Mie Solution to Maxwell’s Equations for Scattering of an Electromagnetic Plane Wave
Abstract

Mie solution is a rigorous Maxwell’s solver for the problem of absorption and scattering of an electromagnetic plane wave by a spherical particle with an arbitrary radius and refractive index. The resulting scattering effect is highly dependent on the size of the particle. According to its characteristics, scattering can be classified into Rayleigh scattering, Mie scattering, and Geometric Optics. The full Mie solution is included in VirtualLab Fusion, and the scattering by spherical particles with different radii of spheres is investigated.
**Modeling Task**

- **input plane wave**
  - wavelength: 532 nm
  - propagate along z direction
  - linearly polarized along x direction

- **spherical scatterer**
  - material of the sphere: Fused Siica or Gold-Au
  - surrounding medium: standard air
  - radius of sphere: variable

- **viewing screen**
  - xz - plane
  - origin: center of sphere
Classification of Scattering

scattering phase function

The intensity (radiance) at \( \theta \) relative to the normalized integral of the scattered intensity at all angles.

\[
x = 10
\]

\[
x = 3
\]

\[
x = 1
\]

\[
x = 0.1
\]

\[
x = \frac{2\pi r}{\lambda}
\]
Scattering by a non-absorbent sphere (Fused Silica)

- Sub-wavelength particle: \( r = 30 \text{ nm} \)
- Micro-sized particle: \( r = 1 \mu m \)
- Micro-sized particle: \( r = 5 \mu m \)

Field distribution amplitude of \( E_x \) component
Scattering by an absorbent sphere (Gold-Au)

Field distribution amplitude of $E_x$ component

Sub-wavelength particle $r = 30\text{ nm}$

Micro-sized particle $r = 1\mu\text{m}$

Sub-wavelength particle $r = 100\text{ nm}$

Micro-sized particle $r = 5\mu\text{m}$
Peek into VirtualLab Fusion
VirtualLab Fusion Technologies

Free space prisms, plates, cubes, ...
lenses & freeforms
apertures & boundaries
gratings
diffractive, Fresnel, meta lenses
HOE, CGH, DOE
micro lens & freeform arrays
SLM & adaptive components
diffractive beam splitters
diffusers
scatterer
waveguides & fibers
crystals & anisotropic components
nonlinear components
free space
prisms, plates, cubes, ...

Field Solver
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