Scattering Tomography Using Ellipsoidal Mirror

Ryuichi Akashi †, Hajime Nagahara †, Yasuhiro Mukaigawa †, Rin-ichiro Taniguchi †
† Kyushu University, ‡ Nara Institute of Science and Technology

• Abstract
Optical tomography provides visual images of the interior of objects. When scattering is strong, light paths are scattered and a large field of view is required to observe all of the scattered light. We propose a method based on computed tomography which employs a large field of view and observes the scattered light efficiently. We implement a projector-camera system that can send light and receive scattered light from all fields of view.

• Contribution
- Estimate cross-sectional image from scattered light.
- Efficiently observe the scattered light by large FoV.
- Implemented large FoV system by using ellipsoidal mirror.

• Motivation
Food contamination is a serious problem. Contaminant detection is required.

• Estimation of Cross-sectional Image

Simulated scattered light by Monte Carlo ray tracing \(E(\theta)\)

Observed scattered light \(T(\theta)\)

Vote value = \(\frac{T(\theta)}{E(\theta)}\)

Vote ratio of intensity

Intensity

0° 30° 60° 90° 120° 150° 180° 210° 240° 270° Detector angle

• Merit of Large FoV
Efficient observation of scattered light.

- Observe almost all scattered light.
- Observe weakly attenuated light by the target object.

• Simulation Result
At the boundary area, obstacle's distribution is estimated accurately.

Ground truth
Large FoV
90° FoV

• Large FoV Implementation

Property of Ellipsoid
Light from a focal point is reflected toward the other focal point.

Not need any mechanical motion.

Simple system
Shorten the time for capture

• Experiment of Real Object
Experimental result is not good.
Parameters of scattering model do not correct.

Metal wire exists in silicon object
Result

• Conclusion
- Estimate cross-sectional image from scattered light.
- Efficiently observe the scattered light by large FoV.
- Implemented large FoV system by using ellipsoidal mirror.

• Future Work
- Improve the estimation result of real object.
- Consider multiplexing, encoding and compressive sensing.