Aalto University
School of Engineering

Helsinki Summer School 2013: Representation of Curves and Surfaces

Introduction to Computer Aided Geometric Modeling and Mathematics of Curves and Surfaces

Time and Location

- 6.8. get-together at the main building of University of Helsinki
- 7.–22.8. (weekdays), Aalto University, Otaniemi Campus, Espoo
  - Lectures: 10.15–12.00 @ Rakentajanaukio 4 A, Lecture Hall R3
  - Exercises: 13.15–15.00 @ Sähkömiehentie 3, Maari-A

Instructors

- Lectures: Antti H. Niemi, antti.h.niemi@aalto.fi
- Exercises: Mahmoud Mousavi, mahmoud.mousavi@aalto.fi

Class Format

Class will be taught with twelve two-hour lecture and exercise sessions. One of the sessions may be replaced by a visitor demonstration. The topics to be covered are as follows:

1. Transformations of the Plane (1 class)
2. Homogeneous Coordinates (1 class)
3. Curves (2 classes)
4. Bézier Curves (2 classes)
5. B-Splines (2 classes)
6. Non-uniform Rational B-Splines (NURBS) (1 class)
7. Surfaces (1 class)
8. Curvature (1 class)
9. Splines in numerical solution of differential equations (2 classes)

Homework assignments will be given on a daily basis. Assignments will include effective written and graphical communication and most of the assignments will have a computational component. Wolfram Mathematica will be used throughout the course but prior experience with Mathematica is not needed.

Mathematica is available on all the PC's in the computer classes of Aalto University, Otaniemi Campus. To use these machines you will need an account. The account information will be provided to the students at the beginning of the class.

Students who complete succesfully at least 75% of the course assignments will receive a passed grade.

Course Readings

An electronic copy of the lecture notes will be distributed to the students. The following books on computational geometry can be recommended for further reading:

- Duncan Marsh, Applied Geometry for Computer Graphics and CAD, Second Edition, Springer.
- Gerald Farin, Curves and Surfaces for CAGD, Fifth Edition, Academic Press
- Micahel E. Mortenson, Geometric Modeling, Third Edition, Industrial Press
- Les A. Piegl, The NURBS Book, Second Edition, Springer

Registration

Register for the course at the HSS website:

www.helsinkisummerschool.fi

Examples of Material Covered During the Course

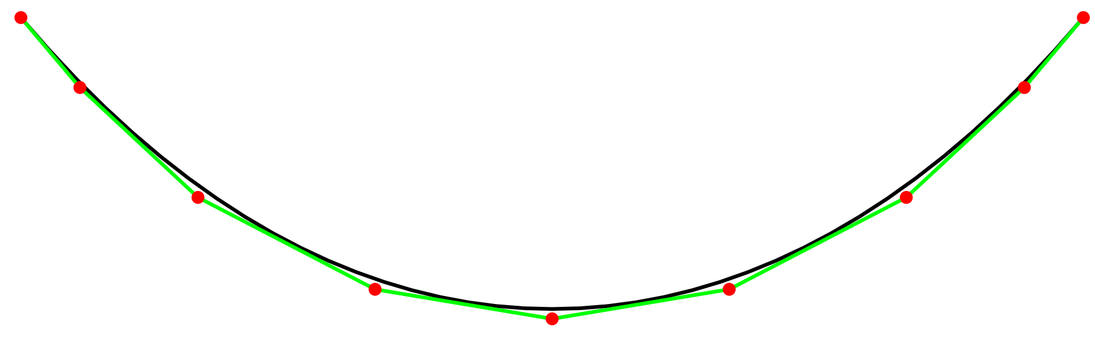

Figure 1: The catenary curve is an idealization of the shape of a hanging cable under its own weight when supported at its ends. A cubic B-spline approximation of the curve is obtained by using a collocation method for the numerical solution of the differential equation $y''(x) = \sqrt{1+(y'(x))^2}$.

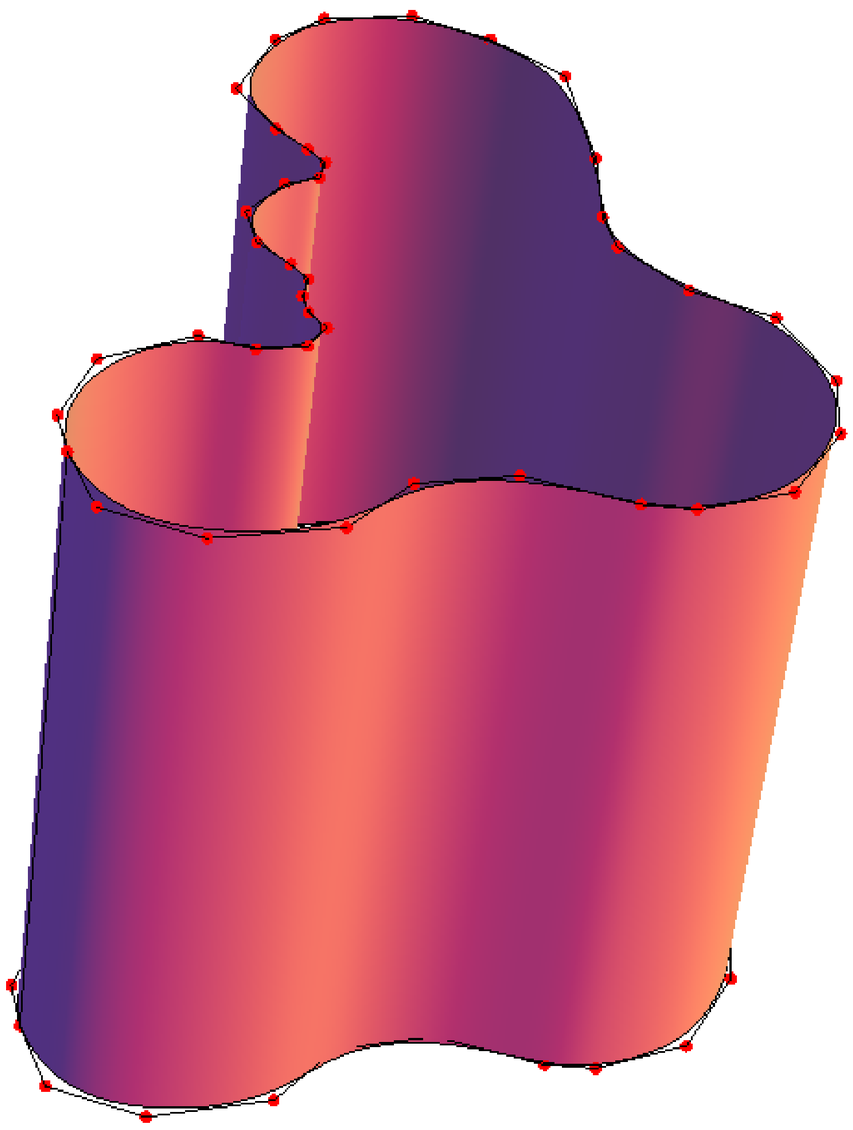

Figure 2: The Aalto-Savoy vase is an icon of Finnish design. The shape of the vase is presented here using an extruded NURBS surface.

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