and the decision to adopt the design was finalised on the spot."

## Translating the artisan's 'instinct' and 'know-how' into the language of science

The company's strength lies not merely in selling ingredients, but in providing comprehensive support that extends to the customer's manufacturing process. For example, when making choux pastry, they used CT scans to analyse how the timing and quantity of egg addition affect the volume. Images and numerical data revealed that the factors responsible for the puffing up of choux pastry—previously attributed to the artisan's 'experience' and 'know-how'—actually stem from differences in the formation of air bubbles. "Being able to scientifically substantiate the transmission of these techniques is a major achievement," says Mr Mizobe.



High-resolution visualisation of the internal pore structure and cream distribution in choux pastries using X-ray CT



Mr Mizobe and Mr Sugawara from the Tsukishima Food Industries Co., Ltd. Research Institute discuss texture analysis

## Trial and error following implementation and utilising support

Initially, they struggled with analysing 'food'—which has an uneven structure—and the process sometimes took up to three hours.

However, by utilising the training and technical support included in the premium support package for the image analysis software 'VGSTUDIO MAX' and acquiring specialist operational know-how, they are now able to complete analyses in around 30 minutes. Furthermore, advancements in the software itself, such as the shape extraction function, have also contributed significantly to this increase in speed. "To fully harness the performance of the CT scanner, the use of VGSTUDIO MAX and the support services are indispensable," says Mr Mizobe.

## Accumulating data reduces the number of prototypes and accelerates development

The company is currently accelerating the 'accumulation of insights' through CT analysis. Mr Sugawara is convinced that this accumulation of know-how will become a major asset in the future.

"We are currently at the stage of accumulating foundational data whilst varying various factors such as raw materials, formulations and process conditions. As this data accumulates, the causal relationship regarding 'how to achieve the intended structure (texture)' will gradually become apparent. Once that happens, we believe we will be able to dramatically reduce the number of trial-and-error prototyping iterations, ultimately leading to a significant improvement in product development speed."

By converting aspects that previously relied on intuition into objective, quantitative data in the form of 'images and numerical values', we are on the verge of enabling more logical and rapid product development.



The process of quantifying and analysing internal food data captured by CT using the dedicated software 'VGSTUDIO MAX'

# As a partner in the pursuit of 'what lies beyond deliciousness'

The company is currently seeking to expand its CT analysis, which has primarily focused on bread products, to a wider range of categories, including cooked processed foods and baked goods. It is also exploring the potential to utilise X-ray CT to visualise wear and deterioration in factory equipment for application in facility management. Furthermore, the company is hopeful for the industry's continued development, anticipating that as scanning speeds improve, the technology could be utilised for in-line quality control.

Finally, we have received a message from the research team.

"Research into the relationship between texture and structure is still in its pioneering stages, with many unknown areas remaining. As a partner in the pursuit of what lies beyond 'deliciousness', please do not hesitate to consult us if you have any concerns regarding texture."

Tsukishima Food Industries has acquired the 'scientific eye' of X-ray CT. The true nature of texture that the company unravels will continue to underpin many 'delicious' experiences in the future.



Mr Murakawa, Mr Sugawara, Mr Fukuda and Mr Mizobe, who are scientifically exploring the 'secrets of deliciousness' at the Research Institute and R&D Centre



The head office and Tokyo factory, which moved from Tsukishima in Chuo Ward, Tokyo—the company's founding location—to its current site in Higashi-Kasai, Edogawa Ward, in 1962

## Introduction to the products used

The equipment and software featured in this case study are as follows.

Shimadzu Corporation Desktop  
Xray CT System XSeeker 8000

A benchtop X-ray CT system equipped with a 160 kV high-power X-ray source and a high-resolution flat-panel detector. Despite its compact size, it offers high penetration capability and enables the acquisition of clear images, supporting non-destructive inspection of a wide range of objects, from plastic mouldings to metal parts. Thanks to its high-speed imaging and intuitive operation, it can be flexibly utilised across a range of applications, from research and development to quality assessment and inspection processes.

Product details:  
Shimadzu Corporation Official  
Website



## Hexagon Industrial CT Data analysis Software VGSTUDIO MAX

This is the de facto standard industrial CT analysis software for the high-precision visualisation and analysis of volume data acquired via CT. Equipped with a wide range of functions, including porosity analysis, dimensional measurement, defect analysis and CAD comparison, it enables the quantitative evaluation of an object's internal structure. It is used in a wide variety of applications, including product development, quality control and research.

Product Details:  
VGSTUDIO MAX Official Website

