PRESENTATION OF THE COURSE

Rodrigo Silveira

Curve and Surface Design
Facultat d'Informàtica de Barcelona
Universitat Politècnica de Catalunya

What is curve and surface design?

Essential to **computer graphics** and **computer-aided design and manufacturing (CAD/CAM)**

- Computer graphics: goal is to produce realistic-looking images

- CAD/CAM: software to design and manufacture products

What is curve and surface design?

Essential to **computer graphics** and **computer-aided design and manufacturing (CAD/CAM)**

- Computer graphics: goal is to produce realistic-looking images

- CAD/CAM: software to design and manufacture products

What is curve and surface design?

Essential to **computer graphics** and **computer-aided design and manufacturing (CAD/CAM)**

- Computer graphics: goal is to produce realistic-looking images

- CAD/CAM: software to design and manufacture products

CAD:
design each part
of the car

Graphics:
render each part of
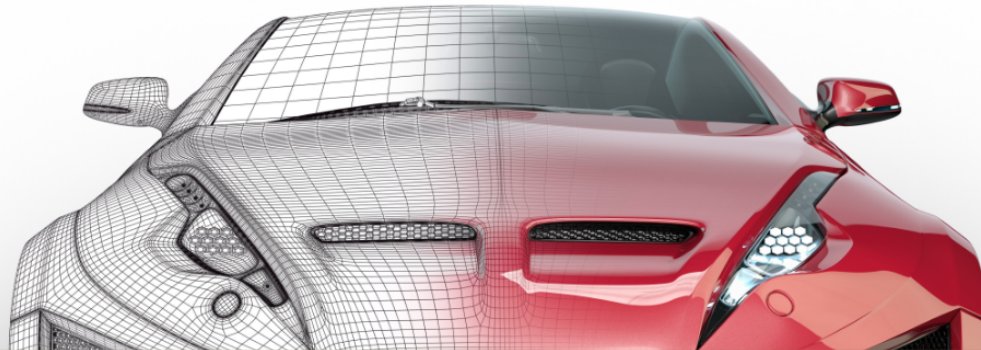the car as realistically
as possible

What is curve and surface design?

Essential to **computer graphics** and **computer-aided design and manufacturing (CAD/CAM)**

- Computer graphics: goal is to produce realistic-looking images

- CAD/CAM: software to design and manufacture products
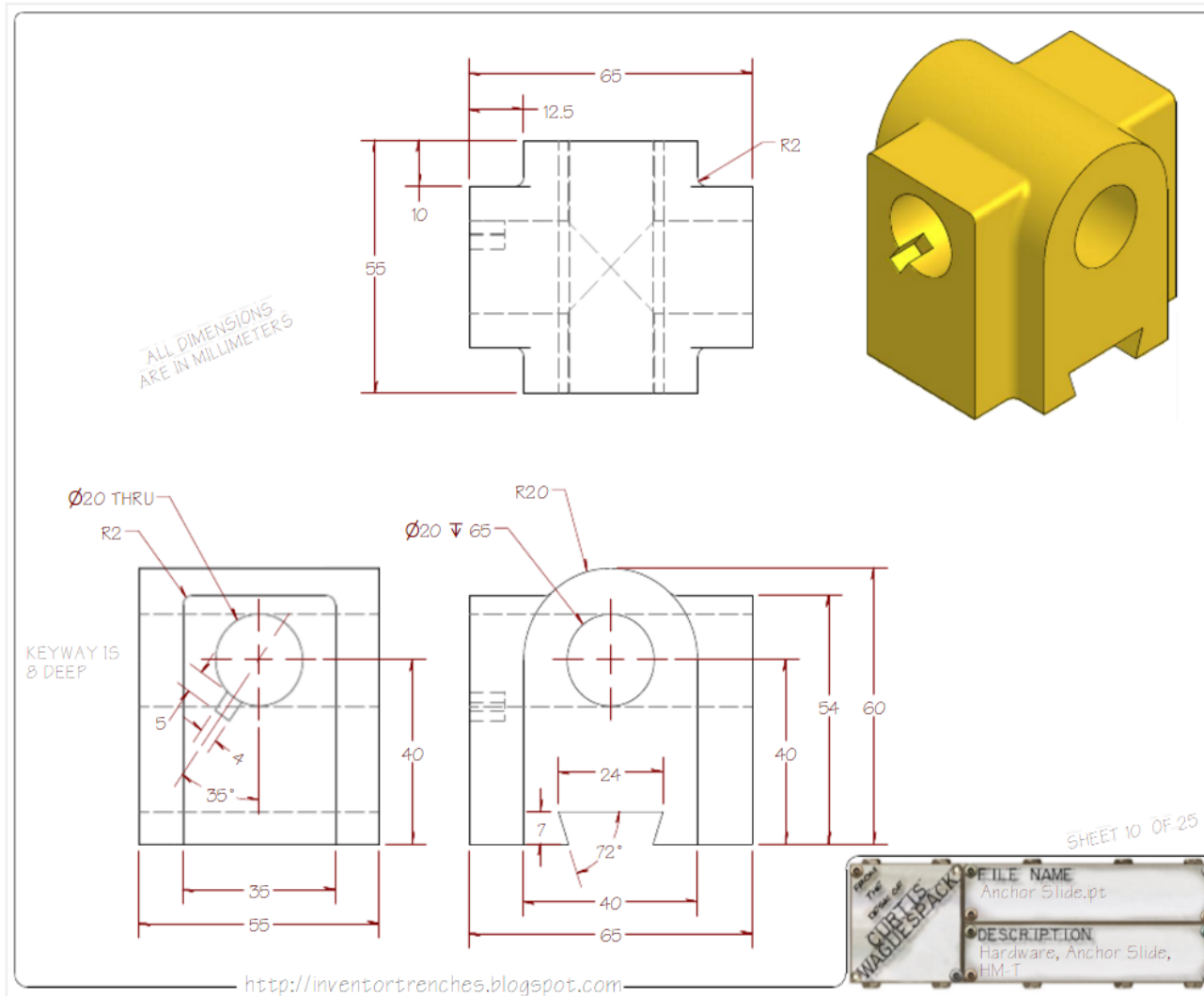
CAD:
design each part
of the car

Graphics:
render each part of
the car as realistically
as possible

Curve and surface design: design / represent / model
the curves and surfaces needed to model the car

Design of curves and surfaces

How to go from the idea to an actual 3D model?

Design of curves and surfaces

How to go from the idea to an actual 3D model?

Replace physical models (wood, clay, resin) by a *geometric model*: a precise mathematical description of the object.

Where are geometric models used?

- Computer-aided design (CAD)

- Computer-aided manufacturing (CAM)

- Robotics

- Computer vision (e.g., construct models from images)

- Artificial intelligence (e.g., recognize objects from sensors)

- Virtual reality

- Engineering analysis (e.g., using finite element methods)

- Kinematics analysis (e.g., check clearance between different parts)

History of curves and surfaces in Computer-Aided Geometric Design

The CAGD term was coined in 1974. But things started much earlier...

- AD Roman times: ship buildings (ship's ribs produced from reusable templates). Technique perfected over the centuries...

- 1950s: US aircraft companies: store a design in terms of numbers instead of manually traced curves (e.g., work of Coons and Liming)

- 1950s: numerical control (NC) arrives: early computers controlling milling machines

- 1960s: seminal work by de Casteljau (Citroën) and Bézier (Rénault) on "blueprint-to-computer challenge": how to represent mechanical parts in a computer. Also important progress in Ford, General Motors, and aircraft companies.

- 1970s: Rénault's UNISURF system: a pioneer CAD/CAM system by Bézier

- 1974: First conference on the subject, CAGD is born as a field

- 1979: First textbook on the topic: *Computational Geometry for Design and Manufacture*

- 1984: First scientific journal (*Computer Aided Geometric Design*)

For more on CAGD history, see http://www.farinhansford.com/gerald/papers/history.pdf

Course syllabus

1. Fundamentals of Euclidean vector & affine spaces
2. Parametrizing curves
3. Introduction to interpolation
4. Polynomial interpolation
5. Cubic Hermite interpolation
6. Spline interpolation
7. Bézier curves
8. B-Splines
9. Introduction to surface design
10. Bézier surfaces
11. NURBS surfaces

Methodology

Course language: English

Methodology

Course language: English

Two types of classes

- Theory lectures
- Lab classes: with lab assignments in **javascript**

Methodology

Course language: English

Two types of classes

- Theory lectures
- Lab classes: with lab assignments in **javascript**

Lab classes

Lab assignments are expected to be carried out in part during the lab class. All assignments must be shown to the instructor, and delivered to the Racó at the end of the lab class

Methodology

Course language: English

Two types of classes

- Theory lectures
- Lab classes: with lab assignments in **javascript**

Lab classes

Lab assignments are expected to be carried out in part during the lab class. All assignments must be shown to the instructor, and delivered to the Racó at the end of the lab class

Evaluation

- Five lab assignments that will be carried out during the lab sessions (50% of the final grade). Each lab has a different weight in the final grade.

- Final exam, covering theory and practice (50% of the final grade).

Methodology

Two types of classes

- Theory lectures (Mondays*)
- Lab classes: with lab assignments in **javascript** (Thursdays*)

Lab schedule (preliminary)

L1: to be presented on February, 27
L2: to be presented on March, 19
L3: to be presented on April, 16
L4: to be presented on May, 14
L5: to be presented on May, 28

(*) A few Thursdays there will be Theory lectures (Feb 13, March 26, April 23)

Methodology

Two types of classes

- Theory lectures (Mondays*)
- Lab classes: with lab assignments in **javascript** (Thursdays*)

Lab schedule (preliminary)

L1: to be presented on February, 27
L2: to be presented on March, 19
L3: to be presented on April, 16
L4: to be presented on May, 14
**L5:** to be presented on May, 28

Final exam

June, 11 — 10:00–13:30

(*) A few Thursdays there will be Theory lectures (Feb 13, March 26, April 23)

Main bibliographic references

- Farin, Gerald, *Curves and surfaces for computer aided geometric design: a practical guide*, Morgan Kaufmann, 5th edition, 2002, ISBN:1558607374.
  Available online via UPC library!

- Salomon, David, *Curves and Surfaces for Computer Graphics*, Springer, 2006, ISBN:0-387-24196-5.
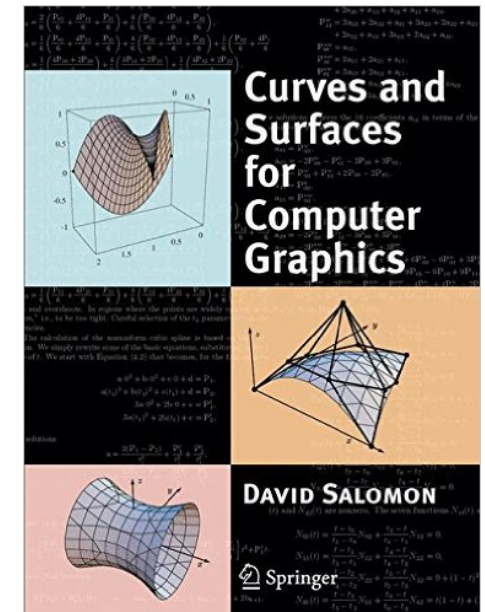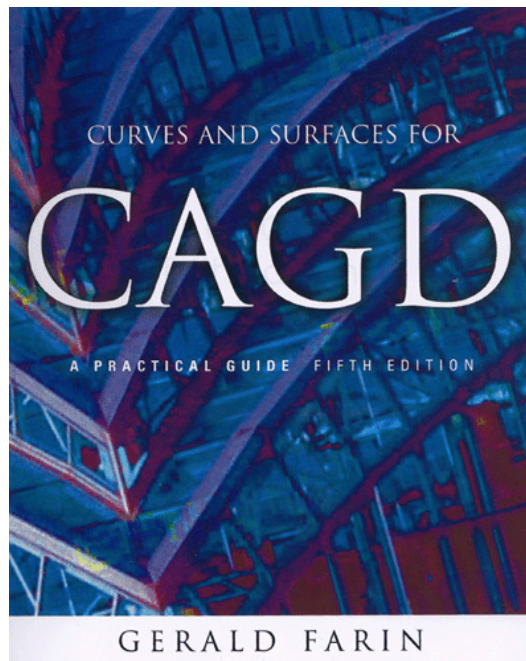
Contact

Office hours: You are welcome to drop by my office (please, announce your visit in advance!). You can also ask for advice through e-mail.

Rodrigo Silveira: Omega building, 4th floor, Office 422. rodrigo.silveira@upc.edu

Contact

Office hours: You are welcome to drop by my office (please, announce your visit in advance!). You can also ask for advice through e-mail.

Rodrigo Silveira: Omega building, 4th floor, Office 422. rodrigo.silveira@upc.edu

We hope that you enjoy the course!