Computational light scattering, PAP315, fall 2020, period 1, 5 cr

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October 14, 2020

Overlook

- Zoom Lectures, Aug. 31 – Oct. 16 (28 h)
  - on Mondays, 10.15-12.00
  - on Wednesdays, 12.15-14.00
- Zoom exercise sessions, Aug. 31 – Oct. 16 (13 h)
  - on Mondays, 9.15-10.00 (excluding Aug. 31)
  - on Wednesdays, 9.15-10.00
- 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
- 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. 14, 2020
    - short reports due on Oct. 26, 2020
  - final exam, maximum 24 points
    - home exam on Oct. 14-26, 2020
  - 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

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.

- Aug. 31, Introduction to single scattering, 10-12, KM
- Sept. 2, Introduction to single scattering, 12-14, KM
- Sept. 7, Scattering by a spherical particle (Mie scattering), 10-12, KM
- Sept. 9, Discrete-dipole approximation, volume integral equation, 12-14, KM, AP
- Sept. 14, Finite-difference time-domain method, 10-12, GX
- Sept. 16, Ray-optics approximation, 12-14, KM
- Sept. 21, *T*-matrix method, 10-12, AP
- Sept. 23, Superposition *T*-matrix method, 12-14, AP
- Sept. 28, Introduction to multiple scattering, 10-12, GX
- Sept. 30, Introduction to multiple scattering, 12-14, GX, AP
- Oct. 5, Monte Carlo methods for multiple scattering, 10-12, KM, AP
- Oct. 7, Monte Carlo methods for multiple scattering, 12-14, KM, AP
- Oct. 12, Geometric optics for close-packed particulate media, 10-12, KM, AP
- Oct. 14, Geometric optics for close-packed particulate media, 12-14, KM, AP

Exercises

- Sept. 2, 9-10, Guidance for Exercise 1, answers due Sept. 7 (KM)
- Sept. 7, 9-10, Guidance for Exercise 2, answers due Sept. 14 (KM)
- Sept. 9, 9-10, Exercise 1 (KM)
- Sept. 14, 9-10, Guidance for Exercise 3, answers due Sept. 21 (GX, AP)
- Sept. 16, 9-10, Exercise 2 (KM)
- Sept. 21, 9-10, Guidance for projects (AP, GX, KM)
- Sept. 23, 9-10, Exercise 3 (GX, AP)
- Sept. 28, 9-10, Guidance for Exercise 4, answers due Oct. 5 (GX)
- Sept. 30, 9-10, Guidance for projects (GX)
- Oct. 5, 9-10, Guidance for Exercise 5, answers due Oct. 12 (GX, KM)
- Oct. 7 30, 9-10, Exercise 4 (GX, KM)
- Oct. 12, 9-10, Guidance for projects (AP, GX, KM)
- Oct. 14, 9-12, Exercise 5 (AP, GX, KM), Project Workshop, All