20th European Doctoral School on Metamaterials

Introduction to metamaterials

Louvain-la-Neuve, Belgium, May 7-11, 2012

Program:

Monday 7

Hour	Topic	Lecturer
09:30 - 11:45	Introduction to the course Outline of the course Basics: Maxwell equations, constitutive relations, Wave equations, plane cylindrical, spherical waves, wavenumbers, Complements about plane-wave decompositions Dispersion: Constitutive relations in time domain, Causality and Kramers–Kronig conditions	S. Tretyakov, C. Craeye
11:45 - 15:00	Complex materials responses: Exotic and extreme material parameters, Bianisotropy Basic dispersion models: Lorentz model, Drude model, Debye model Split rings: Electromagnetic response of conducting rings, Circuit model, Lorentz behaviour Wire media: Electromagnetic properties of wire lattices, Circuit model, Drude behaviour and spatial dispersion	S. Tretyakov
15:00 - 17:15	Content: Effective material parameters and homogenization Double-negative metamaterials: Negative material parameters, plane waves, Physical limitations o Negative refraction, surface–wave resonance Effective medium modeling: Polarizability and single-particle response, Maxwell Garnett homogenization, Bruggeman homogenization From nanocomposites to metamaterials (expand a little, in accordance with the items above)	C. Rockstuhl, I. Huynen
17:15 - 18:15	Exercise 1: Plane-wave representations Exercise 2: Polarisability	S. Tretyakov, C. Craeye
20:30	Welcome dinner in Louvain-la-Neuve	

Tuesday 8

Hour	Topic	Lecturer
08:30 - 10:30	Plasmonic resonance and plasmonic media: Fundamentals of optical properties of metals, Plasmonic resonance of small particles, Plasmonic materials	N. Engheta
10:45 - 12:45	Surface plasmon polaritons: Fundamentals of surface waves on interfaces, Surface plasmon polaritons on metal surfaces, Excitation and propagation of surface plasmons	N. Engheta

14:00 - 16:00	Bloch waves in periodic media on the base of Bloch modes in various systems Insights into the homogenization problem from a Bloch mode point of view.	C. Rockstuhl
16:15 - 18:15	Visit of Welcome facility Visit of Winfab facility	I. Huynen

Wednesday 9

Hour	Topic	Lecturer
08:30 - 10:30	Exercise 1: Plasmonics Exercise 2: Bloch modes	
10:45 - 12:45	Periodic Green's functions MoM: spectral and spatial domain approaches Calculation of dispersion relations Array scanning method Applications to 1D, 2D and 3D metamaterials	C. Craeye
14:00 - 16:00	Exercise 1: Bloch modes Exercise 2: Method of Moments	C. Rockstuhl, C. Craeye
16:15 - 18:30	3 minutes presentation by each participant Poster session	C. Craeye

Thursday 10

Hour	Topic	Lecturer
08:30 - 10:30	Single objects: Cross sections: extinction, scattering, absorption,Static polarizability , The optical theorem, Dynamic polarizability, The unitary limit and size scaling of scattering Finite clusters: Self-consistent multiple scattering equation, Deriving dipole moments for a driven finite system, Deriving scattering observables from dipole moments, LDOS, Example: superradiant, subradiant normal modes and radiation patterns of a plasmon heptamer	F. Koenderink
10:45 - 11:45	1D chains and 2D lattices: Bloch's theorem (reminder), 1D chain quasistatic dispersion relation, 1D electrodynamic dispersion relation – vanishing of radiation damping, 2D lattice summation techniques, Relation with array antennas, spasers, etc.	F. Koenderink
11:45 - 12:45	Discrete dipole methods	F. Koenderink
14:00 - 16:00	Enhanced transmission through sub-wavelength apertures and fundamentals of cloaking devices Fundamentals of cloaking devices Applications of enhanced transmission and cloaking devices	F. Bilotti
16:15 - 17:15	Self-study	
20:30	Social event in Brussels	

Friday 11

Hour	Topic	Lecturer
08:30 - 10:30	Analogies between microwave circuits and arrangements of plasmonic nanoparticles: Fundamentals of plasmonic nanoparticles as resonators, Optical capacitors and inductors, Epsilon-near-zero and mu-near-zero materials, Large values of material parameters, Optical conductors and isolators Optical nanocircuits: Optical filters, "Squeezing" electromagnetic fields through small openings, Optical transmission lines, Overview of "metactronics"	N. Engheta
10:45 - 12:45	Graphene metamaterials Graphen plasmonics	N. Engheta
14:00 - 15:00	Problem solving	N. Engheta
15:00 - 16:00	Final test	C. Craeye
16:00 - 17:00	Conclusion and evaluation	C. Craeye