KENNESAW STATE UNIVERSITY

SYLLABUS

SOUTHERN POLYTECHNIC COLLEGE OF ENGINEERING AND ENGINEERING TECHNOLOGY
DEPARTMENT OF ROBOTICS AND MECHATRONICS ENGINEERING
MTRE 6710: MANIPULATION OF 3D POINT CLOUD DATA

Course Information

Class meeting time: Asynchronous | Optional Meetings: Wednesday at 8:30PM (TBD)
Modality and Location: Online

Instructor Information

Name: Razvan Voicu, Ph.D.
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Office Location: Q340
Office phone: 470-578-7234
Office Hours: By Appointment
Preferred method of communication: Email

Course Description

Credits: 3-0-3
Prerequisites: N/A
Description: Processing of point cloud data is of increasing importance for perception in autonomous systems. This course examines the primary algorithms for extracting features from raw point cloud data for use with object detection and localization tasks, with data acquired from both LiDAR and stereo imaging. The efficiency of such algorithms is explored by developing them from the ground up, as well as assessing performance using popular point cloud libraries.

Course Materials

Required Texts: An Introduction to Pointcloudmetry: Point Clouds from Laser Scanning and Photogrammetry, Mathias Lemmens, 2023.
Recommended Texts: Lidar Technologies and Systems, Paul McManamon, 2019
Technology requirements: Laptop Computer, Internet Accessibility

Learning Outcomes

After successful completion of this course, the students will be able to:
- Develop code to acquire, filter, and prepare point cloud data for processing
- Identify appropriate algorithm or technique for given task with point cloud data
- Understand operation of primary point cloud functions including feature extraction, keypoint matching, registration, segmentation, and classification
- Select appropriate algorithm parameters to optimize algorithm performance
- Be familiar with and implement solutions using the latest freely available point cloud libraries
- Analyze latest developments in research of novel point cloud techniques

- Develop solutions to point cloud applications including localization and object detection

Course Delivery

The course will be delivered asynchronously online. KSU may shift the method of course delivery at any time during the semester in compliance with University System of Georgia health and safety guidelines. In this case, alternate teaching modalities that may be adopted include hyflex, hybrid, synchronous online, or asynchronous online instruction.

Course Requirements and Assignments

Assignments: Students will complete 4 assignments relating to LiDAR applications, concepts, or notions

Literature study: Students will first identify a recent research paper from the open literature (from e.g. arXiv or IEEE Transactions) and have it approved by the instructor. Students will then prepare and record a presentation summarizing the work, relating it to material covered in the course, and placing its importance in the state-of-the-art in the field. (15 Minute Presentation). By submitting the video, students acknowledge and agree that the video recordings will be made available to the public.

Project: A group project will be explored where students will work to develop code for solving practical applications using point cloud data. Students will then prepare and record a presentation summarizing the work, relating it to material covered in the course, and placing its importance in the state-of-the-art in the field. (15 Minute Presentation). By submitting the video, students acknowledge and agree that the video recordings will be made available to the public.

Evaluation and Grading Policies

Breakdown of the overall course grade is as follows:

Assignments (4)	60%
Lecture and Video Review	10%
Point Cloud Project	30%
Bonus: Literature Study	10%

Grades will be assigned according to the scale:
90% - 100% (A) | 80% - 89% (B) | 70% - 79% (C) | 60% - 69% (D) | 0% - 59% (F)

Students will receive feedback within two weeks of submission.
Assignment 1 will be graded on completion and correct application. It will not be graded on the correct answer.
Assignment 2 will be graded on the correct implementation and correct solution.
Assignment 3 will be graded on a comprehensive survey of a chosen paper or will be graded based on the successful implementation of code. Code formatting, commenting, and syntax are vital, and points are taken off when standards are not maintained.
Assignment 4 will be graded based on successful implementation of code. Code formatting, commenting, and syntax are vital, and points are taken off when standards are not maintained.
Project will be graded based on the comprehensive literature survey, successful implementation, and a 5-page report. The implementation code requires the following strict standard programming procedures.

Course Policies

Communication: Course material will be disseminated in D2L, including lecture notes, etc. All course announcements will be sent via email or D2L. Email is the surest means of contacting the instructor regarding problems or requests. The subject line of the email should have the course number "MTRE 6100".

Attendance Policy: Attendance is optional. A student is responsible for any material covered in class. No credit is possible for any missed grade items.

Instructional Continuity Plan

Kennesaw State University (KSU) may decide to close campuses, operate on a delayed schedule, or transition to remote instruction for inclement weather or in case of emergency.

The University will announce campus closures, delayed schedules, or remote instruction through KSU Alerts sent to your cell number on file and to your university email account. In addition, announcements will be posted on KSU's home page: www.kennesaw.edu.

Our class continuity plan includes:

1. Communication: Please check D2L or e-mail for necessary instructions.
2. Virtual Classes: If in-person classes are not possible, we may transition to virtual classes using MS Teams.
3. Assignments and Assessments: Deadlines for assignments and assessments may be adjusted to accommodate the emergency situation.

We understand that emergencies create unique challenges. If you need additional support during an emergency, reach out via Brightspace or e-mail. The university also offers resources such as counseling and academic support, which can be accessed remotely.

In Case of illness

If you are feeling ill, please stay home and contact your health professional. In addition, please email your instructor to say you are missing class due to illness. Wearing a face covering inside campus facilities is permitted for anyone who feels more comfortable doing so.

Policy on the Usage of Artificial Intelligence

AI Use Allowed, but Not Required: In this class, you are welcome to use AI for any purpose. However, you should note that all AI generative tools still tend to make up incorrect facts and fake citations, code generation models tend to produce inaccurate outputs, and image/art generation tools can produce copied work or offensive products. You will be responsible for any inaccurate, biased, offensive, or otherwise unethical content you submit regardless of whether it originally comes from you or an AI tool. If you use an AI tool, its contribution must be credited in your submission. The use of an AI tool without acknowledgement is cheating and constitutes a violation of the KSU Code of Academic Integrity.

Relying on AI in a programming course may prevent you from developing the core fundamental skills needed to truly understand the content, which can lead to gaps in your knowledge and the inability to apply concepts independently in future work.

However, it is equally important to know how to use it.

Institutional Syllabus Policies, Procedures, and Resources

Federal, BOR, & KSU Required Syllabus Policies and Student Resources

Tentative Schedule

Week	Topic A	Topic B
Week 1	Introduction to LiDAR	History of LiDAR
Week 2	LiDAR Ranging	Types of LiDAR
Week 3	LiDAR Receivers	Beam Steering & Optics
Week 4	LiDAR Application	LiDAR Application
Week 5	Common Principles & Equations	Mapping
Week 6	Interpolation	Filtering
Week 7	Feature Detection	Software Processing
Week 8	Review	Review