



Computational Science:
Computational Methods in Engineering

Course Introduction



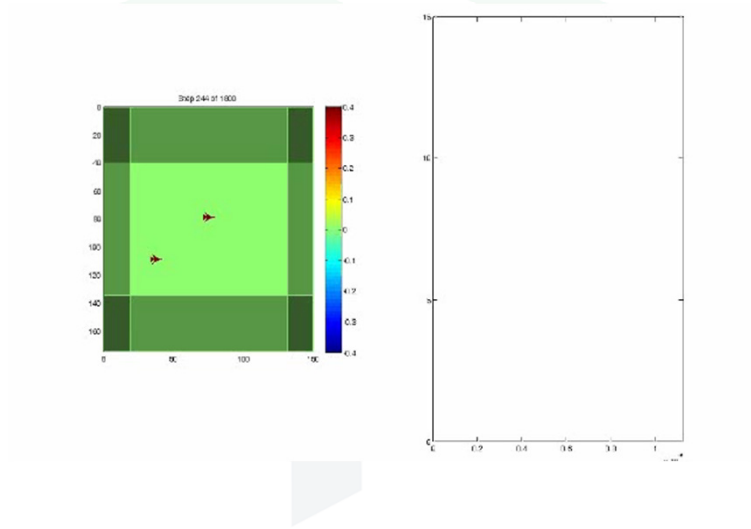
Outline

- What are computational methods?
- Rules and procedures for the course
- Your computer codes

What are Computational Methods?

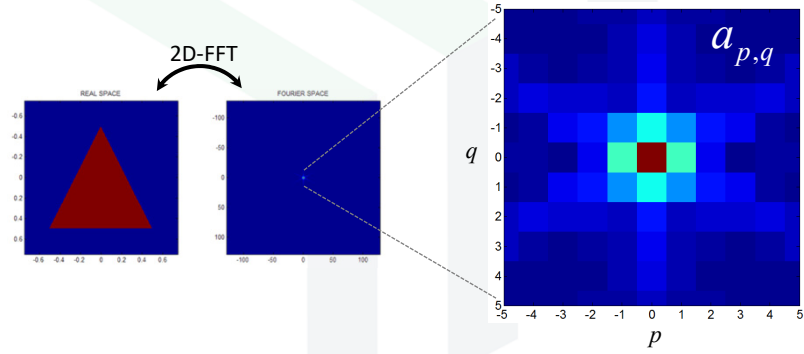
Slide 3

Electromagnetic Simulations

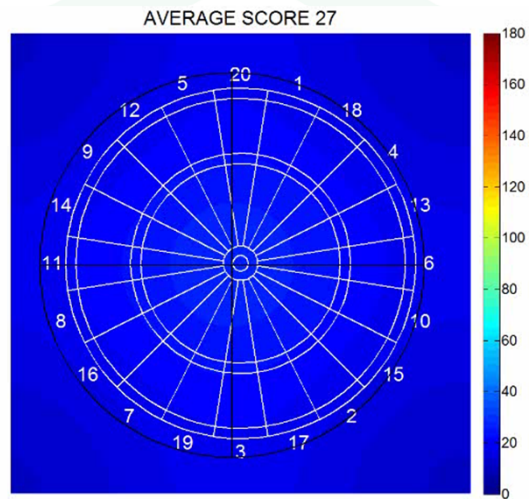


Slide 4

2D Fast Fourier Transform

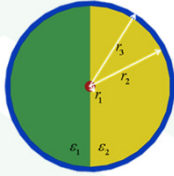
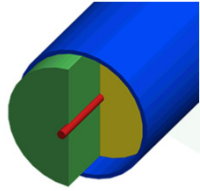


Dart Throwing Analysis



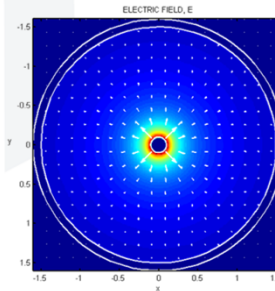
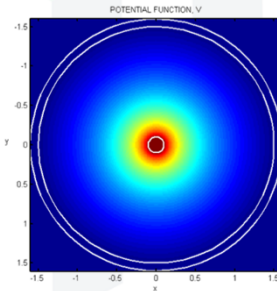
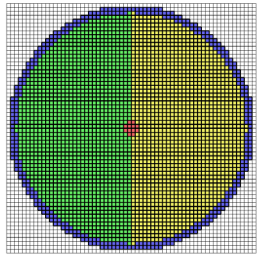
Analysis of Microwave Transmission Lines

Problem definition:



$$\begin{aligned} r_1 &= 0.1 \text{ mm} \\ r_2 &= 1.5 \text{ mm} \\ r_3 &= 1.6 \text{ mm} \\ \epsilon_1 &= 3.0 \\ \epsilon_2 &= 9.0 \end{aligned}$$

Problem results:

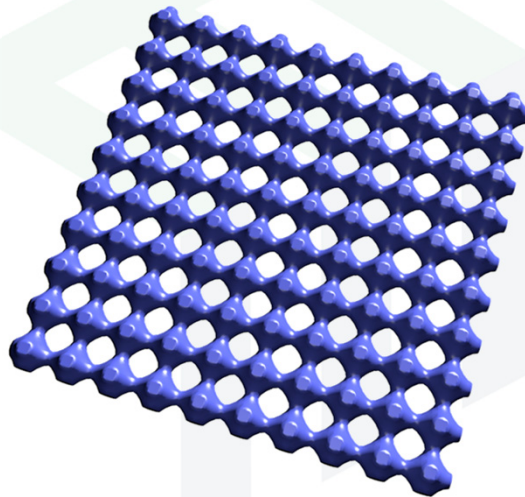


EMPossible

$$L = 554 \frac{\text{nm}}{\text{mm}}, C = 121 \frac{\text{pF}}{\text{mm}}, \epsilon_{\text{eff}} = 6.0, Z_c = 67.78 \Omega$$

Slide 7

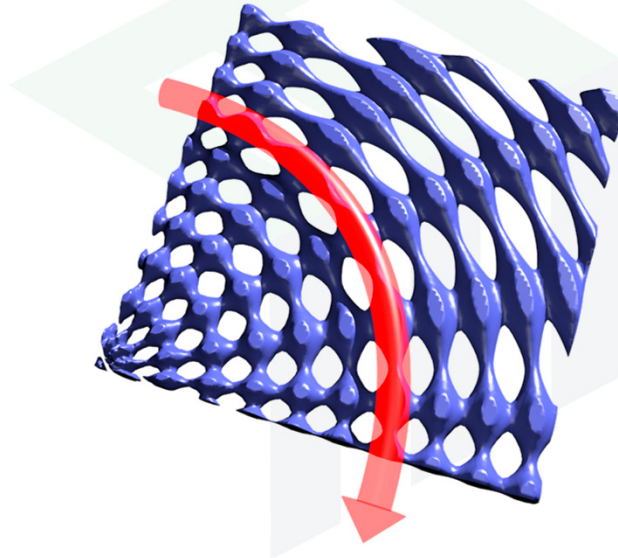
Spatially Variant Lattices (1 of 3)



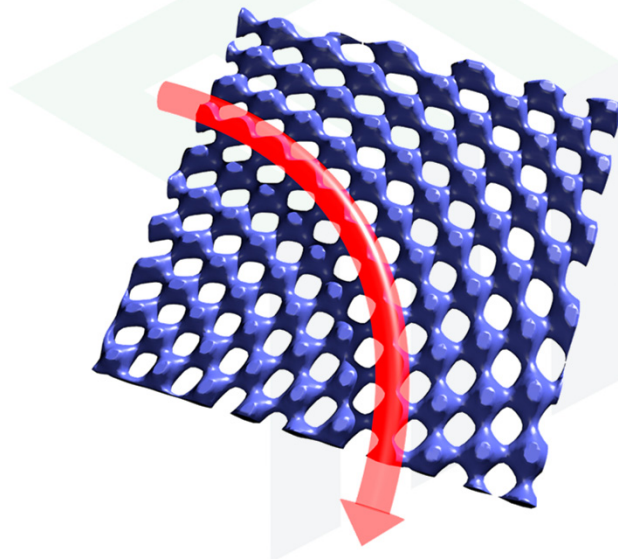
EMPossible

Slide 8

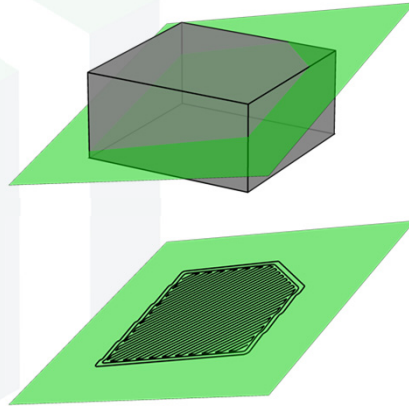
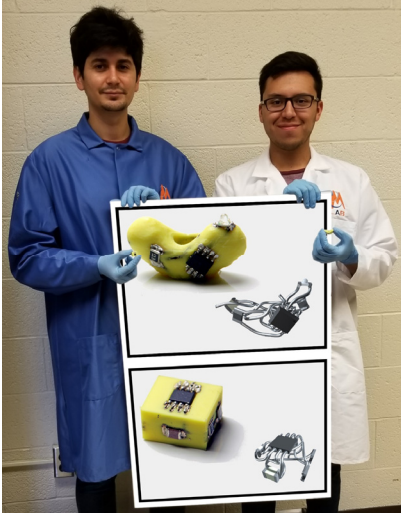
Spatially Variant Lattices (1 of 3)



Spatially Variant Lattices (1 of 3)



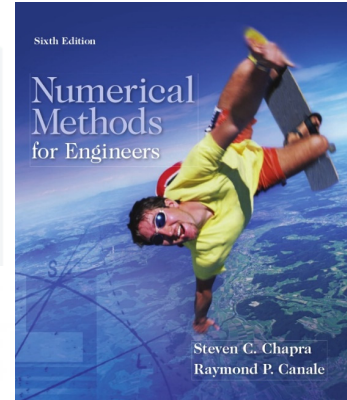
Real Science and Engineering



Rules and Procedures

Needed for This Course

1. A scientific calculator
2. Access to a computer with MATLAB installed.
3. Internet access
4. Text Book



Course Outline

- Review of MATLAB
- Numerical error
- Review of linear algebra
- Finding roots of equations
- Fitting curves to data
- Numerical differentiation and integration
- Finite-difference method for solving ODEs.
- Optimization

**Awesome
Graphics**

Homework Rules/Format

- **Do your own work. Do not copy from other students.**
- Due by 11:59pm on due date. No late homework accepted.
- Submit homework as a single PDF document by uploading to Blackboard.
- Must have a cover sheet.
- Provide all answers and in the order the questions were asked.
- Final answers clearly marked with a box.
- All computer codes placed at end of assignment in an Appendix.
- High level of professionalism – exceed that of the solutions.
- Must include a *signed* graphics checklist at the end of each assignment that includes graphics.
- Extremely good graphics – See checklists

Typical Outline of Homework

- Cover sheet
 - Name + 800#
 - Course information + Date
 - Homework #
- Answers and work to problems (no codes)
- Appendix
 - All computer codes go here
- Graphics checklist if homework contains graphics

Grading

Homework is critical in this course!
Note it is worth 40% of your grade!
No late homework accepted!
Due date/time enforced by Blackboard!

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

Participation → Discussion Boards

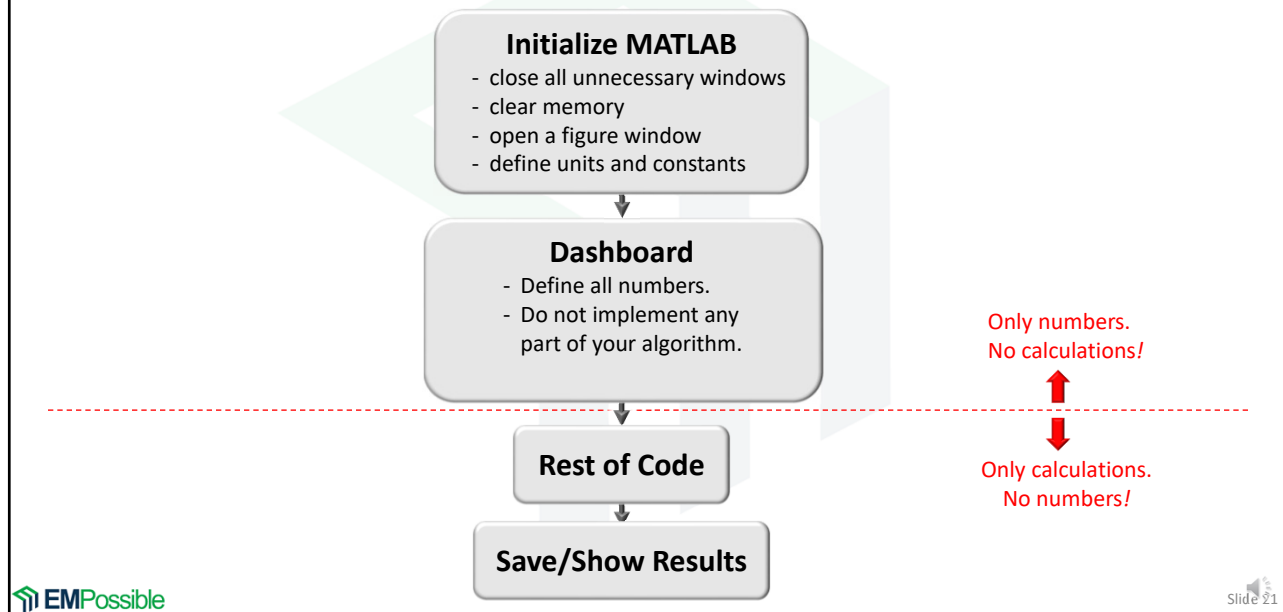
- **At least two posts to discussion boards per week.**
- Ask questions or respond to others' questions
- Post help (not answers) or suggestions.
- Provide feedback or suggestions to improve the course.
- Do not post codes that are part of solutions to homework or exams
- Do not give any answers to homework or exams
- Keep it professional and polite.
- Post only topics related to the course
- Anonymous posting enabled

Unique Things About Rumpf

- Classes start and end exactly on time. Show up several minutes early to be ready.
- Crazy about proper formatting and high-quality graphics
- Want to encourage questions and interactions
 - Grades are never lowered from your given grade, even if a blatant grading error was made.
- Expects code that:
 - Is clean, well-organized, and well-commented.
 - Follows block diagrams exactly

Your Computer Codes

Structure of the Ideal Code



Rules For Your MATLAB Codes

- You must use MATLAB for all homework and exams.
- Programs must follow the block diagrams in the class exactly.
- Codes must be neat, well organized, and well commented.
- Unless otherwise instructed, code must be a single program and NOT broken into separate functions.
- Try to use the same variable names as the notes and in the codes written by the instructor.
- No vestigial code (i.e. code that has no purpose or effect).
- Need help? If you are stuck: (1) be sure to follow ALL of the above rules, (2) e-mail me your MATLAB code.
 - `rcrumpf@utep.edu`
 - Cannot provide help on exams.

Advice for Computation

- Write clean code that is well organized and well commented.
- Follow block diagrams in the notes exactly.
- Do not make artificial corrections. For example, do not change an equation in the notes in order to get your code working. There must be another problem. Find the problem.

Course Website

CMEE Website(s)

https://blackboardlearn.utep.edu/ultra/courses/_115932_1/cl/outline

https://empossible.net/academics/emp4301_5301/

The screenshot shows a Blackboard course outline for EE 4386/5301 Computational Methods for Electrical Engineering. The course is listed as 'Build Content' with a status of 'Published'. The outline includes sections for 'Build Content', 'Assessments', 'Tasks', 'Partner Content', 'Course Information', 'Assignments', 'Course Notes & Videos', and 'Discussion Boards'. The 'Course Information' section is expanded, showing 'Enrollment Statistics Tracking' and a note that the page contains a syllabus and the tentative course calendar. The 'Assignments' section is also expanded, showing 'Enrollment Statistics Tracking' and a note that the page contains a syllabus and the tentative course calendar.

The screenshot shows the EMPossible website for Computational Methods in Electrical Engineering. The page features a search bar, a 'Course Paperwork' section with a 'Homework' dropdown menu, and a 'Course Topics' section with a list of topics including 'Topic 0 - Course Information & Graphics', 'Topic 1 - Numerical Errors in Computation', 'Topic 2 - MATLAB', 'Topic 3 - Linear Algebra', 'Topic 4 - Root Finding', 'Topic 5 - Curve Fitting & Interpolation', 'Topic 6 - Numerical Integration & Differentiation', 'Topic 7 - Finite Difference Method', 'Topic 8 - Optimization', and 'Topic 9 - Bonus Material'. There is also an 'Other Resources' section with links for 'Internet Resources', 'Open Source Software', and 'Course Resources'.