FJI3325 Array Antennas 10.0 credits

Gruppantenner

This is a translation of the Swedish, legally binding, course syllabus.

If the course is discontinued, students may request to be examined during the following two academic years

Establishment

Course syllabus for FJI3325 valid from Spring 2019

Grading scale

P, F

Education cycle

Third cycle

Specific prerequisites

The course expects advanced knowledge within the area of electromagnetic fields. It is most desirable that the student has knowledge about techniques needed for RF- and microwave-techniques, and a solid ground in engineering mathematics. Students with an MSc exam in telecommunication, electrical engineering, or electronics engineering or physics should have the required background.

The course EI3204 in Antenna Theory, PhD Course is a required prerequisite. It is an advantage if the course EI3200 in Electromagnetic Theory, PhD course is passed.

Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

Intended learning outcomes

After the course the student shall be able to

- Define and present relevant derivation for concept like unit-analysis of an array, active reflection coefficient, total active reflection coefficient, active radiation pattern, mutual coupling, array scan blindness, Floquet modes and edge effects.
- Describe how phase shifts and time-delays are implemented in array antennas and how it affects the bandwidth of scanning. Explain concepts like beam squint.
- Make an array antenna radiation pattern synthesis both analytically and with numerical methods, optimizing for different features of the radiation pattern.
- Derive relevant expression for measurement of signal direction with monopuls radar for different kinds of arrays.
- Implement the summation of active element pattern in Matlab, and to derive their respective normalizations. They should also compare and use Ludwigs three definitions of polarization.
- Describe limitations of array antennas. Explain concepts like super directivity, array figure of merit, end fire.
- Define concepts like lobe widening, scan impedance and scan loss, excitation efficiency.
- Calculate the antenna parameters like radiation patterns from reflector antennas, leaky wave arrays based on array theory.
- Explain different practical methods to feed arrays. Define concepts like digital arrays, integrated arrays and connected arrays, and understand the challenges in this type of arrays.

Course contents

Array antennas, electromagnetic field theory, advanced antennas, measurement of signal direction, electromagnetic calculation, radar.

Disposition

The course consists of lectures, literature studies, seminars, laborations and project works. The distribution between the parts is as follows:

Seminars, literature studies, seminars: 5hp.

Laboration: 2hp.

Project work: 3 hp

Course literature

The course is based mainly on two books below in combination with a large number of research articles:

- R. C. Hansen, Phased array antennas, 2009
- R. J. Mailloux, Phased array antenna handbook, 2005

Equipment

The students will use computers in the ETK lab and thus have access to CST Microwave Studio och Matlab.

- CST Microwave Studio is a commercial software that enables simulation of antennas and other microwave devices.
- Matlab is used to develop scripts and for simulation of array antennas.

Examination

- EXA1 - Examination, 10.0 credits, grading scale: P, F

Based on recommendation from KTH's coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

Other requirements for final grade

- Written report/oral presentation of the laboration.
- Solved exercises on the theory part.
- Each student is responsible for a 30 minutes seminar for the other students (and interested members of the department). Participating students also have to act as opponents on the presentation. This is part of illustrating knowledge of the theory.
- Presentation of the result from the project work. Here the presentation comes as a technical report.

Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.