College of Performance, Visualization and Fine Arts

VIZA 656 Syllabus

Section 600 (53522)
Image Synthesis
Spring 2026 - College Station

Credit Hours: 3

Instructor Details

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Office Hours

MW 9:40-10:20 + Flexible meetings with Appointment

Preferred Contact Method

Zoom or in-Person

Webpage: https://people.tamu.edu/~ergun/courses/viza656/26spring/

Biography

I have been a faculty member at Texas A&M University since 1995, contributing to its academic and creative communities for nearly three decades. During this time, I have held positions as a Professor in the Departments of Visualization and Architecture and am currently a Professor in the Visual Computing and Computational Media Section of the newly established School of Performance, Visualization, and Fine Arts. I also hold a joint appointment with the Department of Computer Science and Engineering, reflecting the transdisciplinary nature of my teaching and research.

I received my Ph.D. in Electrical and Computer Engineering from the Georgia Institute of Technology in 1992, where my academic foundation in engineering laid the groundwork for my diverse research interests, which span computer graphics, geometric modeling, and topology. My work focuses on developing innovative computational tools and methodologies that blend artistic creativity with technical rigor, such as my contributions to topological mesh modeling and the creation of the TopMod system, widely used by artists and educators.

Beyond academia, I am a professional cartoonist, illustrator, and caricaturist, having published over 750 works in various formats. My artistic endeavors extend to children's books, popular science articles, and a bi-monthly column in the flagship magazine of the IEEE Computer Society, IEEE Computer. My unique integration of artistic intuition with computational techniques has allowed me to mentor nearly 100 graduate students, many of whom now hold leadership roles in companies such as PIXAR, Disney, DreamWorks, and Google.

My ongoing goal is to bridge the disciplines of computation and creativity, advancing fields like interactive storytelling, computational aesthetics, and design visualization while continuing to inspire and support the next generation of innovators.

Catalog Description

Image Synthesis. (2-2). Credit 3. Principles of image synthesis from 3-D scene descriptions; topics may include local and global illumination, shading, shadow determination, hidden surface elimination, texturing, raster graphics algorithms, transformations and projections. Prerequisites: Graduate classification in Visualization; VIZA 652, or approval of instructor. Cross-listed with CSCE 647.

Course Prerequisites

Prerequisite/Corequisite(s): Graduate classification in Visualization; VIZA 652, or approval of instructor. Cross Listing: CSCE 647/VIZA 656.

Course Learning Outcomes

Upon completion of this course, the learner will be able to:

- Identify and explain essential rendering and shading algorithms used in modern image synthesis.
- Apply fundamental principles of light behavior, including key concepts from ray and wave optics, to the analysis and design of rendering systems.
- Design, implement, and evaluate core rendering algorithms, including ray tracing and path tracing, through original programming assignments.
- Apply rendering and shading techniques to both photorealistic and non-photorealistic image synthesis problems, considering physical accuracy,

visual quality, and computational efficiency.

- Critically assess rendering results and justify algorithmic choices based on theoretical foundations and practical performance considerations.

Special Course Designation

None

This course is a **(C) cross-listed** course. It is a **prescribed elective** for the **PhD in Visual Computing & Interactive Media** program and a **core curriculum (CORE) elective** for the **MS in Visualization** program.

Textbook and/or Resource Materials

This material Is: Recommended
Conference Articles on Rendering & Shading
Notes:
Early papers are published in conferences such as ACM SIGGRAPH, Eurographics, and Graphics Interface. You can search for them in Google Scholar and access them through the Texas A&M University Library.

This material Is: Recommended
Articles from Computer Graphics Journals
Notes:
Now, even conference papers are published in journals such as ACM TOG, IEEE TVCG, Computer Graphics Forum, Computers & Graphics, IEEE Computer Graphics and Applications. You can search for them in Google Scholar and access them through the Texas A&M University Library.

This material Is: Recommended
Books on Image Synthesis & Rendering and Shading

Notes:
There are many coursenotes and books on Image Synthesis & Rendering and Shading. Most of them are useful for the class.

Grading Policy

Grading Breakdown

- **Quizzes:** 52 points
- **Projects:** 36 points
- **Class Participation:** 12 points

The highest possible total is **100 points**.

Grading Scale:

- **A:** Grade > 90 points
- **B:** 80 < Grade ≤ 90 points
- **C:** 70 < Grade ≤ 80 points
- **D:** 60 < Grade ≤ 70 points
- **F:** Grade ≤ 60 points

Quizzes:
We will have weekly quizzes, which will not necessarily be equally weighted. Quizzes will be given and graded using WebAssign. Make sure to pay attention to the due dates and times. If you miss the deadline, your quiz will be graded at **50% of the actual score**.

Projects:
Students will be responsible for completing six projects. The projects will be discussed in the class. To be graded, all required materials should be uploaded to the class website and the designated Google Drive folder on or before the deadline. There are six required projects, each equally weighted, contributing 1/6 **(6 points out of 36)** to the final grade (out of 100). Grading will be based on both quality and

process. If you miss the deadline, your project will be graded at **50% of the actual score**.

Class Participation:
Class participation will be determined mainly by attendance. Students will lose **1.0 point** from their class participation grade for each class they miss, up to a maximum deduction of **12 points**. Students who regularly contribute insightful comments during class discussions may receive bonus points in class

Late Work Policy

Work submitted by a student as makeup work for an excused absence is not considered late work and is exempt from the late work policy (Student Rule 7).

Course Specific Late Work Policy

Quizzes: If you miss the deadline, your quiz will be graded at **50% of the actual score**.

Projects: If you miss the deadline, your project will be graded at **50% of the actual score**.

Course Schedule

Week 1
Normal Maps, Diffuse Illumination, and Specular Highlights
Surface detail representation using normal maps. Review of diffuse and specular reflection models and basic shading concepts.

Week 2
Mirror Reflection, Refraction, Fresnel Equations, and Light Types
Physical principles of reflection and refraction, Fresnel effects, energy conservation, and light source models.

Week 3
Shadows and Subsurface Scattering Using Depth Maps
Shadow computation techniques and approximations for subsurface light

transport using depth-based methods.
(Project 1 deadline)

Week 4
Camera Models, Ray Casting Basics, and Ray–Surface Interaction Algorithms
Camera models, ray generation, and fundamental ray–geometry intersection techniques.

Week 5
Advanced Ray–Surface Interaction Algorithms, Texture Mapping, and Solid Texturing
Robust intersection algorithms, UV texture mapping, procedural textures, and solid texturing methods.
(Project 2 deadline)

Week 6
Ray Tracing with Multiple Reflections and Refractions
Recursive ray tracing, secondary rays, and handling reflection and refraction depth.

Week 7
Distributed Ray Tracing
Stochastic sampling techniques for soft shadows, depth of field, motion blur, and glossy reflections.
(Project 3 deadline)

Week 8
Image-Based Illumination
Environment mapping and illumination from captured or synthesized lighting data.

Week 9
Projection Methods, Triangular Meshes, and Triangle–Ray Intersections
Geometric representations, projection techniques, and efficient triangle–ray intersection algorithms.
(Project 4 deadline)

Week 10
Path Tracing, Photon Mapping, and Multiple Light Sources
Monte Carlo integration, global illumination, photon mapping, and complex lighting scenarios.

Week 11
Radiosity and Comparison of Rendering Algorithms
Diffuse global illumination, radiosity methods, and comparative evaluation of rendering approaches.
(Project 5 deadline)

Weeks 12–13
Advanced Topics in Rendering
Selected advanced and research-oriented topics in image synthesis, based on current trends and student interests.

Week 14
Project Integration and Final Topics
Final project development, discussion, and synthesis of course concepts.
(Project 6 deadline)

Additional Course Information

Course Materials:
Additional course materials and quizzes will be available on WebAssign: https://www.webassign.net/. Students are responsible for enrolling in WebAssign. For enrollment instructions, please visit https://www.getenrolled.com/?courseKey=tamu94908888. The class key for enrollment is **tamu 9490 8888**. To access WebAssign, each student needs to pay a content subscription fee.

Codes, Presentations, and Old Videos:
Additional materials, including code examples, PowerPoint presentations, and archived videos, will be available in the class's shared Google Drive available in the class website https://people.tamu.edu/~ergun/courses/viza656/26spring/. These materials are **dynamic and will be updated continuously throughout the**

semester. Archived class videos are only for reference purposes. Therefore, **regular class attendance is essential**.

Technology Support

Technology Services (IT) - Main Campus

Hours: 24/7
Phone: (979) 845-8300
Email: helpdesk@tamu.edu
Call/Chat/Email/visit: https://it.tamu.edu/help

Canvas LMS Technical Support

Hours: 24/7/365
Phone: (877) 354-4821
Email: support@instructure.com

Support is available by clicking the Help button at the far left in the Canvas global navigation menu.
Canvas Resources are also linked on the home page of every Canvas course.

University Policies

This section outlines the university-level policies that must be included in each course syllabus. The TAMU Faculty Advisory Council established the wording of these policies.

Academic Integrity Statement and Policy

"An Aggie does not lie, cheat or steal, or tolerate those who do."

"Texas A&M University students are responsible for authenticating all work submitted to an instructor. If asked, students must be able to produce proof that the item submitted is indeed the work of that student. Students must keep appropriate records at all times. The inability to authenticate one's work, should

the instructor request it, may be sufficient grounds to initiate an academic misconduct case" (Section 20.1.2.3, Student Rule 20).

You can learn more about the Aggie Honor System Office Rules and Procedures, academic integrity, and your rights and responsibilities at aggiehonor.tamu.edu.

University Attendance Policy

The university views class attendance and participation as an individual student responsibility. Students are expected to attend class and to complete all assignments.

Please refer to Student Rule 7 in its entirety for information about excused absences, including definitions, and related documentation and timelines.

Makeup Work Policy

Students will be excused from attending class on the day of a graded activity or when attendance contributes to a student's grade, for the reasons stated in Student Rule 7, or other reason deemed appropriate by the instructor.

Please refer to Student Rule 7 in its entirety for information about makeup work, including definitions, and related documentation and timelines.

Absences related to Title IX of the Education Amendments of 1972 may necessitate a period of more than 30 days for make-up work, and the timeframe for make-up work should be agreed upon by the student and instructor" (Student Rule 7, Section 7.4.1).

"The instructor is under no obligation to provide an opportunity for the student to make up work missed because of an unexcused absence" (Student Rule 7, Section 7.4.2).

Students who request an excused absence are expected to uphold the Aggie Honor Code and Student Conduct Code. (See Student Rule 24.)

Notice of Nondiscrimination

Texas A&M University is committed to providing safe and non-discriminatory learning, living, and work environments for all members of the University community. The University provides equal opportunity to all employees, students, applicants for employment or admission, and the public, regardless of race, color, sex (including pregnancy and related conditions), religion, national origin, age, disability, genetic information, or veteran status.

Texas A&M University will promptly, thoroughly, and fairly investigate and resolve all complaints of discrimination, harassment (including sexual harassment), complicity, and related retaliation based on a protected class in accordance with System Regulation 08.01.01, University Rule 08.01.01.M1, Standard Administrative Procedure (SAP) 08.01.01.M1.01, and applicable federal and state laws. In accordance with Title IX and its implementing regulations, Texas A&M does not discriminate on the basis of sex in any educational program or activity, including admissions and employment.

The following person has been designated to handle inquiries and complaints regarding the non-discrimination policies: Jennifer M. Smith, TAMU Associate VP & Title IX Coordinator at YMCA Ste 108, College Station, TX 77843, 979-458-8407, or email civilrights@tamu.edu. For other reporting options, visit the U.S. Department of Education Office for Civil Rights Complaint Assessment System to locate the address and phone number of the office that serves your area, or call 1-800-421-3481.

Civil Rights, Free Speech, and Title IX Policies

Texas A&M University is committed to fostering a learning environment that is safe and productive for all. University policies and federal and state laws prohibit discrimination and harassment based on an individual's race, color, sex, (including pregnancy and related conditions), religion, national origin, age, disability, genetic information, veteran status, or any other legally protected characteristic. This includes forms of sex-based violence, such as sexual assault, sexual harassment, sexual exploitation, dating/domestic violence, and stalking.

Students can report discrimination/harassment, access supportive resources, or learn more about their options for resolving complaints on the University's Civil Rights & Title IX webpage.

Students should be aware that all university employees (except medical or mental health providers) are mandatory reporters, which means that if they observe, experience or become aware of an incident that they reasonably believe to be discrimination/harassment alleged to have been committed by or against a person who was a student or employee at the time of the incident, the employee must report the incident to the university.

Americans with Disabilities Act (ADA) Policy

Texas A&M University is committed to providing equitable access to learning opportunities for all students. If you experience barriers to your education due to a disability or think you may have a disability, please contact the Disability Resources office on your campus (resources listed below). Disabilities may include, but are not limited to, attentional, learning, mental health, sensory, physical, or chronic health conditions. All students are encouraged to discuss their disability-related needs with Disability Resources and their instructors as soon as possible.

To request academic accommodations, contact the designated ADA office based on your location:

- Texas A&M University, College of Nursing, College of Dentistry, Irma Lerma Rangel College of Pharmacy College Station, College of Medicine, School of Public Health, Institute of Biosciences and Technology, EnMed Program, Bush School in Washington DC, Mays Business School – CityCentre, TAMU Engineering Academies, Texas A&M University Higher Education Center at McAllen and Texas A&M University at Galveston should contact Disability Resources at (979) 845-1637 or disability@tamu.edu.
- Texas A&M University School of Law should contact the Office of Student Affairs at (817) 212-4111 or law-disability@law.tamu.edu to request accommodations.

- Irma Lerma Rangel College of Pharmacy in Kingsville should contact the Disability Resource Center at Texas A&M University-Kingsville at (361) 593-3024 or drc.center@tamuk.edu to request accommodations.
- Texas A&M University College of Veterinary Medicine & Biomedical Sciences in Canyon should contact the Office of Student Accessibility at West Texas A&M University – Canyon at (806) 651-2335 or osa@wtamu.edu.

If you are experiencing difficulties with your approved accommodations, contact the office responsible for approving your accommodations or the Texas A&M ADA Coordinator Julie Kuder at ADA.Coordinator@tamu.edu or (979) 458-8407.

Pregnancy Accommodations

Texas A&M provides reasonable accommodations to students due to pregnancy and/or related conditions, such as childbirth, recovery, and lactation. Students should contact the University's Pregnancy Coordinator as soon as they become aware of the need for accommodation. Depending on the circumstances, accommodations could include extended time to complete assignments or exams, changes in course sequence, or modifications to the physical classroom environment.

Texas A&M will also allow a voluntary leave of absence, ensure the availability of lactation space, and maintain grievance procedures to provide for the prompt and equitable resolution of complaints of sex discrimination. For information regarding pregnancy accommodations, email TIX.Pregnancy@tamu.edu.

Statement on Mental Health and Wellness

Texas A&M University recognizes that mental health and wellness are critical factors influencing a student's academic success and overall wellbeing. Students are encouraged to engage in healthy self-care practices by utilizing the resources and services available through University Health Services. The TELUS Health Student Support app provides access to professional counseling in multiple languages anytime, anywhere by phone or chat, and the 988 Suicide & Crisis Lifeline offers 24-hour emergency support at 988 or 988lifeline.org.

Texas A&M College Station

Students needing a listening ear can contact University Health Services at 979.458.4584. Call 911 or visit your nearest emergency room if you are currently experiencing a life-threatening situation or if your safety is at risk. 24-hour emergency help is also available through the 988 Suicide & Crisis Lifeline (988) or at 988lifeline.org.

Statement on the Family Educational Rights and Privacy Act (FERPA)

FERPA is a federal law designed to protect the privacy of educational records by limiting access to these records, to establish the right of students to inspect and review their educational records, and to provide guidelines for the correction of inaccurate and misleading data through informal and formal hearings.

Currently enrolled students wishing to withhold any or all directory information items can do so within howdy.tamu.edu using the Directory Information Witholding Form. The complete FERPA Notice to Students and the student records policy is available on the Office of the Registrar webpage.

Items that can never be identified as public information are a student's social security number, citizenship, gender, grades, GPR, or class schedule. All efforts will be made in this class to protect your privacy and to ensure confidential treatment of information associated with or generated by your participation in the class.

Directory items include name, UIN, local address, permanent address, email address, local telephone number, permanent telephone number, dates of attendance, program of study (college, major, campus), classification, previous institutions attended, degrees, honors and awards received, participation in officially recognized activities and sports, medical residence location, and medical residence specialization.

Free Speech and Civil Discourse

Texas A&M recognizes that the pursuit of truth through open and robust discourse is critical to academic inquiry. However, as a community of scholars, the university has an aspirational expectation that such discourse will be conducted in accordance with Aggie Core Values. In this “marketplace of ideas,” we encourage civil dialogue creating an environment that allows individuals to express their ideas and to have their ideas challenged in respectful and responsible ways. Students can learn more about Freedom of Expression and Free Speech on the University's website about the First Amendment.