

Scattering Tomography by Monte Carlo Voting

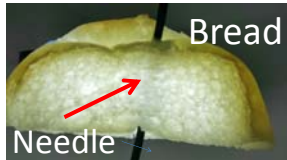
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Background

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Detection of foreign substances (such as needles) in food, bodies etc.



Difficult to detect foreign substances because of **the influence of light scattering**

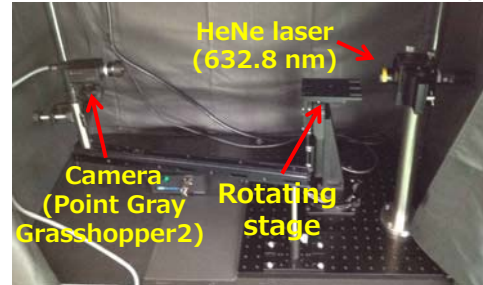
Purpose

Visualize cross-sectional views of **scattering media**

- Generation of light rays by **Monte Carlo ray tracing**
- Statistical estimation by **Voting**

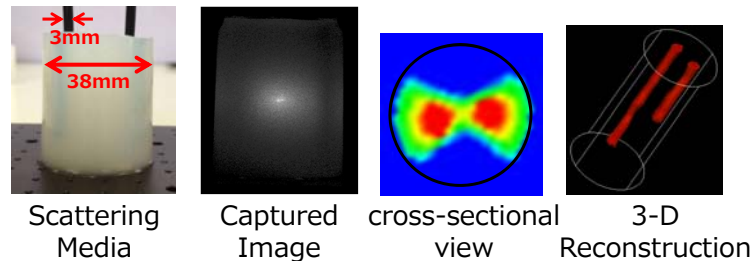
Experimental Results

Measurement Setting



Assumption: scattering parameters are already known.

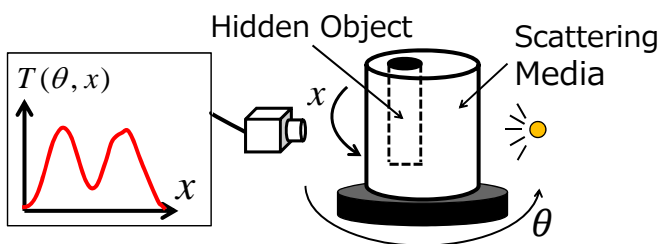
Experimental Results



Monte Carlo Voting

Light Transport: $T(\theta, x), E(\theta, x)$

Relationships between illumination to scattering media and observed intensities.

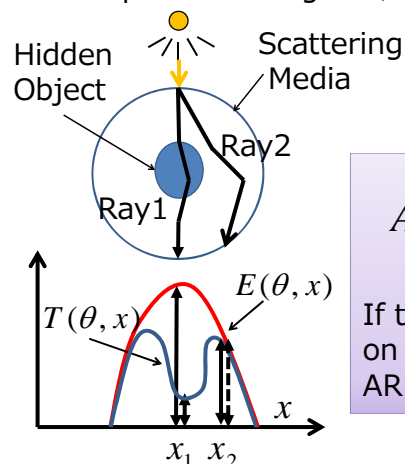


$T(\theta, x)$: Light transport **with** hidden object

$E(\theta, x)$: Light transport **without** hidden object

Attenuation Ratio: $AR(\theta, x)$

Existence likelihood of hidden object on the paths arriving at (θ, x) .

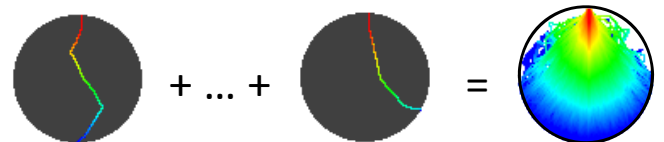


$$AR(\theta, x) = \frac{T(\theta, x)}{E(\theta, x)}$$

If there are hidden objects on the paths, AR becomes small.

Monte Carlo ray tracing

Generate many light paths randomly for voting

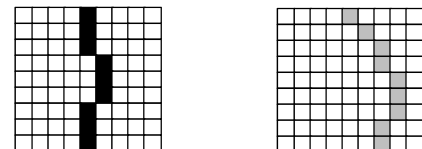


Monte Carlo Voting

- Voting AR on the generated paths
- Accumulated voting values

indicate the distribution of hidden objects

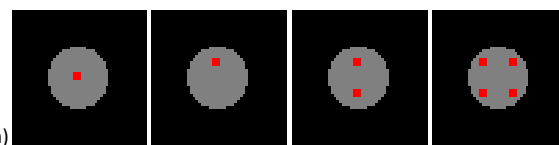
Ray1: $AR(\theta, x_1)$ Ray2: $AR(\theta, x_2)$



Simulation Results

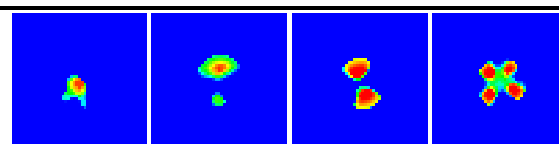
Ground truth

(Red indicates hidden object position)



Estimated Results

(Red indicates estimated position)



Matching Ratio (%)

88.8

77.8

61.1

52.8