NAME 4141

Lothar Birk
University of New Orleans

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Curved Surface Design

Course description and learning outcome

This course covers the foundation of computer aided shape modeling and its application in today’s design of ship geometries. The content is mathematical (differential geometry) but also contains practical application of 3D modeling programs to marine design problems. In particular the course addresses the following topics:

- basics of parametric curves and surfaces
- Bézier, B-spline and NURBS curves and surfaces
- geometric properties of curves and surfaces
- curve and surface generation, analysis and fairing
- special topics like e.g. surface-surface intersection, trimming, and plate development.

The learning outcomes of this course enable you to

- understand principal elements of computer aided geometric design,
- compute and assess geometric properties of curves and surfaces,
- understand and apply curve and surface algorithms,
- select surface representations appropriate for a specific problem,
- design objects with curved surfaces,
- apply the methods learned to solve problems in naval architecture,
- improve your proficiency in 3D modeling, and
- enable you to continue studying computer aided ship design on your own.

Prerequisites

Prerequisites is the course Calculus III (MATH 2314, multi-variable calculus). If you have enrolled in this course without satisfying these constraints, please contact me and we will discuss your case.

Instructor

Instructor: Lothar Birk, Associate Professor of NAME  
E-mail: lbirk@uno.edu  
Office: 911 Engineering Building  
Phone: 280 6183  
Office hours: Tuesday 9:00am–11:00 am  
Tuesday 2:00pm–4:00 pm  
Wednesday 10:00am–noon

I’m open to meet with you outside office hours, preferably in small groups, to discuss any questions and open topics. Give me a call or send an e-mail to schedule an appointment.
Classes and attendance

Location: EN 320 and NAME computer lab EN 209
Class hours: Monday 6:30–7:45 pm
Wednesday 6:30–7:45 pm

Classes will be taught in an interactive manner. Therefore your attendance at every class session is important. Please initial the attendance sheet at the beginning of each class. If you are unable to attend class (illness, conflicts with other classes, etc) inform me by e-mail as soon as possible to avoid negative effects on your final grade (see Grading).

Since we use the NAME computer lab as a class room from time to time, distractions like e-mail, Facebook and YouTube are readily at hand. Please refrain from using them because it not only distracts you but your classmates and me as well.

I intend to make use of the UNO Moodle web-site http://uno.mrooms3.net for this course. Please make sure you have access and are familiar with the system. There will be a list with links to notes and pointers to additional reading and references for each class.

References

The primary reference for the course are my notes and the book by


The book offers a very concise and short description of the most important topics. To my knowledge it is the only book with special emphasis on naval architectural applications. In addition you should take notes in class and refer to the summaries and references provided for most of the classes. I expect that you review the material I post in a timely manner.

There are many textbooks on geometric modeling which extensively treat B-splines and NURBS curves and surfaces. Many web sites offer useful introductory articles (google for B-splines or NURBS).

David F. Rogers’ book An introduction to NURBS: with historical perspective provides a good mix of mathematical foundation and practical conclusions. Statements by renowned figures provide interesting insight into the development of the CAGD field. The NURBS Book by Piegl and Tiller is an excellent reference for algorithms related to B-splines and NURBS. As a textbook for the beginner or occasional CAGD user it may be too much. The book by Farin is a better introduction into the field but not as comprehensive as The NURBS Book. Before you buy any, take a look at them. Big book retailers usually have some in stock.


Homework

Homework assignments will be given out in class about every two to three weeks. A PDF copy will also placed in the assignments section of the NAME 4141 Moodle web site at http://uno.mrooms3.net. Due dates will be specified on the problem sheet (usually 2 weeks after they have been issued).

- Be on time with your homework. Late submission of homework will only be accepted if I get an explanation before the due date.
- It is up to you if you want to use a text processor for homework preparation. Neatly handwritten homework is fine.
- Your homework must clearly show how you derived the solution. Showing only the result is usually not sufficient.
- *Poorly structured and/or illegible homework will be returned for rework.*
- Turn in your homework with the problem sheet on top. Put your name on the problem sheet!
- In no case send me MS Word (*.doc) or similar files. If necessary, send files in PDF, PNG or Postscript format instead.
- Graduate students will have to complete an additional term project.

Some homework may require familiarity with a spreadsheet program (Excel, gnumeric, etc) and/or writing small programs in a programming language (Matlab, Fortran, C, Python, ...).

**Graduate Students**

Graduate students will be assigned two additional projects which will be counted towards their homework score. The projects encompass short written reports accompanied by electronic files with digital models and program code.

- Digital 3D model of a historically significant sailing ship: Involves researching history, digitizing the lines plan, creating, and fairing the digital model
- Curve fairing project. Develop a numerical tool to fair B-spline curves.

Details of the deliverables will be stated in the actual assignment. If you are interested in a specific project topic we can discuss it.

The graduate student projects serve the following additional learning outcomes

- Create 3D computer models of complex surfaces
- Implement curve and surface algorithms
Exams

There will be a mid-term exam (tentatively October 7, 75 minutes) and a final exam according to the University schedule (Monday, December 7, 2015, 5:30 pm–7:30 pm).

All exams will be open notes and books. However, amount and difficulty of problems will not allow a great deal of searching and re-reading. Get organized before the exams!

Grading

The final course grade will be based on the total number of points scored during the term. The contributions are weighted as follows:

- homework 35%
- mid-term exam 25%
- final exam 40%

Percentage of points $P$ is then given by

$$P = 0.35 \cdot \frac{\text{your homework points}}{\text{total homework points}} + 0.25 \cdot \frac{\text{your midterm exam points}}{\text{total midterm exams points}} + 0.40 \cdot \frac{\text{your final exam points}}{\text{total final exam points}}.$$ 

I will round up every figure to one significant decimal place (e.g. 90.712 will become 90.8). *In case your final grade is close to a respective boundary (see table below) I will down-grade it, if the attendance has been low (more than one unexcused absence).* Graduate project scores –where applicable– will be included in the homework score.

The percentage of the scored points will define your final grade:

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<thead>
<tr>
<th>Percentage $P$ [%]</th>
<th>Grade</th>
<th>Final grade</th>
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<tbody>
<tr>
<td>97.0 – 100</td>
<td>A+</td>
<td>A</td>
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<tr>
<td>94.0 – 96.9</td>
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<td>91.0 – 93.9</td>
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<td>87.0 – 90.9</td>
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<td>83.0 – 86.9</td>
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<td>79.0 – 82.9</td>
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<td>75.0 – 78.9</td>
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<td>67.0 – 70.9</td>
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<th>Grade</th>
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<tbody>
<tr>
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<td>D+</td>
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<td>57.0 – 61.9</td>
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<td>52.0 – 56.9</td>
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<td>below 51.9</td>
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Academic integrity

Academic integrity is fundamental to the process of learning and evaluating academic performance. Academic dishonesty will not be tolerated. Academic dishonesty includes, but is not limited to, the following: cheating, plagiarism, tampering with academic records and examinations, falsifying identity, and being an accessory to acts of academic dishonesty. Refer to the UNO Judicial Code for further information. The new policy on Academic Dishonesty and other policies are available online at: [http://www.studentaffairs.uno.edu/policies.cfm](http://www.studentaffairs.uno.edu/policies.cfm)
Accommodations for students with disabilities

Students who qualify for services will receive the academic modifications for which they are legally entitled. It is the responsibility of the student to register with the Office of Disability Services each semester and follow their procedures for obtaining assistance. See also http://www.studentaffairs.uno.edu/policies.cfm.

Cell phones

Cell phones –as always– are switched off during class. If your cell phone rings nonetheless you will donate 5 US$ to the SNAME student section of UNO. (Instructor donates 20 US$ if his cell phone rings in class).