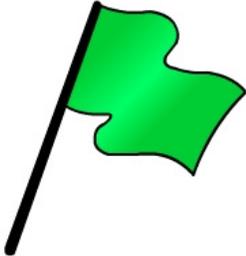




EE 5303

Electromagnetic Analysis Using Finite-Difference Time-Domain

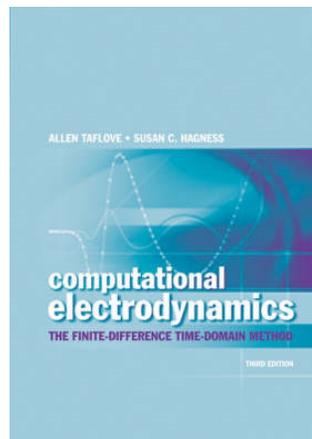
Course Overview, Policies, and Procedures



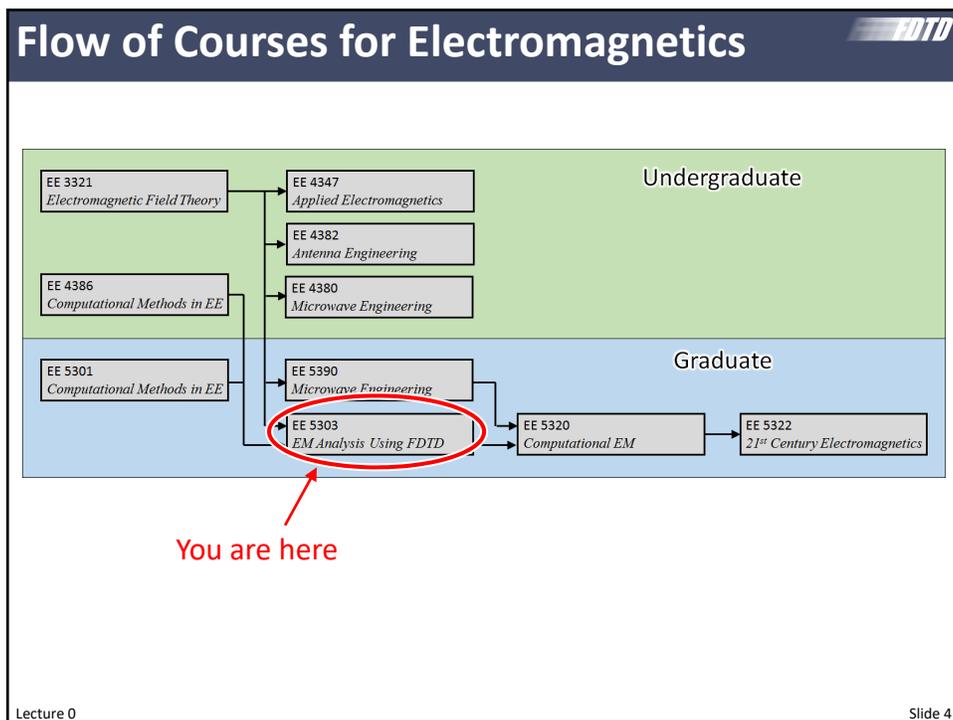
Instructor
Dr. Raymond C. Rumpf

Lecture Outline

- Course Overview
 - Mission
 - Course Objectives
 - Course Outline
- Policies and Procedures
 - Grading
 - Homework
 - Final Project
- Policies & Best Practices
for Coding



Course Overview



Mission of This Class



The mission of this class is to begin teaching the art of computational electromagnetics using MATLAB. The course will take a slow and methodical approach to teach finite-difference time-domain (FDTD) including theory, formulation of the equations, and implementation in MATLAB.

Lecture 0

Slide 5

Course Objectives



- Teach the finite-difference time-domain method.
- Teach students the art of computation and visualization in MATLAB.
- Teach best practices for developing and implementing new numerical algorithms.
- Motivate students in the areas of simulation and electromagnetics.
- Provide the students with real skills that are in high demand in industry.

Lecture 0

Slide 6

Course Outline

FDTD

- Review of MATLAB
 - Graphics, movies, and helpful tidbits.
 - Building geometries in arrays.
- Introduction to FDTD
- One-Dimensional FDTD
 - Formulation, implementation, and examples.
- Two-Dimensional FDTD
 - Formulation, implementation, and examples.
- Advanced Concepts
 - Perfectly match layer boundary condition
 - Grid strategies and alternatives
 - Periodic structures in FDTD
 - Modeling waveguide devices
 - Three-dimensional FDTD
 - Near-field-to-far-field transformation
 - More...

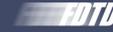


Lecture 0

Slide 7

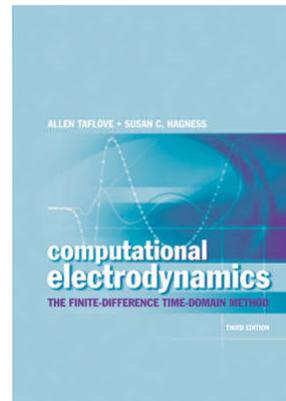
Policies and Procedures

The Book



Allen Taflove, Susan C. Hagness, *Computational Electrodynamics, the Finite-Difference Time-Domain Method*, 3rd edition, Artech House, 2005.

- Good aspects of the book
 - This is the most rigorous and comprehensive book on FDTD available.
 - Many topics and references are provided.
- Drawbacks of the book
 - This is not a good book to learn FDTD from scratch.



Lecture 0

Slide 9

The Syllabus (1 of 4)



- Instructor Information
 - Dr. Raymond C. Rumpf
 - Office: ENGR A-337
 - Telephone: (915) 747-6958
 - E-Mail: rcrumpf@utep.edu
 - Course website: <http://emlab.utep.edu/ee5390fddd.htm>
- Prerequisites
 - Basic electromagnetics
 - Differential equations
 - Programming / MATLAB

Lecture 0

Slide 10

The Syllabus (2 of 4)



- Course Objectives
 - Be able to use the FDTD method to model electromagnetic devices
 - Strengthen MATLAB and graphics skills
- Attendance
 - Attendance is required
 - Attendance is accounted for in participation grade
 - Coordinate with instructor ahead of time if you need to miss a class
 - In some cases, absence can be excused if coordinated with instructor well before the lecture is missed.

Lecture 0

Slide 11

The Syllabus (3 of 4)



- Exam Policy
 - Exams represent 20% of final grade
 - Two midterm exams and one final exam
 - May be take-home or in-class
 - In-class exams, students can have a calculator and a single 8.5"x11" paper with whatever they wish
 - **Take home exams will require working FDTD codes!!!!**
- Homework
 - **Worth 40% of final grade**
 - Homework will build on prior homework so keeping up is essential
 - Homework is due by midnight on the due date
 - Subtract 10% from homework for every day late
 - 12:01am will be considered late
 - **Do you own work. Do not copy from other students.**

Lecture 0

Slide 12

The Syllabus (4 of 4)



- List of Topics
 - MATLAB
 - Programming and graphics
 - Representing devices on a grid
 - Finite-Difference Time-Domain
 - One-Dimensional FDTD
 - Formulation, implementation, visualization, post processing
 - Two-Dimensional FDTD
 - Formulation, implementation, PML, sources, visualization
 - Modal sources, analysis of waveguide devices
 - Advanced Topics
 - Boundary conditions, periodic structures, PML, and more.

Lecture 0

Slide 13

Grading



Homework	40%	90% – 100% → A
Project	20%	80% – 89% → B
Two Midterm Exams ..	15%	70% – 79% → C
Final Exam.....	15%	60% – 69% → D
Participation	10%	0% – 59% → F

HOMEWORK IS 40%
OF YOUR FINAL GRADE!!!!!!!

Lecture 0

Slide 14

Homework Policy



- Due by midnight on due date. 12:01am is late.
- Submit a single PDF file (uploaded to dropbox account provided)
- Neat, organized, answers provided in the order they are asked.
- All codes must be in an appendix placed at the end of your homework document.
- Cover page: name, 800#, date, assignment #, etc.
- **Do your own work. Do not copy from other students.**

Lecture 0

Slide 15

The Final Project



- Purpose – to learn, practice, and share something outside of what was taught in class.
- Project should be summarized in Power Point.
 - Must be complete enough that instructor can reproduce your work if needed.
- Projects will be presented during the final exam period. Duration ~10 minutes for presentation.
- May work alone or in teams, but teams must do proportionally more work.
- Must submit all electronic files (i.e. slides, codes, movies, etc.) to course instructor or project will be given a grade of zero.
- ***Get started on this early!!***

Lecture 0

Slide 16

Project Ideas



- Optimize PML parameters
- Implement a different boundary condition
- Implement higher-order accurate derivatives
- Implement a different type of source
- Model a new device
- Implement 3D FDTD
- Use FDTD to calculate a band diagram
- Do part of your research as this project!
- Others...

Lecture 0

Slide 17

Graphics

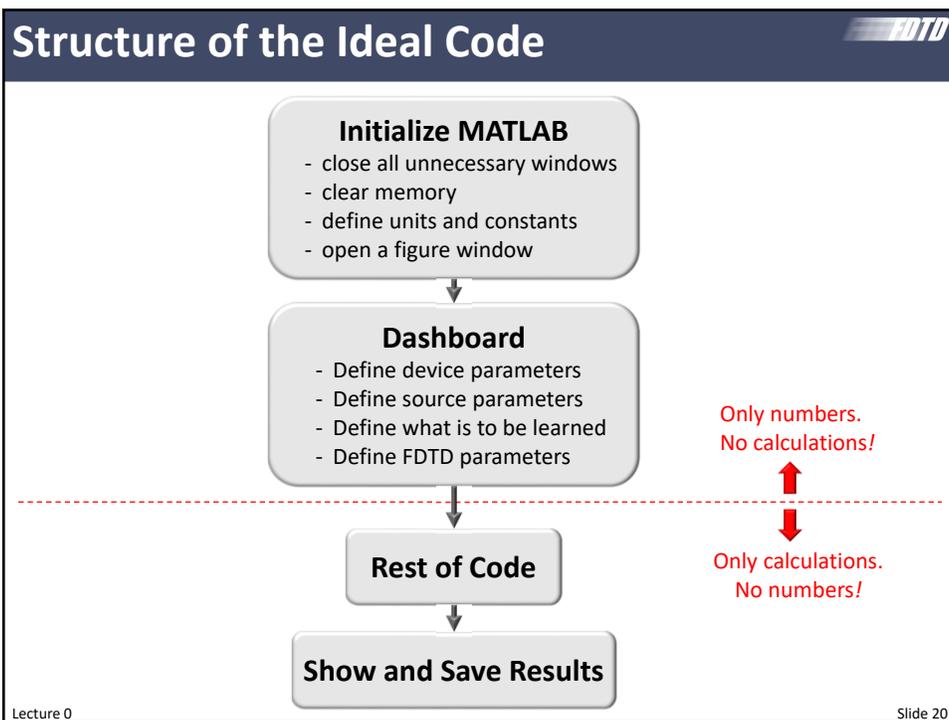


- All figures and graphics must be of professional quality and easy to understand and use.
- The best figure is made as small as possible so that it is still neat and reads clearly
- Lines should be thick enough to be identified, but not awkwardly thick
- Fonts should be large enough to be read easily, but not awkwardly large
- All entities of the figure should be labeled and given proper units

Lecture 0

Slide 18

Policies and Best Practices for Coding



Coding Requirements



- Codes must be clean, commented, and well organized.
- Codes must follow the block diagrams in the lecture notes exactly.
- Constants must include units and as many significant digits as possible.
- Do not breakup codes into subroutines (i.e. functions) unless instructed specifically to do so.
- No calculations in the dashboard, unless absolutely necessary.
- All hard-coded numbers should appear only once within the “dashboard” at the start of your code.

Lecture 0

Slide 21

Coding Best Practices



- Do not hard code any numbers you may want to change.
- If you have to change more than one thing in your code or change something outside of your dashboard to alter a devices dimensions, material properties, etc., you are probably doing something wrong.
- Develop your codes in small increments that you can benchmark at each step.

Lecture 0

Slide 22