ASEN 5245 – Radar and Remote Sensing

Course Content

The course is divided into several sections, which consist of the following topics:

Radar fundamentals

Radar basics; pulsed radar; target ranging; range ambiguity; pulse-to-pulse motion; signal, noise and loss; target detection; receiver components and processing; Doppler radar; Doppler velocity ambiguity

Radar sensitivity

Radar power equation: derivation and application for point targets; Radar power equation for area targets; Radar power equation for volume targets; radar power losses; radio and receiver noise

Radar Antenna

Directivity; gain; illumination; antenna patterns; aperture antennas; phased array antennas

Scattering Processes

Radar cross section; Rayleigh; Mie; geometric; Bragg; rough surfaces; polarization, propagation

Radar Signals

Transmitter/signal generating characteristics; pulsed ri-1 (Eeon,)5.; r0.7 (i)-qi.w [Tc -5.29 -2.Gp; a(g

campus's network, or use the CU VPN (Virtual Private Network) to access the CU network. To get VPN on your computer, see https://oit.colorado.edu/. You will need your CU username and identikey password to install the software and every time you login to the VPN. Once connected to the CU network via the VPN, browse to the Knovel website: www.knovel.com and search for 'Principles of Modern Radar'. You will see three volumes of this text. We will use volume 1. You can use the book online, or download individual chapters.

It is difficult to find a textbook that covers the topic of radar from a remote sensing perspective. Additionally, many radar texts are written as reference books for practicing engineers and not specifically designed as a textbook for students. As reference books, they do not clearly develop subjects from first principles and do not provide problems that can worked by the student. Furthermore, many radar textbooks are written specifically for electrical engineers and assume a significant depth of understanding in electromagnetics and wave propagation, which are not required for this course.

Depending on your specific background, you may need to draw from other supplementary material to provide more clarity or depth to a topic. One complication of supplying supplemental material is that the notation may change. Since this is a graduate course, you should be able to figure out changes in notations used in different books. Many books on radar fundamentals are available through the Engineering Library and through www.knovel.com. Some good references include:

- Introduction to Radar Analysis, 2nd Edition, by Majafza
- Introduction to Airborne Radar, 2nd edition, by Stimson
- Radar Principles, by Peyton Z. Peebles, Jr.
- Radar System Principles, by Harold R. Raemer
- Radar Handbook, by Skolink
- Introduction to Radar Systems, by Skolink
- Tools of Radio Astronomy, by Rohlfs and Wilson
- Modern Radar System Analysis, by Marton
- Radio Techniques for Probing the Terrestrial Ionosphere, by Hunsucker
- Fundamentals of Applied Electromagnetics, by Fawwaz T. Ulaby
- Elements of Engineering Electromagnetics, 6th edition, by Rao
- Antenna Theory – Analysis and Design, 3rd edition, by Constantine A Balanis (2005)

Several radar books are available online through an agreement between the University of Colorado and www.knovel.com.

Class Format

This class is scheduled to meet for two 75-minute sessions on Tuesdays and Thursdays (4:25-5:40 pm). To improved efficiency and adapt to different learning styles, the Tuesday class meeting will be replaced with pre-recorded technical lectures. The material in those lectures will be discussed and built upon during the Zoom lecture on Thursday afternoon. Benefits of pre-recorded technical lectures include watching them multiple times on your own schedule before we discuss the material on Thursday. There will be about 75 minutes of pre-recorded technical lectures every week which is the same duration as a Tuesday lecture. The Thursday lecture will

focus on answering your questions about the pre-recorded lectures, working through example problems, and having a discussion about radar systems.

Video Recording of Thursday Class

In addition to pre-recorded lectures, the Thursday afternoon classes will be recorded and posted on the class Canvas page. Please be aware that all conversations during the Thursday afternoon class may be recorded both on video and/or audio by the Zoom application.

Zoom Link for Thursday Class

The Thursday afternoon class will be conducted via Zoom. Connect to the Zoom meeting using:

- Zoom Meeting ID: TBA
- Join via web browser: TBA
- Join via Zoom app, use meeting ID: TBA

Additionally, if you need help with getting Zoom up and running, please visit the following link:

- https://oit.colorado.edu/services/network-internet-services/vpn

Slido Communication App

During the Thursday class, we will use a third-party app called Slido (https://www.sli.do/) to conduct polls to gauge learning of concepts and for you to submit questions. The app is designed to get user feedback and questions during panel discussions. When a user submits a question (you can choose to include your name or submit the question anonymously), your class-mates can vote the question up in priority. The questions with the most votes float to the top of the list and will be the next question discussed during class. I will use the polling feature to produce multiple-guess questions that you would answer in real time. I will use this information to gauge which material needs to be emphasized or rephrased in order to improve your understanding of the topic. The polling feature aggregates the responses and I do not see answers associated with any one

Aerospace Engineering Sciences & University Policies: Spring 2021

"Spring Pause"

Due to public health concerns, the University decided to forego a "spring break" this semester and changed the Spring 2021 academic calendar. To provide a safe and supportive way to promote health, wellness, and learning without leaving campus, the week of March 22-26 has been declared a "spring pause" by the College of Engineering and Applied Sciences (CEAS). During this week, Engineering classes will not have any exams or assignments due. Engineering classes with interactive activities requiring your attendance will still occur and will be part of your final course grade. While March 25 is a wellness day with no University classes meeting that day, attendance is still required for all other Engineering class sessions that week. It is important for all Buffs to behave responsibly at all times, not just during the "spring pause", by not engaging in risky behavior that could be detrimental to yourself, your friends, your family, your colleagues, your neighbor, and the unknown person next to you in public.

Classroom Behavior

Both students and faculty are responsible for maintaining an appropriate learning environment in all instructional settings, whether in person, remote or online. Those who fail to adhere to such behavioral standards may be subject to discipline. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteran status, political affiliation or political philosophy. For more information, see the policies on classroom behavior and the Student Code of Conduct.

COVID-19 Health and Safety and classroom behavior and the Student Code of Conduct. If you require accommodation because a disability prevents you from fulfilling these safety measures, please see the “Accommodation for Disabilities” statement on this syllabus.

All students who are new to campus must complete the COVID-19 Student Health and Expectations Course. Before coming to campus each day, all students are required to complete the Buff Pass. For this class, students do not need to be on campus to complete the requirements for this class. Also, the instructor will not be on campus during the Spring semester.

Students who have tested positive for COVID-19, have symptoms of COVID-19, or have had close contact with someone who has tested positive for or had symptoms of COVID-19 must stay home. In this class, if you are sick or quarantined, you do not need to inform the instructor. The course grading with the dropping of one quiz is to accommodate the possibility of a student or a family member being sick during the semester.

Accommodation for Disabilities

If you qualify for accommodations because of a disability, please submit your accommodation letter from Disability Services to your faculty member in a timely manner so that your needs can be addressed. Disability Services determines accommodations based on documented disabilities in the academic environment. Information on requesting accommodations is located on the