Department of Precision Engineering, School of Engineering, The University of Tokyo

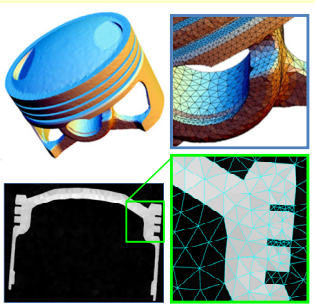
3D Geometric Modeling for Industry — Suzuki & Ohtake Lab.

Developing industrial applications based on geometry processing from 3D scanning data of real-world objects.

Object → (Optical scan / XCT scan) → Measurement data → Geometry processing → Measurement (CAT), design (CAD), manufacture (CAM), analysis(CAE)

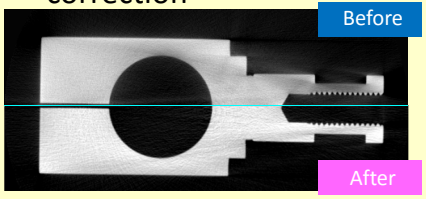
High-accuracy digitalization with X-ray CT scanning

- CT reconstruction with unstructured grid

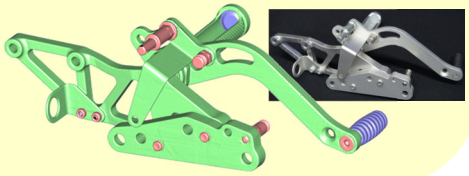


- Reconstructing sharp features
- Small number of elements

- Beam-hardening correction

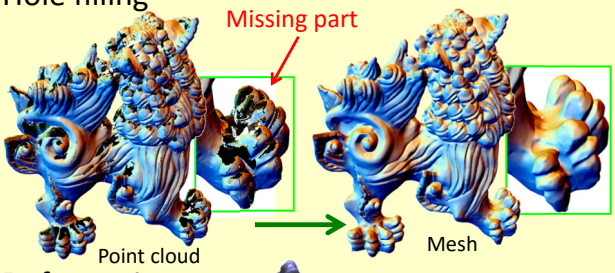


- Processing multi-material object

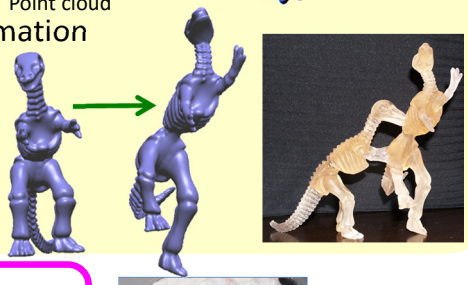


Implicit modeling

- Hole filling

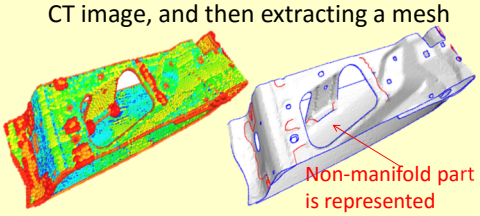


- Deformation



Non-destructive inspection with X-ray CT

- Extracting medial surface
  Generating a spherical cover from X-ray CT image, and then extracting a mesh



- Extracting voids inside
  Avoiding failure of the products

Application for archaeology

- Estimating the shape of Neanderthal's brain

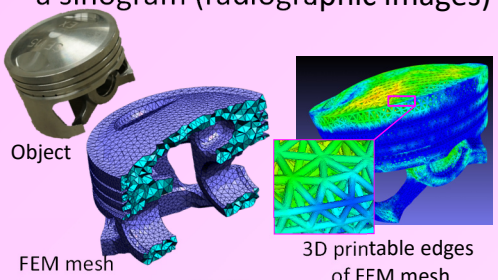
Estimating the area of brain from an X-ray CT image of a fossil of skull

[Data is provided by Lab. Of Physical Anthropology, Kyoto University]

Geometry processing + 3D printing

Structural analysis based on real-world object

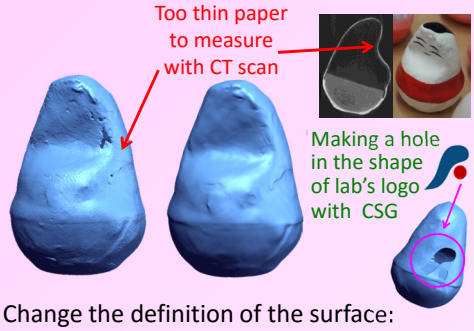
- Direct generation of FEM mesh (mesh for structural analysis) from a sinogram (radiographic images)



You can recognize deformation better than on a monitor!!

Shape modeling

- Robust extraction of thin parts

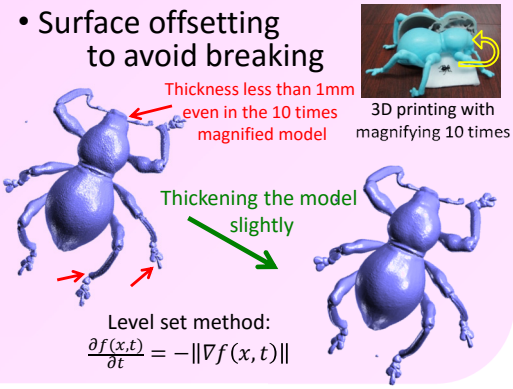


Change the definition of the surface:

Isosurface of CT image: $f(x) = T$

→ Variable thresholding : $\frac{\nabla f(x)}{\|\nabla f(x)\|} \cdot \nabla \|\nabla f(x)\| = 0$

- Surface offsetting to avoid breaking



Level set method: $\frac{\partial f(x,t)}{\partial t} = -\|\nabla f(x,t)\|$