

Computational light scattering, PAP315, fall 2022, period 1, 5 cr

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October 14, 2022

Overlook

- Lectures, Sept. 5 – Oct. 21 (28 h)
 - on Mondays, 10.15-12.00,
 - Zoom, Sept. 5, 12, and 19
 - D116 and Zoom, Sept. 23 – Oct. 21
 - on Fridays, 12.15-14.00,
 - Zoom, Sept. 9 and 16
 - D116 and Zoom, Sept. 23 – Oct. 21
- Exercise sessions, Sept. 9 – Oct. 21 (14 h)
 - on Fridays, 14.15-16.00, D104 and Zoom
- Project tasks
 - Single scattering
 - **Discrete-dipole approximation** or
 - **T-matrix method** or
 - Ray-tracing approximation
 - Multiple scattering
 - **Radiative transfer & coherent backscattering** or
 - Radiative transfer with reciprocal transactions or
 - **Geometric optics in close-packed media**
- Zoom workshop with student presentations on project tasks
- Zoom link: <https://helsinki.zoom.us/j/64852774848?pwd=SFJMdEVNMTNlZXhuRFIxQ0VIYjk5QT09>
- Home page of the course: <https://wiki.helsinki.fi/display/PAP315/Computational+light+scattering>

Overlook

- Exams (2)
 - project tasks including an interactive session, maximum 6 points
 - [interactive session on Oct. 21, 2022](#)
 - [short reports due on Oct. 28, 2020](#)
 - final exam, maximum 24 points
 - [home exam on Oct. 21-28, 2022](#)
 - 30 points in total from exams
- Exercises (20)
 - 20% of points required
 - maximum 6 bonus points on a linear scale
- Course points, maximum 36/30 points

Literature

Main reading:

- K. Muinonen, Light Scattering, Lecture Notes (latest draft)
- C. F. Bohren & D. R. Huffman, Absorption and Scattering of Light by Small Particles, Wiley & Sons, 2010
- J. D. Jackson, Classical Electrodynamics, Wiley & Sons, 1998
- M. I. Mishchenko, L. D. Travis, A. A. Lacis, Multiple Scattering of Light by Particles: Radiative Transfer and Coherent Backscattering, Cambridge University Press, 2006
- F. T. Ulaby & D. G. Long, Microwave Radar and Radiometric Remote Sensing, Artech House, 2015
- B. Campbell, Radar Remote Sensing of Planetary Surfaces, Cambridge University Press, 1st edition, 2002

Supplementary reading:

- H. C. van de Hulst, Light Scattering by Small Particles, Wiley & Sons, 1957 (Dover, 1981)
- M. I. Mishchenko, J. W. Hovenier, & L. D. Travis, Light Scattering by Nonspherical Particles, Academic Press, 2000
- M. I. Mishchenko, L. D. Travis & A. A. Lacis, Scattering, Absorption, and Emission of Light by Small Particles, Cambridge University Press, 2002
- A. Doicu, Y. Eremin & T. Wriedt, Acoustic & Electromagnetic Scattering Analysis Using Discrete Sources, Academic Press, 2000
- M. I. Mishchenko, Electromagnetic Scattering by Particles and Particle Groups, An Introduction, Cambridge University Press, 2014

Lectures

The lectures on the **computational methods** will introduce **open source software**. **Guidance for exercises and projects** available during lectures and exercise sessions.

- Sept. 5, Introduction to single scattering, 10-12, KM
- Sept. 9, Scattering by a spherical particle (Mie scattering), 12-14, KM
- Sept. 12, Discrete-dipole approximation, volume integral equation, 10-12, KM, AP
- Sept. 16, Discrete-dipole approximation, particle near a surface, 12-14, KM, AP
- Sept. 19, Ray-optics approximation, 10-12, KM
- Sept. 23, Rough-surface scattering modeling, 12-14, AV
- Sept. 26, *T*-matrix method, 10-12, AP
- Sept. 30, Superposition *T*-matrix method, 12-14, AP
- Oct. 3, Introduction to multiple scattering, 10-12, KM
- Oct. 7, Monte Carlo methods for multiple scattering, 12-14, KM
- Oct. 10, Monte Carlo methods for multiple scattering, 10-12, KM, AP
- Oct. 14, Geometric optics for close-packed particulate media, 12-14, AP, KM
- Oct. 17, Radar Scattering, 10-12, AV, AP
- Oct. 21, Project Workshop, 12-14, AV, AP

Exercises

- Sept. 9, 14-16, Guidance for Exercise 1 with answers due Sept. 14, guidance for projects, AV, AP
- Sept. 16, 14-16, Exercise 1, Guidance for Exercise 2 with answers due Sept. 21, guidance for projects, AV, AP
- Sept. 23, 14-16, Exercise 2, Guidance for Exercise 3 with answers due Sept. 28, guidance for projects, AV, AP
- Sept. 30, 14-16, Exercise 3, Guidance for Exercise 4, answers due Oct. 12, guidance for projects, AV, AP
- Oct. 7, 14-16, Guidance for Exercises 4 & 5, guidance for projects, KM
- Oct. 14, 14-16, Exercise 4, Guidance for Exercise 5 with answers due Oct. 19, guidance for projects, AV
- Oct. 21, 12-14, Exercise 5, Guidance for projects, AV, AP
- Oct. 21, 14-16, Project Workshop, AV, AP