

CS419/519 Image and Flow Synthesis

Instructor: Eugene Zhang

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Prerequisite: Linear Algebra, Trigonometry, Computer Graphics CS450/550

Office Hours: TBA

Description:

Advanced course in computer graphics focusing on image and flow synthesis topics.

Topics include:

- Computer-generated paintings and drawings.
- Texture synthesis.
- Fluid simulation.
- Vector and tensor field analysis and visualization.
- Hair modeling.
- Image-based rendering and modeling.

Learning Objectives:

Through this course, I expect students to achieve the following:

- Implement advanced algorithms that generate paintings and drawings from an input image.
- Develop proficiency with working with vector and tensor fields in the plane and on surfaces. Takes include analysis, design, and visualization of such fields.
- Perform texture synthesis using either pixel- or patch-based methods.
- Articulate main theoretical results on the analytical and topological properties of a vector or tensor field.
- Fluid simulation in the plane by solving the Navier-Stokes equation for incompressible but viscous flows.
- Articulate the pipeline for hair modeling and animation.
- Articulate the main problems and applications in image-based rendering and modeling.

Textbooks (recommended, but not required):

- OpenGL Programming Guide, 2nd Edition [OpenGL Architecture Review Board]
- Computer Graphics: Principles and Practice, 2nd Edition [Foley, Van Dam, van Dam, Hughes]
- Topology-based Methods in Visualization, 1st Edition [Hauser, Hagen, Theisel]
- 3D Math Primer for Graphics & Game Development, 2nd Edition [Dunn]

Reading Materials:

A collection of recent papers in the field of computer graphics and scientific visualization.

Projects and Grading:

This course is primarily project based. Each student will complete 4 independent projects plus a term project to be discussed later. In addition, every student will give a presentation on a topic or paper. Term Project Ideas (some examples):

- Optimization-based texture synthesis.
- Flow visualization.
- Fluid and solid simulation.
- Rendering of fluid flow.
- Painterly rendering of animations.

Class attendance is mandatory. The final grade is made up in the following fashion:

Each project: 15% (x4)

Term project: 25%

Presentation: 10%

Class participation: 5%

Late Policy

Late assignments will be marked off 10% for each weekday that it is late.

Tentative Schedule

<i>Week</i>	<i>Topics</i>
1	Introduction to 3D graphics. Review of relevant math. <i>Assign#1 Out</i>
2	Image-based paintings. <i>Assign#1 Due</i> <i>Assign#2 Out</i>
3	Streamline tracing and pen-and-ink sketch. <i>Assign#2 Due</i> <i>Assign#3 Out</i>
4	Texture synthesis. <i>Assign#3 Due</i> <i>Assign#4 Out</i>
5	Vector field visualization and analysis.
6	Vector field design. <i>Assign#4 Due</i>
7	Fluid simulation.
8	Hair modeling.
9	Image-based rendering and modeling.
10	Miscellaneous topics.

Finals	<i>Term Project Due</i> No Exam Scheduled Demonstration & Grading of Term Projects
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Academic Dishonesty

Please do your own work. The default consequence for academic dishonesty is a failure for the course. It is okay to discuss with other students general ideas about implementing a program. It is not okay to copy another student's program. It is okay to discuss possible program bugs. It is not okay to debug another student's program.

Expectations

Students are expected to attend lectures, participate in the discussions, and work with their group members on group projects. You should come to class prepared and speak up when something is not clear. Being prepared means completing the assigned reading and assignments. Students are expected to be creative and have fun!

Students with documented disabilities who may need accommodations, who have any emergency medical information the instructor should be aware of, or who need special arrangements in the event of evacuation, should make an appointment with the instructor as early as possible, and no later than the first week of the term. Class materials will be made available in an accessible format upon request.