Computing and Data Analysis: Deciphering Climate Change Clues
Tuesday & Thursday 2:00 pm – 3:15 pm, CSS 3426

***** **Satisfy the programming course requirement for AOSC and MATH majors** *****

Instructor:

Xin-Zhong Liang (xliang@umd.edu; 301-405-6300)
Office Hours: Tuesday & Thursday 3:30 pm – 4:30 pm by appointment, CSS 3439

Required Textbook:

Essential MATLAB for Engineers and Scientists, 5th Edition
By Brian D. Hahn & Daniel T. Valentine, Elsevier Science & Technology

Course Description:

This is a comprehensive introductory course designed to prepare students to identify, interpret, and visualize Earth's climate variations observed in the past and projected into the future. The class emphasizes real-world applications, providing students with essential hands-on experience using MATLAB for data analysis and visualization, developing analytical skills for observational and modeling data, and performing virtual experiments to distinguish data contributing factors. Students will gain an understanding of the scientific issues concerning the modern global warming debate on detection and attribution including: signal vs noise, trend vs periodicity, natural vs anthropogenic forcing, local vs remote response, mean vs extreme changes, and accuracy vs uncertainty.

This course has two overarching components: first, students will learn how to program with MATLAB, and second, students will learn statistical and spectral methods of analyzing data. These two components will be bridged with homework plus exercise assignments utilizing both mathematical and programming skills to examine Earth's climate data, both observed and modeled, accessible to the public. The analysis and programing skills learned can be more generally applied to other scientific data with variations in time and/or space. The lecture notes will be made available on my web page after each class: http://www.atmos.umd.edu/~xliang/aosc347/.

Recommended Prerequisite:

Familiarity with basic descriptive statistics, differential/integral calculus (MATH140)

Grade:

Your final grade will be based on your performance on homework (75%) and exercises (25%). There will be five (5) homework assignments that involve both reasoning and quantitative problem solving, and eight (8) simpler exercises throughout the semester.

Course Topics:

MATLAB Basics, Functions, Graphics, Programming, Designing, Debugging,

Data Input/Output Format, Data Import/Export, Numerical Methods, Root Finding,

Univariate Statistics, Probability Distributions, Statistical Tests, Correlation Analysis,

Regression Analysis, Time Series Analysis, Signal Processing, Spatial Data Processing.
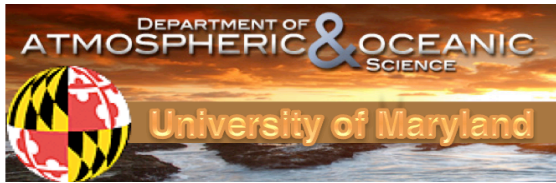
Tentative Course Schedule

The schedule below gives a tentative overview of the topics we will cover in the course. It may be subject to changes as appropriate. Please see my course website for update.

Class #	Date	Topic Covered	Homework
1.	01/27	MATLAB Introduction (Ch 1)	
2.	01/29	MATLAB Fundamentals 1 (Ch 2)	
3.	02/03	MATLAB Fundamentals 2 (Ch 2)	
4.	02/05	MATLAB Matrices and Arrays (Ch 6)	
5.	02/10	MATLAB Logical Vectors and Loops (Ch 5, 8)	
6.	02/12	MATLAB Graphics Introduction (Ch 9)	HW1 assigned
7.	02/17	MATLAB Program Debugging (Ch 7, 11)	
8.	02/19	MATLAB Program Design (Ch 3, 10)	HW1 due
9.	02/24	MATLAB Functions (Ch 7)	
10.	02/26	MATLAB Data Input/Output Format (Ch 4)	
11.	03/03	MATLAB Data Import/Export (Ch 4)	HW2 assigned
12.	03/05	MATLAB Program Improvement	
13.	03/10	MATLAB Advanced Data Import/Export	HW2 due
14.	03/12	MATLAB Advanced Graphics	
		Enjoy Spring Break (March 15 to 22)	
15.	03/24	Introduction to Numerical Methods (Ch 14)	
16.	03/26	Numerical Methods for Root Finding	HW3 assigned
17.	03/31	Dynamic System Model Simulation	
18.	04/02	NetCDF for Earth Sciences Data	HW3 due
19.	04/07	Univariate Statistics	
20.	04/09	Effective Programming	
21.	04/14	Probability Distributions	
22.	04/16	Statistical Tests	
23.	04/21	Correlation Analysis	
24.	04/23	Regression Analysis	HW4 assigned
25.	04/28	Time Series Analysis (1)	
26.	04/30	Time Series Analysis (2)	HW4 due
27.	05/05	Signal Processing	
28.	05/07	Spatial Data Processing	
29.	05/12	Concise Programming	HW5 assigned
30.	05/18	**No Class but turn in your HW5**	HW5 due