Computing the scattering properties of participating media using Lorenz-Mie theory

This paper introduces a theoretical model for computing the scattering properties of participating media and translucent materials. The model takes as input a description of the components of a medium and computes all the parameters necessary to render it. These parameters are the extinction and scattering coefficients, the phase function, and the index of refraction. Our theory is based on a robust generalization of the Lorenz-Mie theory. Previous models using Lorenz-Mie theory have been limited to non-absorbing media with spherical particles such as paints and clouds. Our generalized theory is capable of handling both absorbing host media and non-spherical particles, which significantly extends the classes of media and materials that can be modeled. We use the theory to compute optical properties for different types of ice and ocean water, and we derive a novel appearance model for milk parameterized by the fat and protein contents. Our results show that we are able to match measured scattering properties in cases where the classical Lorenz-Mie theory breaks down, and we can compute properties for media that cannot be measured using existing techniques in computer graphics.

General information
State: Published
Organisations: Image Analysis and Computer Graphics, Department of Informatics and Mathematical Modeling
Contributors: Frisvad, J. R., Christensen, N. J., Jensen, H. W.
Pages: article number 60
Publication date: Jul 2007
Peer-reviewed: Yes

Publication information
Journal: ACM Transactions on Graphics
Volume: 26
Issue number: 3
ISSN (Print): 0730-0301
Ratings:
BFI (2019): BFI-level 2
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 6.42 SJR 1.344 SNIP 2.841
Web of Science (2017): Impact factor 4.384
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 5.69 SJR 1.946 SNIP 2.57
Web of Science (2016): Impact factor 4.088
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 6.24 SJR 2.382 SNIP 3.686
Web of Science (2015): Impact factor 4.218
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 6 SJR 1.694 SNIP 3.029
Web of Science (2014): Impact factor 4.096
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 6.18 SJR 1.838 SNIP 2.656
Web of Science (2013): Impact factor 3.725
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 4.77 SJR 1.228 SNIP 2.797
Web of Science (2012): Impact factor 3.361
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes