Hitachi High-Tech India Pvt. Ltd.

Unit No.706, Part-A, 07th Floor, Tower-D, Unitech World Cyber Park, Gurugram, Haryana – 122001
https://www.hitachi-hightech.com/jp/ja/products/manufacturing-related/industrial_ct/
Email: htin.customer@hitachi-hightech.com

HITACHI

Industrial X-ray CT

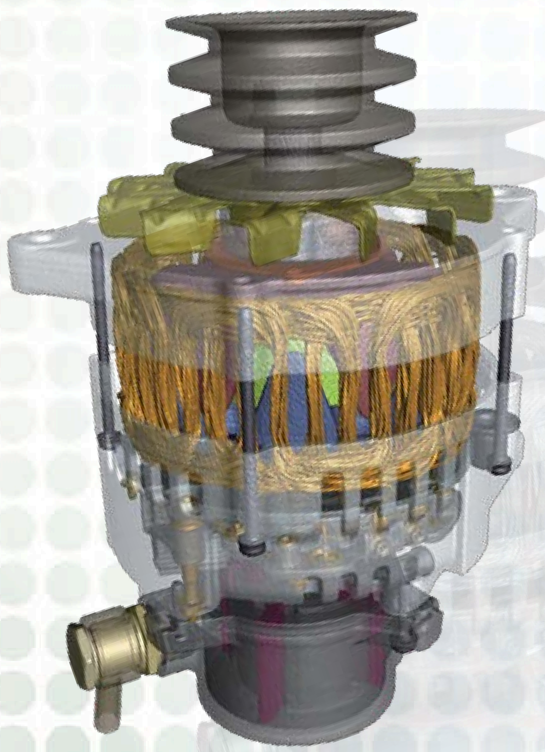
HiXCT Series

Beyond just capturing. To explore the next possibility.

In contemporary society, the physical world and the digital realm represent two facets of the same entity. Tangible objects and digital information are inextricably intertwined. Hitachi seeks to enhance the synergy between the physical and the digital, striving for elevated standards in manufacturing. To this end, we are committed to offering our customers the utmost support, leveraging the diverse X-ray CT technologies we have developed over the years.

By Leveraging CT Data
Creating New Things

Breaking
New Grounds



φ130mm×270mm（H）

Three-dimensional model of an automotive alternator.

Industrial X-ray CT **HiXCT Series**

Elevated penetration capability
Utilizing high-energy X-rays of up to 9MV enables the measurement of a diverse array of specimens, including engines, batteries, castings, and cultural artifacts.

Extended dynamic range
Our proprietary detector generates CT values that correspond to the density of each component

Elevated spatial resolution
It employs the HiBrid imaging technique, enabling the capture of higher resolution images compared to traditional cameras.

HiXCT series

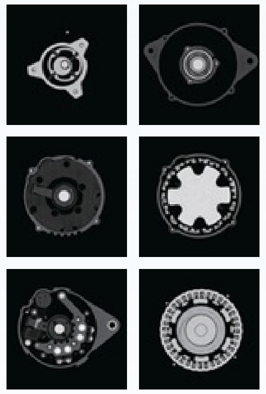
Introduction to various image analysis and digital engineering

The precise shape and internal density of an object can be captured as digital data. This digital data can be utilized to assess internal dimensions, shape, position, density, and other characteristics that are not visible in the physical object.

Visualize

Example of CT Imaging and Analysis of an Automotive Alternator

This alternator comprises various materials, including an aluminum casing, copper coils, and iron magnets. In CT data, these materials are represented by varying intensities (dark areas indicate aluminum, while light areas represent iron and copper). In this instance, each component is derived from density analysis and presented in pseudo-color to illustrate the internal structure.

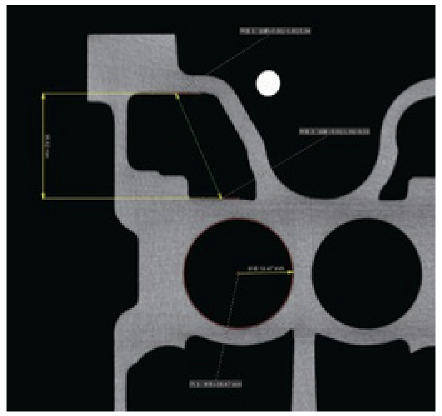


CT data

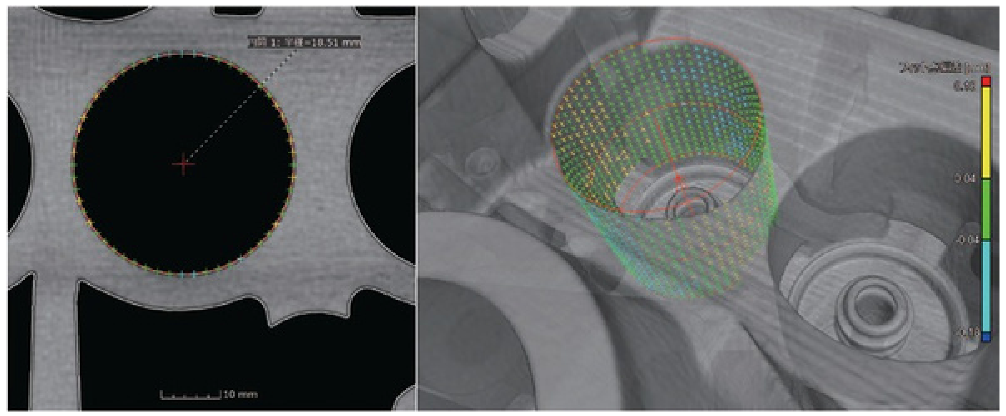
Three-dimensional images

Virtual measurement technology

Based on CT data, a variety of measurements can be conducted, including 2D and 3D dimensions, angles, curvatures, and void volumes. Additionally, comparative measurements can be performed by preparing specimens prior to and following the implementation of changes.



2D dimensional measurement

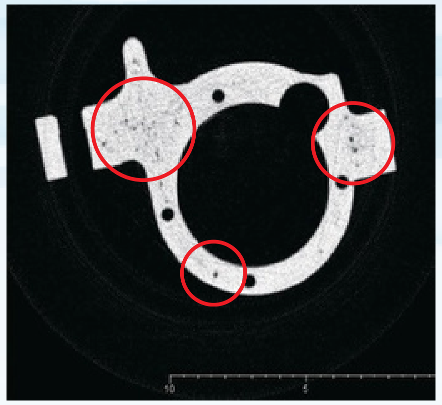


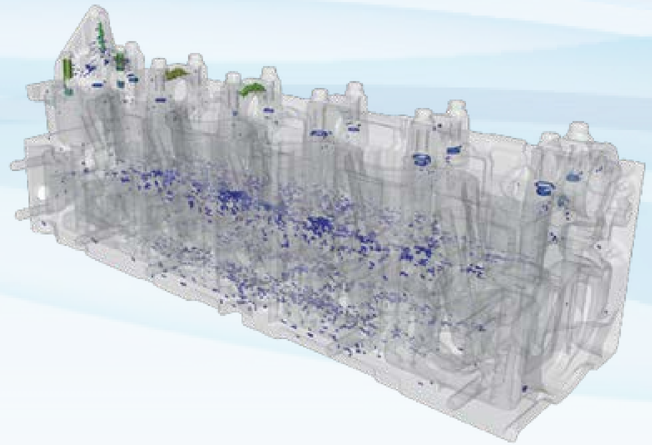
3D coordinate measurement

In two-dimensional measurement, positional data for two points is acquired, and dimensional assessments are conducted based on this information. In three-dimensional coordinate measurement, the emphasis is placed on the upper cylindrical section of the target object, where its geometric parameters—center coordinates, radius, and axis vector—are measured. The disparity between the actual cylinder and the ideal cylinder is visually represented through color coding.

Defect and void detection

CT data can be utilized to identify the shape and size of voids, cracks, internal delaminations, and other features within the sample.





Casting void analysis example

The image on the left presents a two-dimensional representation of the target area of the object. It is evident that there is a void within the region highlighted in red. The image on the right offers a three-dimensional visualization of a void analysis of an automobile cylinder head (aluminum casting), enabling a comprehensive view of the void distribution.

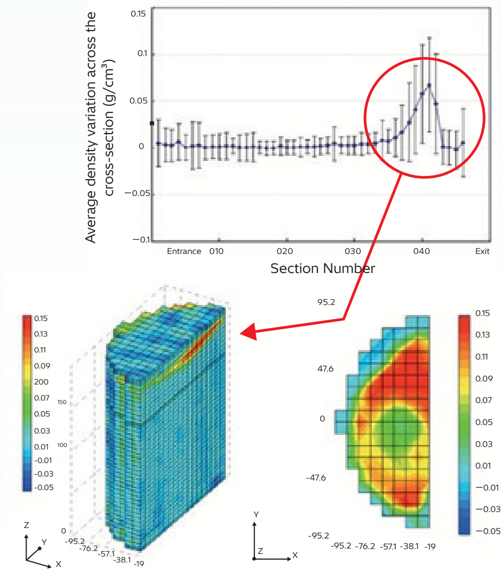
Density analysis

By leveraging the attributes of high-energy X-ray computed tomography, which encompasses a broad spectrum of densities from low to high, imaging of composite materials becomes feasible. The resulting CT data can facilitate density measurement, differentiation of various materials, and visualization of density variations.

[Visualization of soot accumulation on diesel vehicle diesel particulate filter]

DPF image (half-split) The actual component is cylindrical.

	Actual value (g)	Measurement value (g)	The discrepancy between the quantity of soot accumulation and the actual measured value (%)
DPF	20	17.72	-12.87



Cross-sectional distribution of average density change

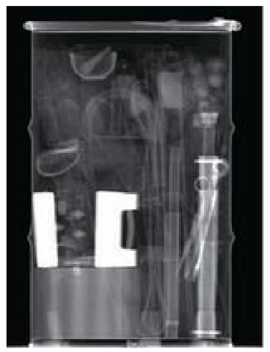
Soot is minuscule and possesses low density, rendering it invisible in CT data; however, image analysis can reveal the extent of soot accumulation. The crux of this image analysis lies in the differential processing of images captured before and after soot accumulation.

Furthermore, due to the non-destructive nature of CT imaging, it is feasible to conduct multiple analyses on the same test specimen by utilizing travel distance as a parameter, thereby facilitating an understanding of changes in the deposition conditions.

DPF: Diesel Particulate Filter

Internal state observation

The interior of a waste drum (simulated body) was examined to detect the presence of liquid and lead materials through density analysis.



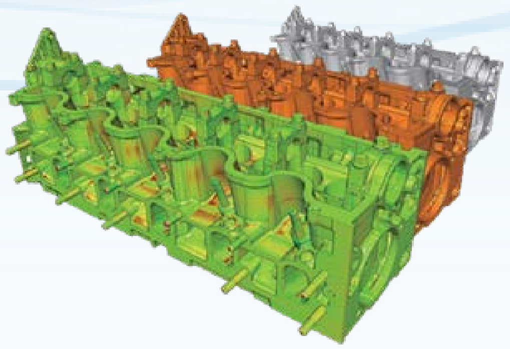
Transparent image of a drum.

Three-dimensional images

Physical-Digital Integration engineering

Analysis models and CAD models can be generated from CT data. A standard polygon model is produced by extracting the surface of the actual object from CT data, which can be utilized for structural analysis and 3D printing. General-purpose CAD models (IGES, STEP) can also be derived from these polygon models. Moreover, by developing a general-purpose CAD model, it can be employed in general-purpose CAD software, for CAM processing, and for CAE analysis. CT technology serves as a robust tool that bridges the physical object with digital data.

3D CAD Analysis

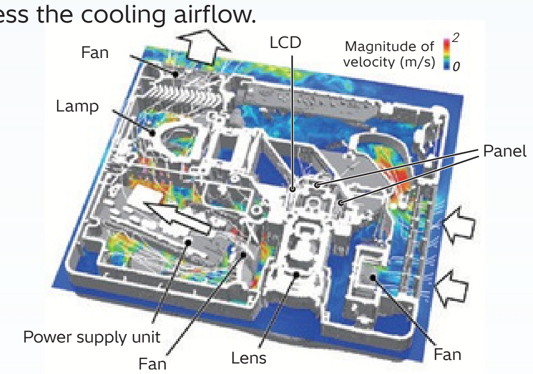


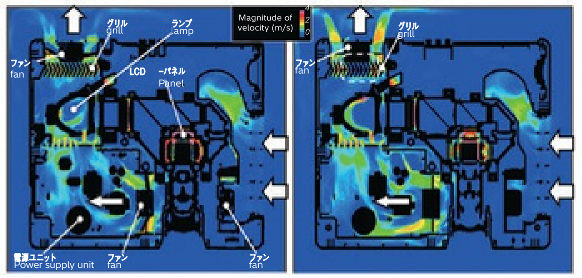
Example of comparing 3D CAD for cylinder heads

The object was scanned using computed tomography (CT), and the resulting 3D CT data was compared with the 3D CAD design. The right side of the figure displays the 3D CT data, the middle presents the 3D CAD data, and the left side illustrates the shape differences, highlighted in color, between the two.

Fluid analysis

The object produced from the CT data was subsequently analyzed through CT imaging, and the CT data was employed to assess the cooling airflow.





a) Results of the analysis derived from the CAD model

b) Results of CT-based analysis

Analysis of Airflow Cooling within a Projector

a) represents the analysis result derived from CAD data, while b) denotes the analysis result obtained from CT data. The disparity in flow rate at the projector's fan outlet is distinctly observable. This variation arises from the configuration of the grill at the outlet, which was modified post-production on the actual product.

Replica generation from analytical 3D model

It is also feasible to produce accurate replicas utilizing 3D printers derived from CT data.

Flame pottery

CT data

Polygonal modeling

Replica

Examples of Utilizing 3D Printers

We are developing a 1/6 scale replica of the Flame Pottery. A CT scan of the original Flame Pottery was conducted, from which we generated a polygon model based on the CT data. Subsequently, this polygon model was utilized to produce the replica using a 3D printer.

HiXCT Overview

Hitachi Industrial X-ray CT System Features

*Specifications as of January 2025. Specifications are subject to change without prior notice.

Distinctive detector

The HiXCT series features a proprietary high-sensitivity, high-performance detector known as "HiR."

We also created a specialized detection circuit to leverage the characteristics of the HiR detector. High-energy X-rays, known for their significant penetrating power, also traverse the detector. Since the 1980s, Hitachi has been advancing detectors capable of sensitively detecting these high-energy X-rays, and we persist in this endeavor today.

The HiXCT series employs a one-dimensional array detector with meticulously arranged detectors and integrates measures to minimize the impact of scattered radiation to an insignificant level.

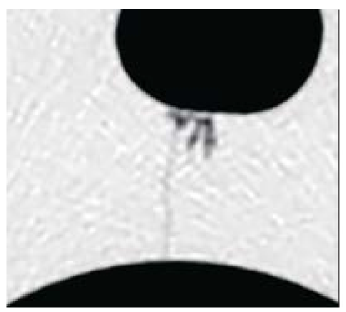
Elevated spatial resolution

We developed the HiBrid imaging technique to maximize the device's high-output, high-resolution capabilities.

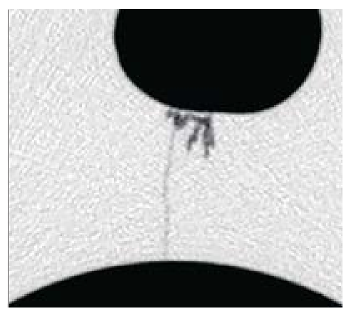
The HiBrid method achieves images with greater precision than traditional techniques. The predominant imaging approach for industrial X-ray CT is the rotate-rotate method (The third generation), known for its rapid imaging speed.

In addition to this imaging technique, Hitachi has introduced the HiBrid method (double rotation method), which conducts CT imaging through two rotations and can enhance the resolution by approximately 1.5 times (in comparison to our previous method: based on a 0.5 MTF value) while utilizing the same detector system.

Third Generation



Hybrid



The figure presents a comparison of images depicting defect areas within cast iron. The HiBrid method facilitates a more thorough verification of the defect.

X-ray source (accelerator)

The X-ray source is an electron linear accelerator, offering high-power, high-energy X-ray sources of 1 MV, 3 MV, 6 MV, and 9 MV.

MV class X-rays possess not only significant penetrating power but also a predominant interaction with the Compton effect. This implies that the attenuation of X-rays correlates with the material's density, thereby facilitating density analysis.

[HiXCT Series Specifications]

Format		HiXCT-1M	HiXCT-3M	HiXCT-6M	HiXCT-9M
X-ray energy (Maximum value)		0.95MV	3MV	6MV	9MV
Maximum X-ray penetration thickness (cm)	Fe	11	20	28	32
	Al	33	56	79	96

Extended dynamic range

Many industrial products consist of a combination of low-density materials, such as resin and rubber, and high-density materials, such as iron and copper. To conduct CT imaging of these composite materials, a broad detection dynamic range is crucial.

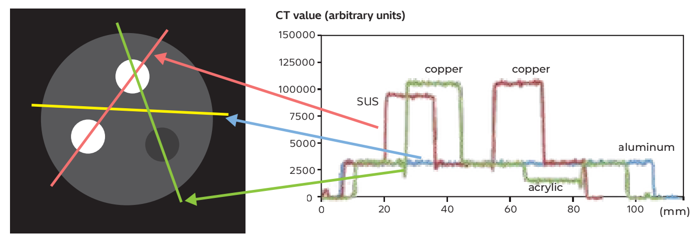


Figure 1 Illustration of density discrimination among various materials (1)

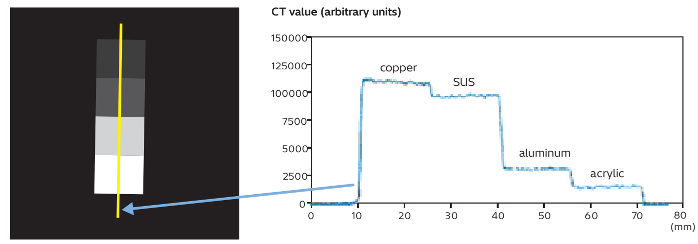


Figure 2 Illustration of density discrimination among various materials (2)

The figure illustrates the outcomes of CT imaging conducted with HiXCT on a sample material composed of copper, iron (SUS), aluminum, and acrylic. The CT values corresponding to the density of each component are presented, indicating that precise density measurement of composite materials is achievable.