



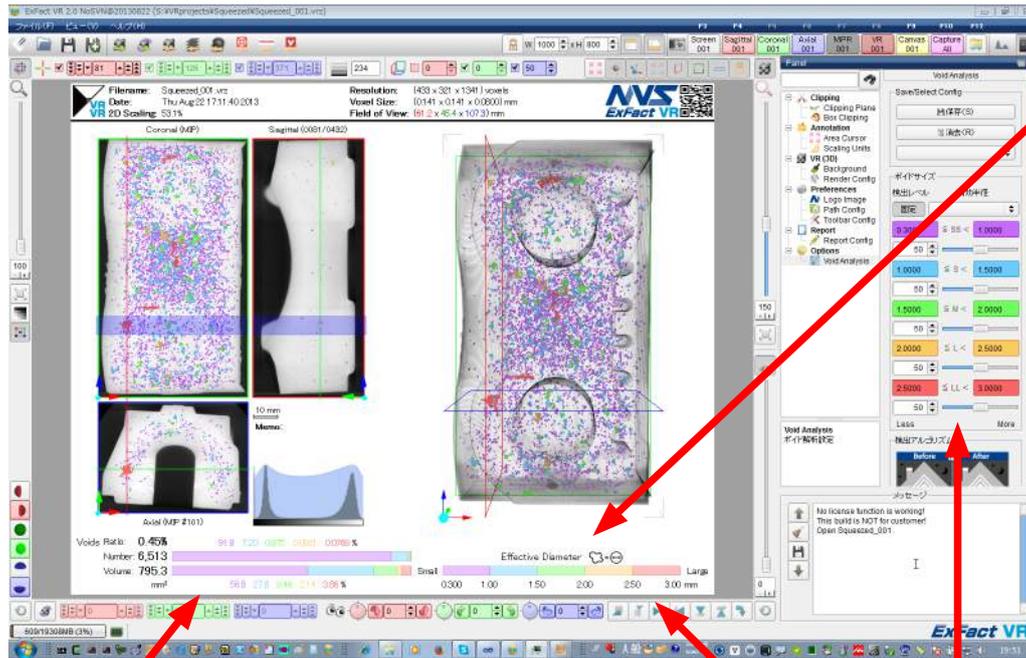
# ExFact VR 2.0 Void Analysis Option Module

The Void Analysis option module released! It can be added to ExFact VR that visualize to 2D/3D image which data obtained from X-ray CT machine. (Sold Separately) Extract internal defect or particles; analyze the output and display colors by size of data such as a casting product or the resin.

The word "ExFact" is coined as a brand name of our software which presents our fine work of performing 3D image processing. The meaning of "ExFact" holds "Examine and Express the Fact"

## Function and Features

- Support a variety of image data because it can be set to various detection conditions.
- Able to define various evaluation criteria due to setting detection conditions arbitrarily.
- Display 5 phases of a different void size so it is expressed as very intuitive
- All detected objects will be out as numerical data format (CSV file).
- Of course, the analysis result is redistributable as VRVR movie.



All voids have irregular shape convert as sphere then classify diameter of the sphere into 5 phases and display in different colors.

Irregular shape = Convert as sphere



Called Effective Diameter is a concept commonly used in the industry of material science. The reason why not classified and displayed as volume, it is difficult to understand because the volume is a cubed numerical value and also tend to be biased towards to one side.

It shows the percent of volume and quantity of voids.

User can set variety conditions of extracting voids make easy to compare among data. Bar is longer, has more voids in the same color.

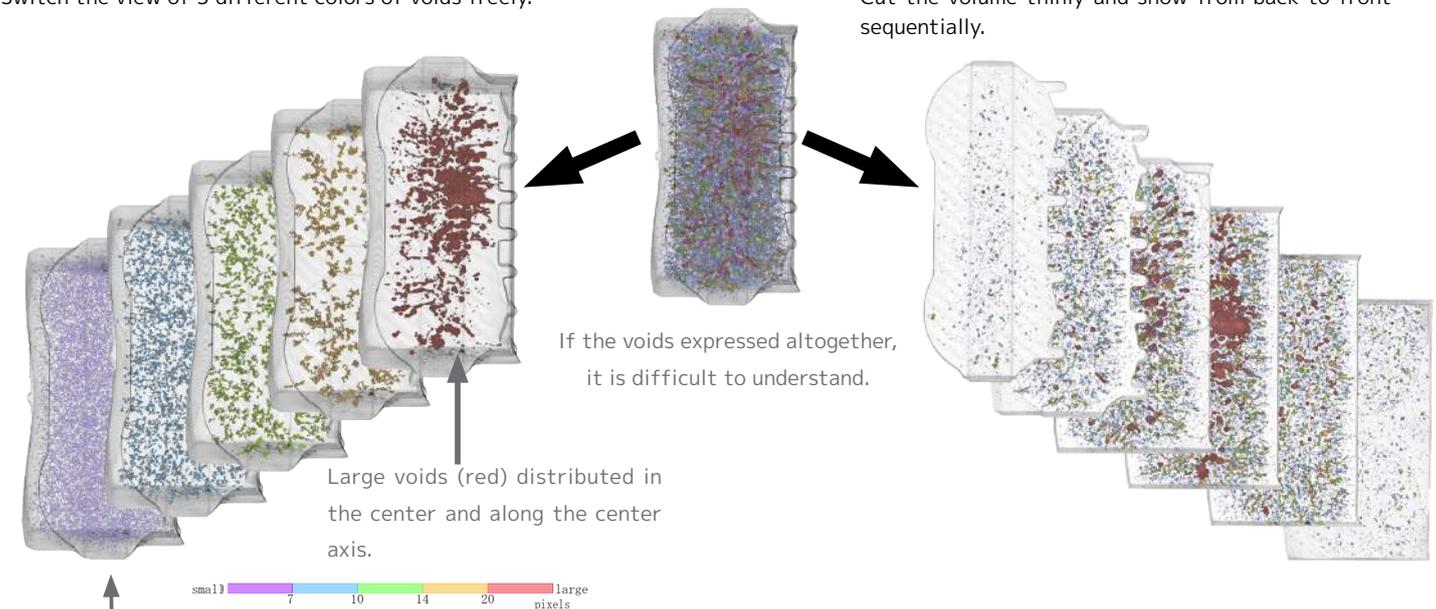
Void can be extracted in various criteria.

Display on the bottom shows charts, bars and numeric values as footer easy to understand the result of detected voids.

## Various Expressions

Switch the view of 5 different colors of voids freely.

Cut the volume thinly and show from back to front sequentially.



If the voids expressed altogether, it is difficult to understand.

Large voids (red) distributed in the center and along the center axis.

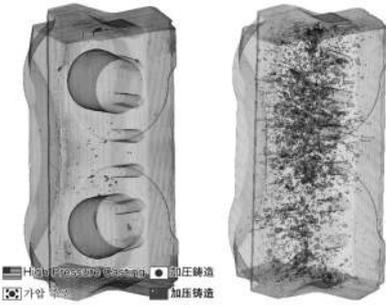
Large voids (red) distributed in the center and along the center axis.

By this sequential view of thin sliced volume, easy to understand even complex shape of data.

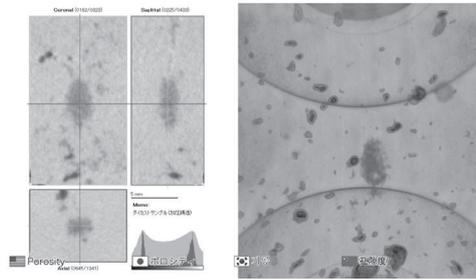
## Analysis example of die-cast product by X-ray CT

Analyzed and visualized X-ray CT image for comparison of between the casting products of compressed and normal.

### Compressed casting

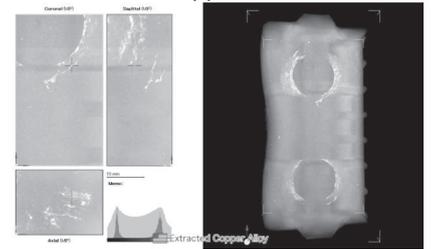


### Porosity



A lot of very small voids got together and structured in like coarse bush.

### The extracted copper

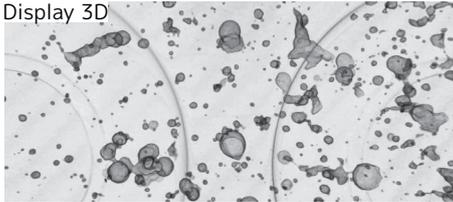


By compressing, the distribution of copper alloys tends to be concentrated in specific places. It is observed by the differences in specific gravity provide one another knowledge.

### products of pressing

### normal

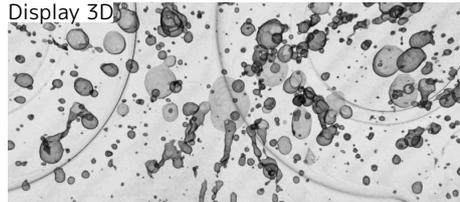
#### Display 3D



The solutions of avoiding voids are many because various types of voids in the product depending on the casting conditions.

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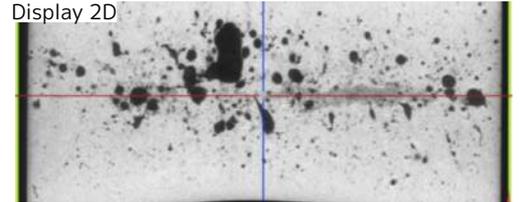
#### Display 3D



· Voids connected continuously, voids occur near surface.

· The flow of the mold effect, some voids have certain direction of structure

#### Display 2D



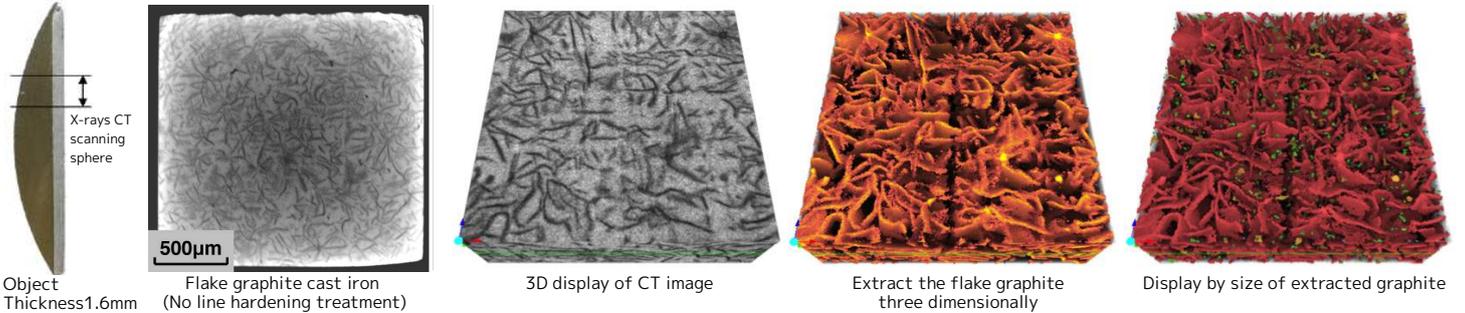
The image is constructed for understanding distribution of void's shape and features. It is a characteristic of ExFact VR 2.0 that **express sharp rendering of contour** even on semitransparent display. By high level of interpolation processing, it express smooth even less than one pixel (sub pixel).

## The cases of analysis

Analyzed and visualized the image of the volume data of gray cast iron and spherical cast iron which data got from X-ray CT. Not only the tool used for detecting voids but also it can be used as visualizing 3D structure and analyzing numerical values.

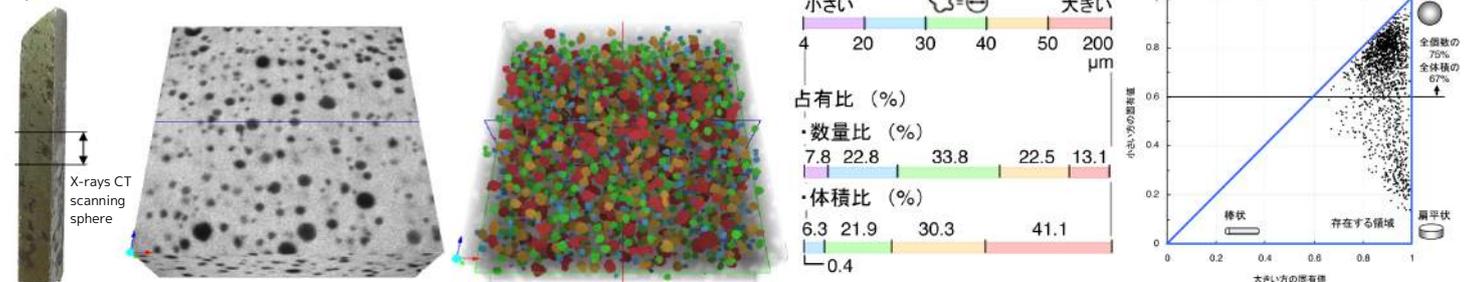
### Gray cast iron

- It is observed that graphite is gathered in center and from the center spread out like petal-shaped structure (flake graphite) in 3D space.
- It seems all scattered out but flake graphite (red) is connected somehow and occupied 98.8% of volume and left over small particles are scattered.



### Spherical cast iron

- Exclude any chunk of spherical cast iron which protruded from the view area even small part for getting precise data of analyzing shape of spherical cast iron.



**Color-coded by the effective diameter:** Classified as the converted diameter of the sphere that each particle extracted from spherical cast iron

The rounding rate that calculated from X-rays CT image of the spherical cast iron

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