From CAGD to virtual/augmented reality

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Timetable: 14–26 May 2012. The course will be held at the University of Bologna, Department of Mathematics-CIRAM, Bologna.

I week: Tuesday 15/05/2012 (11-13; 14-16); Thursday 17/05/2012 (11-13; 14-16)
CIRAM, via Saragozza 8, Bologna, piano terra AULA MUSEO
II week: Tuesday 22/05/2012 (11-13; 14-16); Thursday 24/05/2012 (11-13; 14-17)
CIRAM, via Saragozza 8, Bologna, piano primo AULA SEMINARI
Thursday 31/05/2012 Student seminars/Final Exam

Examination and grading: The final examination can be either an oral presentation about a specific subject based on a research paper, or the completion of a programming project which involves computer modeling using C programming language.

SSD: MAT/08 Numerical Analysis

Aim: The field of geometric modelling or Computer Aided Geometric Design (CAGD), which is mainly based on numerical analysis, analytic, projective and differential geometry as well as computer science, provides the necessary algorithms for the required curve and surface representations. CAGD also supplies the related discipline of Computer Graphics with many of its mathematical and geometrical foundations.

Recently there are the first approaches of combining geometric modelling applications with the emerging fields of Virtual and Augmented Reality. The discipline of Virtual Reality (VR) completely immerses users inside a synthetic environment whereas Augmented Reality (AR) allows the user to see three-dimensional virtual objects superimposed upon the real world.

The objective of this class is to introduce the mathematical foundations of the field of geometric modelling and computer aided geometric design as well as to give a general overview of the emerging fields of virtual and augmented reality.

Course contents:

1. Polynomial Bézier curves
2. Analytic versus geometric continuity
3. B-spline curves, Rational curves (projective geometry, properties, conic sections)
4. Bézier and B-Spline surfaces
5. Virtual and augmented reality: Introduction and applications,
6. 3D-Viewing, Haptics, VR and AR devices
7. Geometric Modelling in VR/AR

References:

1. D.A. Bowman, E. Kruijff, J.J. LaViola,Jr., I. Poupyrev, 3D User Interfaces, Theory and Practice, Addison-Wesley 2005.
2. G. Farin, Curves and Surfaces for Computer Aided Geometric Design: a practical guide, 5th edition, Morgan Kaufmann 2001.
3. G. J. Kim, Designing Virtual Reality Systems - The Structured Approach, Springer 2005.
4. K. M. Stanney (ed.), Handbook of Virtual Environments - Design, Implementation, and Applications, Lawrence Erlbaum Associates, Inc. 2002.