

CEG4500/CEG6500

Computer Graphics



Outline

1. Introduction
 2. Geometric primitives
 3. Attributes of geometric primitives
 4. Anti-aliasing techniques
 5. Homogeneous coordinate system
 6. 2-D and 3-D viewing transformations
 7. Structures and hierarchical modeling
 8. Input devices and interactive techniques
 9. Visible surface detection methods
 10. Three-Dimensional Object Representations (chapter 8)
 11. Visible-Surface Detection (chapter 9)
 12. Illumination Models and Surface-Rendering Methods (chapter 10)
 13. Interactive Input Methods and Graphics User Interfaces (chapter 11)
 14. Color Models and Color Applications (chapter 12)
 15. Advanced Rendering and Illumination Methods
-

Literature (books)

Hearn, Baker, **Computer Graphics with OpenGL**,
Prentice Hall, 2004

Woo, Neider, Davis, Shreiner, **OpenGL Programming
Guide**, Addison Wesley, 2000,
<http://fly.srk.fer.hr/~unreal/theredbook/>

Foley, van Dam, Feiner und Hughes, **Computer
Graphics: Principles and Practice**, Addison-Wesley,
1990

Alan Watt, Mark Watt, **Advanced Animation and
Rendering Techniques**, Addison Wesley, 1992

Farin, **Curves and Surfaces for Computer Aided
Geometric Design**, Academic Press, 1996

Applications for Computer Graphics

- Computer games
- Special effects in movies
- Animation
- Advertisements
- Visualization of scientific data

Computer Games

Project Gotham Racing 3

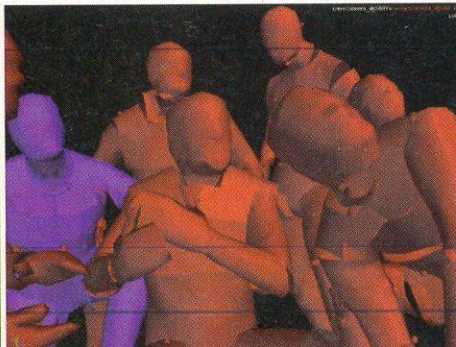
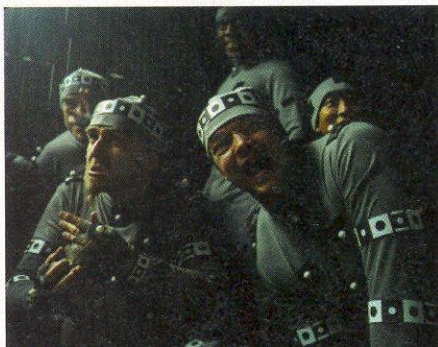


Special effects in movies

Pirates of the Caribbean – Dead man’s chest



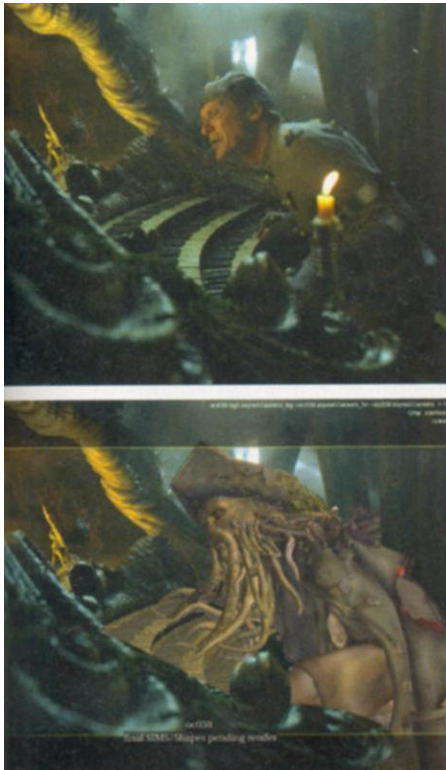
ILM captured data from actors in gray costumes during principal photography (at left below), applied the data to “manikins” (middle below), and then fitted the manikins to specified creatures (at right below) to create a final performance (at left)



Special effects in movies

Pirates of the Caribbean – Dead man’s chest

Davy Jones’s performance by Bill Nighy wearing a gray suit with tracking markers and bands at left, top, top, was captured using ILM’s proprietary Imocap system and then applied to the cursed creature at left, bottom. Keyframe animators and simulation artists performed the tentacles.



Special effects in movies

The DaVinci Code



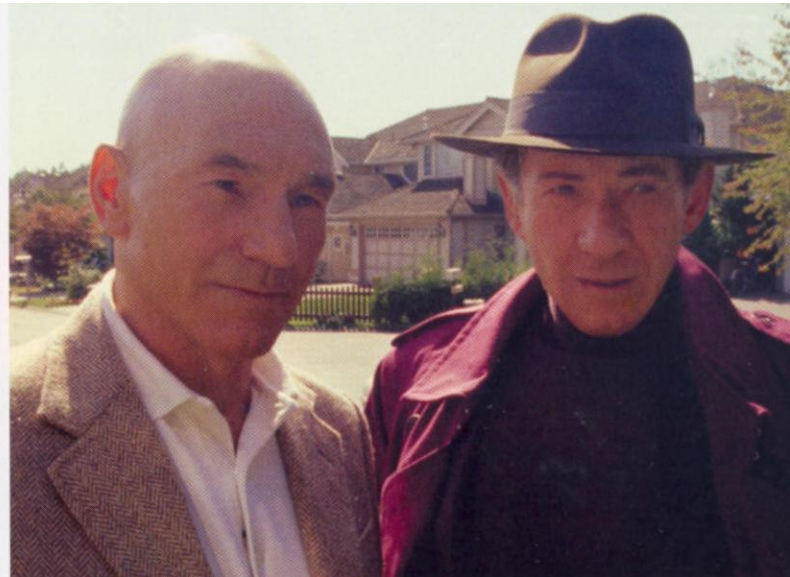
Computer graphics, photographic textures, and a physical set comprise this scene inside Saint-Sulpice. Left is the final shot that appeared in the movie. Bottom left is a photographic image taken inside the actual church, whose textures were used for the final shot. Bottom right shows the 3-D wireframe imagery used to augment the sparse set.



Special effects in movies

X-men 3 – The last stand

Artists applying the digital skin grafting techniques used to make Patrick Stewart and Ian McKellen look younger consulted with a plastic surgeon to avoid the men look androgynous.



Special effects in movies

Up

Carl tied a rope from Russell to a hose he's using to pull the floating house. Creating the final image at top required water simulation (far left), character animation with rigid-body simulation for Russell's pack and a sophisticated

rig for the tether (second from left), cloth simulation (second from right), and shading and lighting (far right).



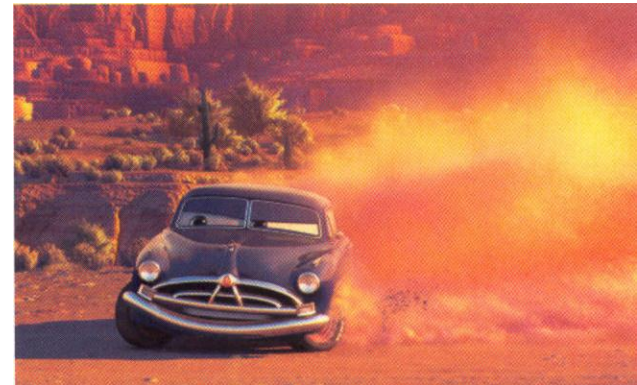
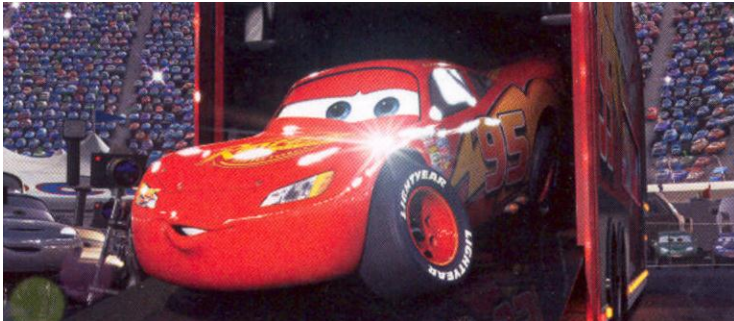
Example: Helm's Deep

<http://www.lordoftherings.net/effects/>

Animation

Cars

Pixar used custom crowd-simulation software to cue specific actions within the thousands of cars in the stadium, and Softimage XSI's behaviour software to control cars queuing up in line.

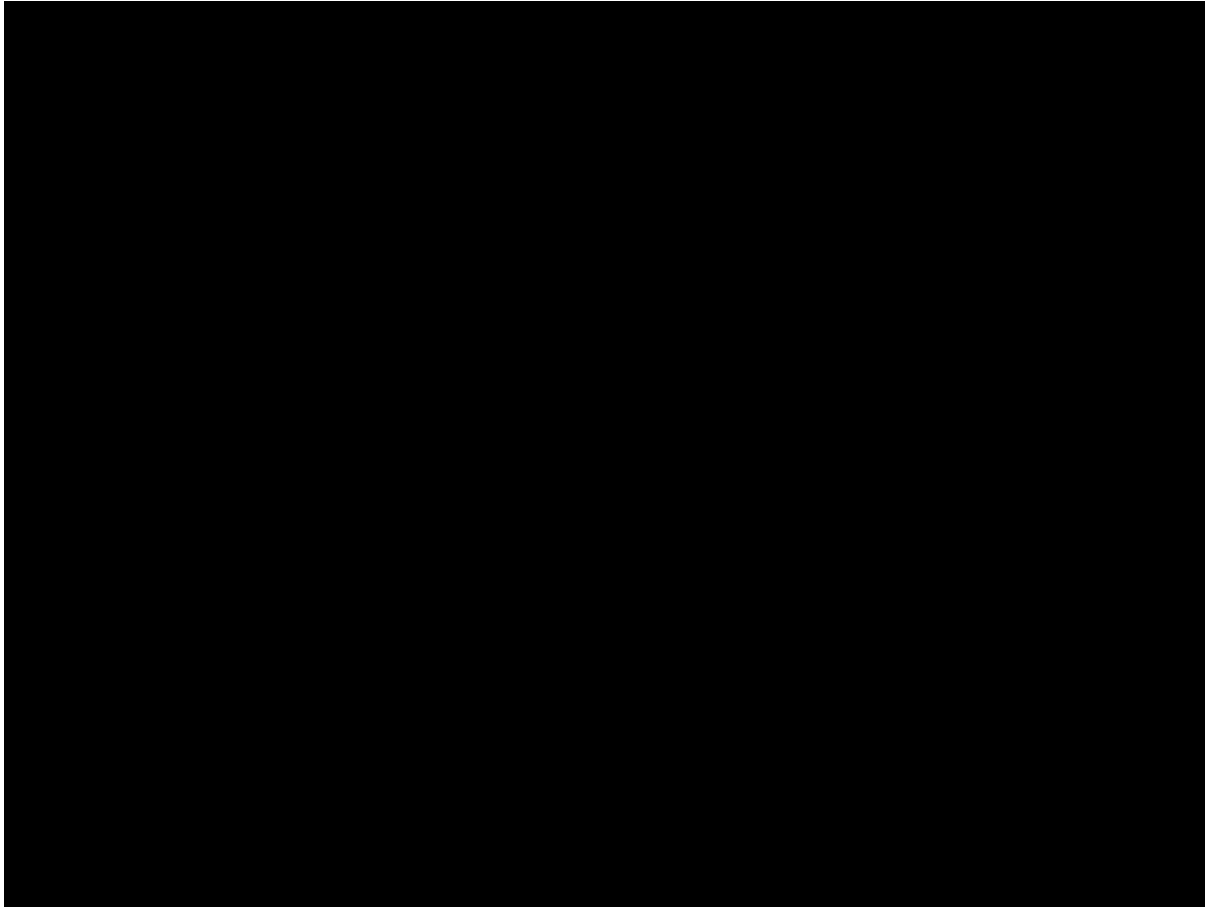


Thousands of tiny Maya particles rendered with PRMan point primitives kicked up dust behind the 1951 Hudson Hornet, Doc. Large particles rendered volumetrically formed distant, billowing dust clouds.

Example: Madagascar



Example: Happy Feet



Animation

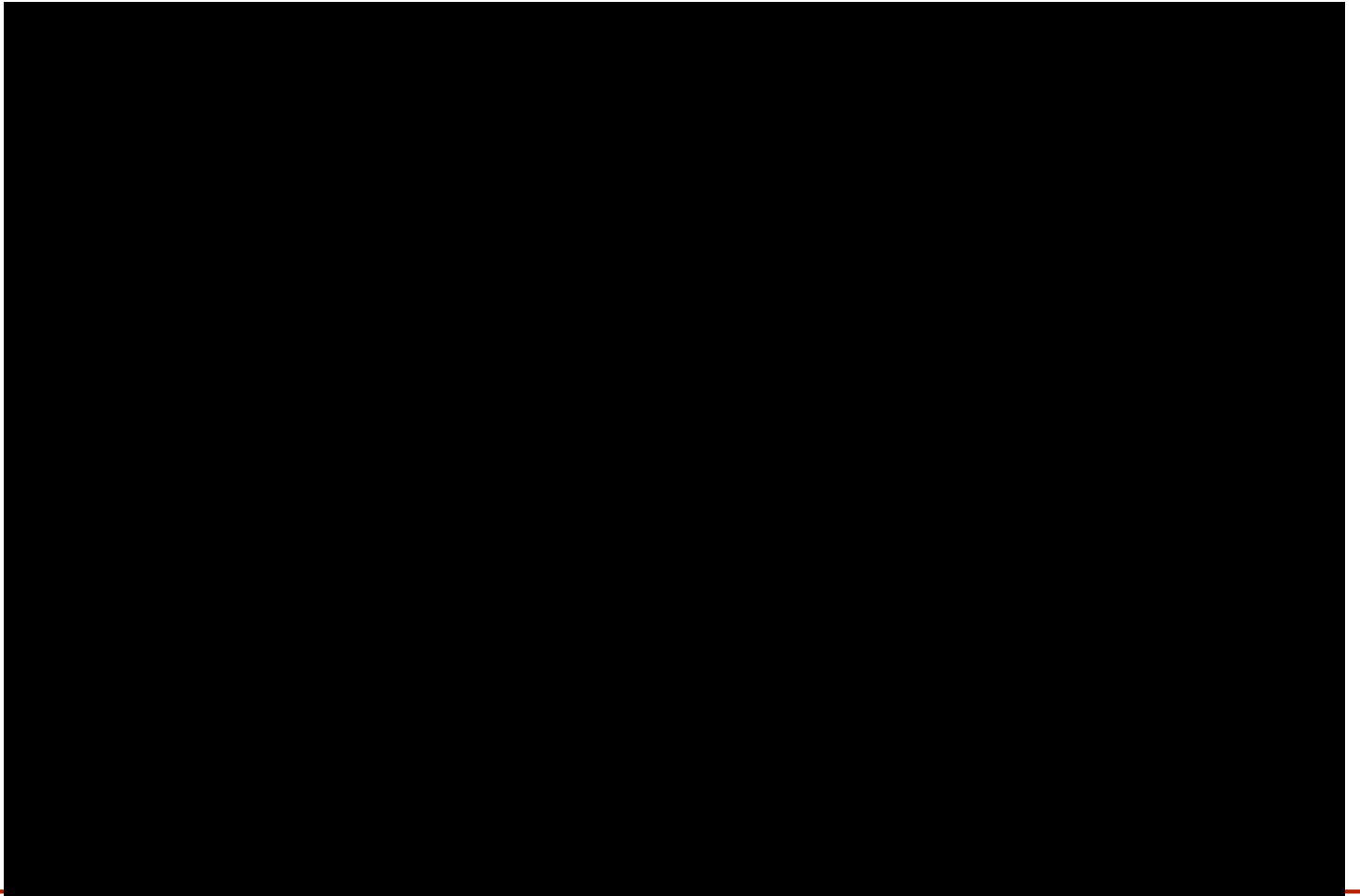
Happy Feet

Rendering water and waves was a challenge for a long time due to the complexity. Besides the geometry that is needed for creating a realistic looking wave, particle spray has to be added.



Animation

Incredibles



Animation

The Adventures of Tintin

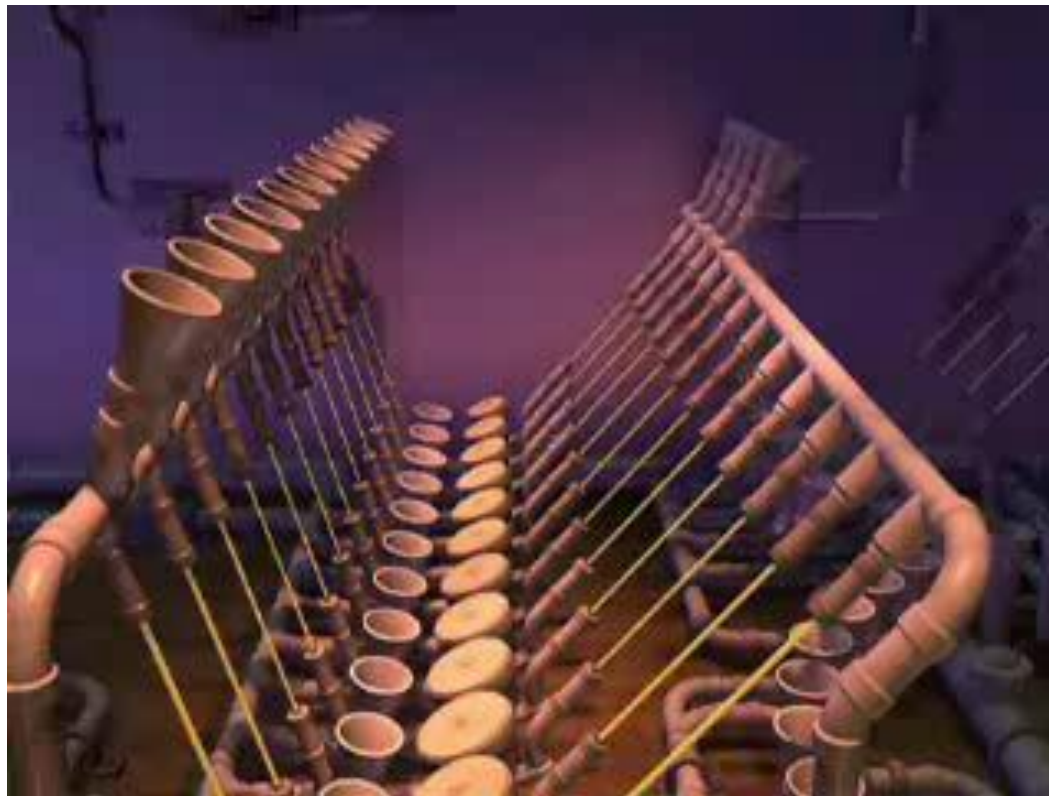
Example: Virtual Ancient Rome

<http://earth.google.com/rome/>

Animation

Fantastic Machine

ANIMUSIC (computer animated music)



Special effects

Bones

For this scene, the team from Look Effects filmed at an arboretum, where set dressers had added Styrofoam headstones, which were digitally multiplied, to simulate Arlington Cemetery. CG elements and greenscreened actors were also added later.



Special effects

Crossing Jordan

Stargate Digital utilizes its Virtual Blacklot to re-create a Boston backdrop, since it is far easier to generate a virtual version of the city than it is to film the actors there.



Special effects

These images are from Stargate Digital's Virtual Backlot Russia location, for a project the group completed last year. The first image is a greenscreen shot, with the digital set applied to the final (below).



Special effects

The scene depicted below was filmed at a power plant. Left shows the film plate, while right contains a 3D monorail composited at the top of the shot.

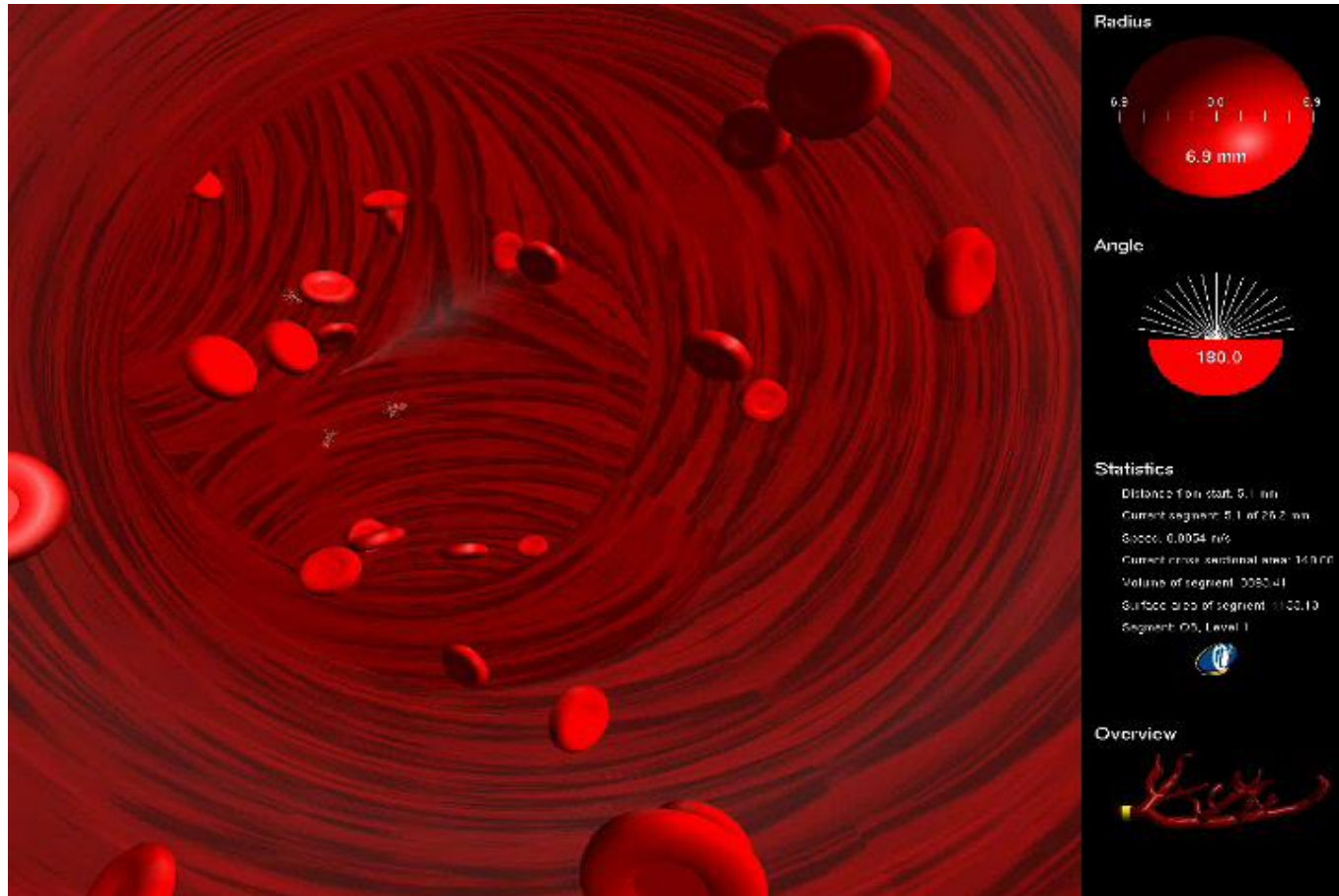


Advertisement

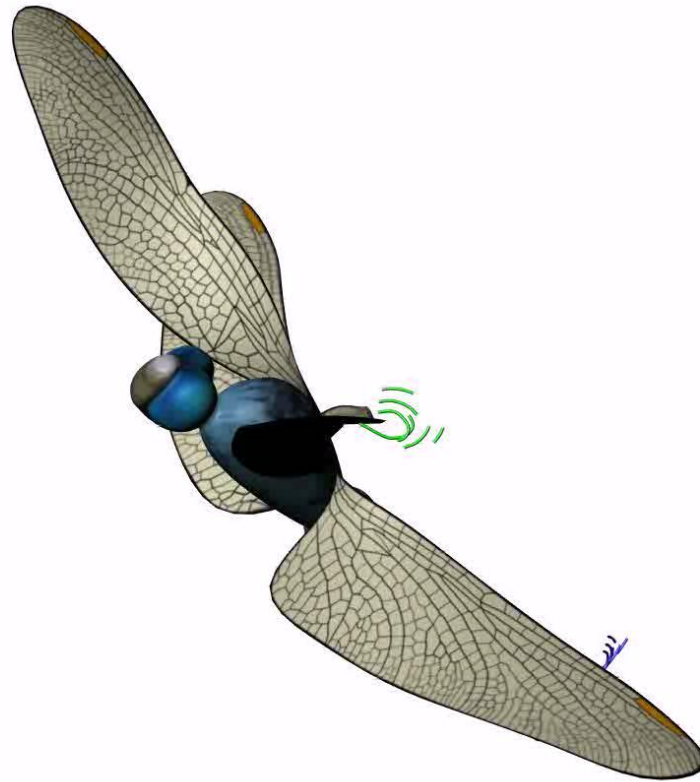
Works Zebra creates visualizations of Lexus car models so that customers can see the new cars in action – even before the vehicles roll off the production line.



Visualization of scientific data



Visualization of scientific data



CEG450/CEG6500 Computer Graphics

After the course, you should be familiar with the following techniques:

- Raster algorithms
- Geometric primitives and their attributes
- Clipping
- Anti-aliasing
- Geometric transformations
- Structures and hierarchical models
- Input devices
- Interactive techniques
- Proper lighting
- Advanced rendering methods

Disclaimer

The slides used for this class contains some images and materials from external sources listed here as further references:

- Computer Graphics World: www.cgw.com
- Some of the math review is based on Steve Rotenberg' Computer Animation slides: http://graphics.ucsd.edu/courses/cse169_w05/index.html
- The chapter 4 slides mostly based on the interactive introduction to OpenGL by Dave Shreiner, Ed Angle, and Vicki Shreiner
- The slides describing GLSL are mostly based on Xiaoyu Zhang's slides for his lecture CS 535 Introduction to Computer Graphics
- Some descriptions of the GLSL shaders follow the OpenGL Wiki https://www.opengl.org/wiki/Main_Page