Computer Graphics and Related Subjects at the FIIT STU and FI BVŠP

Martin Šperka[*]
FI BVŠP and FIIT STU

Peter Drahoš[†]
FIIT STU

Alena Kovárová[‡]
FIIT STU

Abstract

The paper describes Computer Graphics and related subjects education at the Faculty of Informatics and Infromation Technology, Slovak University of Technology in Bratislava and at the Faculty of Informatics, Bratislava School of Law.

CR Categories:

Keywords: computer graphics education

1 Introduction

Faculty of Informatics and Information Technology (FIIT) at Slovak University of Technology (SUT) in Bratislava has accreditation in two bachelor degree study programs: Informatics and Computer Systems and Networks. There are three master degree study programs: Software Engineering, Information Systems, Computer Systems and Networks. For doctoral study another three programs are offered: Applied Informatics, Computer Systems and Networks, Programming Systems and Artificial Intelligence.

At the bachelor level, there is one compulsory subject partially related to the Computer Graphics: Human – Computer Interaction (approximately 15% CG topics). At master degree level there is optional subject Computer Graphics and CG related subject Computer Multimedia Systems (approximately 20% CG topics).

At the doctoral study level we now have four students working on CG related issues. These are realistic real time facial animation and rendering with GPU, information visualization – particularly software visualization, virtual reality application at e-learning and finally computational typography.

Bratislava School of Law is 5 years old private university level school with four faculties – Law, Economy and Enterpreneurship, Mass Media and Informatics. Faculty of Informatics was accredited in July 2008 and is the first private faculty of Informatics in Slovakia. The main objective of the school is to provide exclusive education supported by the selection of full time and part time teachers not only from Slovakia but also Czech republic, Austria, Russia and other countries, excellent infrastructure and synergy of specialization – law, media, economy and informatics. Computer Graphics and related subjects are parts of the curriculum.

[*]e-mail: martin.sperka@uninova.sk, martin.sperka@fiit.stuba.sk
[†]e-mail: peter.drahos@fiit.stuba.sk
[‡]e-mail: alena.kovarova@fiit.stuba.sk

2 CG at FIIT STU

2.1 HCI Syllabus outlines

Motivation, definition and history of HCI - comparing human and computer abilities – sensors, memory, cognitive abilities, models and styles of interaction.

Usability - motivation, principles supporting usability, usability engineering, usability rules and standards, usability evaluation, GUI implementation support - methods, standards, tools.

Introduction to graphics systems, introduction to OpenGL API, Vector Graphics APIs and IDEs for WIMPS, interaction programming in mark-up and script languages.

Methods and principles of UI design - design process, UI design life cycle, prototyping UI design, user models, task analysis, dialogue design and notations, models of system, design evaluation, interactive user support, typography and graphic design.

UI for people with special needs

Trends in HCI – multimedia communication, sound and voice in HCI, character and hand writing recognition, gesture recognition, haptic I/O, computer vision in HCI, virtual and augmented reality, modern methods of information visualization, ubiquitous computing, wearable computers.

Recommended sources are [Dix 1998], [Preece1998], [Shneidermann 2005.], [Mc Cracken 2004]. Most of these books are too expensive for Slovak students so electronic materials [Sperka 2005] in Slovak language are provided.

2.2 Computer Graphics Syllabus Outlines

This subject takes 12 weeks, two hours lectures and two hours of practical courses weekly. The goal of the course is to give an overview of basic facts, terminology, algorithms and methods of digital image creation and processing and acquire skills of programming simple applications using OpenGL API. Prerequisites are basic knowledge of analytic geometry, calculus, algorithms, data structures and programming in C, C++ or Java.

Content of the subject:

Introduction - motivations, definitions and applications of computer graphics, brief history of graphical input/output devices and systems.

Tools for computer graphics - introduction into standards and APIs for computer graphics and geometry modeling, basics of OpenGL and GLUT programming for practical courses.

Vector digital image representations and methods - vector image fundamentals, 2D and 3D coordinate systems and transformations, line and circle equations, chain code, window to viewport mapping, line and polygon clipping.

Raster digital image representation methods - bitmap, color models, LUT, video processor, BitBlt operations, quad tree, RLE image compression, line and circle interpolation, area filling, sampling and anti-aliasing principles,

3D scene modeling - geometry and topology relations, boundary, constructive solid geometry, volumetric and functional 3D objects representation, explicit, implicit and parametric curves and surfaces.

Basic 3D scenes rendering - viewing transformations, parallel, perspective, planar and non-linear projections, 3D clipping lines and triangles, fundamentals of hidden points, lines and faces elimination – back face culling, painters and depth buffer algorithms.

Visual realism - lighting models, shading, texture, bump, reflection mapping, ray casting and ray tracing, global illumination models.

Computer animation, virtual and augmented reality - 2D, 3D animation and interactive visualization, objects positions and orientation computing, articulated objects - direct and inverse kinematics overview, natural objects, elastic bodies, human face modeling.

Data visualization - fundamental methods of visualization scientific data – diagrams, density functions, vector and high fields, streamlines, boundary and volumetric data, information visualization.

Image processing and computer vision - image pre-processing – histogram, contrast, threshold, convolution edge detection and blur filters, image segmentation, some methods of image recognition, 3D models reconstruction, applications in augmented reality.

It is possible to achieve 100 points in the subject; these points are mapped to marks A, B, C, D, E or FX. Usually maximally 50 points from practical courses and semester projects and maximum 50 points from tests and exams. There is no textbook in Slovak on the market and the recommended information source is [Hill 2007] and Internet sources, including Wikipedia. However the last link is generally not recommended but most of the topics are well covered and explained.

2.3 Computer Multimedia systems Syllabus Outlines

Introduction to subject - definition of media, multimedia

Text and multimedia - structured and mark-up text, hypertext – history, standards, systems. Fundamentals of typography.

Image creation, capturing and processing - methods, standards, tools. Graphic design fundamentals. Digital photography principles, tools.

Animation - principles, methods and systems for computer animation.

Interactive 3D models and 2D image panoramas - virtual and augmented reality principles, Web3D.

Signal sampling, coding and compression - transformation methods. JPEG compression. Image and video codecs and formats- overview. JPEG, MPEG 1,2,4 and MP3 principles.

Sound and music in multimedia - principles of sound representation and compression, sound formats and MP3 principles. Music and voice synthesis coding, MIDI description.

Video in multimedia - principles of video representation and compression, MPEG1 a MPEG 2. Camcorders, video shooting and editing. MPEG 4 and MPEG 7 overview.

Multimedia authoring - linear and non-linear scripts, formal models, overview of MM Director, Authorware a Flesh.

Videoconference - standards and existing systems.

This subject takes 12 weeks, two hours of lectures and two hours of practical courses per week. Students have individual semester projects. Among recommended information sources are for example [Sperka 2007] and [Gibson 1998] and Internet sites. We use also some PowerPoint and HTML presentations done by students in past as semester projects from this subject.

3 Computer Graphics at FI BVŠP

3.1 About BVŠP

Bratislava School of Law [BVSP 2009] is 5 years old private university level school with four faculties – Law, Economy and Enterpreneurship, Mass Media and Informatics. Faculty of Informatics was accredited in July 2008, the academic year started in October 2008 and is the first private faculty of Informatics in Slovakia. The main objective of the school is to provide exclusive education supported by the selection of full time and part time teachers not only from Slovakia but also from Czech republic, Austria, Russia and other countries, excellent infrastructure and synergy of specialization – law, media, economy and informatics. Computer Graphics and related subjects are parts of the curriculum.

3.2 Subjects at FI BVŠP

Faculty of Informatics has accredited bachelor level study program in Applied Informatics in daily and external forms of education. There are obligatory subjects Mathematics, Introduction to programming, English, Introduction to Informatics, Introduction to Process Control, Introduction to Scientific Work, Ethics, Discrete Mathematics, Programming Techniques, Computer Architecture, Object Oriented Programming with Java, Computer Networks, operating Systems, Information Security, Economics, Introduction to Databases, Introduction to Computer – Human Interaction, Modeling and Simulation, Management, Web design and Technologies. In the last three semesters there are majority of optional subjects

Students can select from two main groups of subjects - Business Informatics or media oriented subjects. Media oriented obligatory subjects are Introduction to Computer – Human Interaction, Web Design and Technology. Optional subjects are Introduction to Computer Graphics, Introduction to Multimedia, Image processing, Introduction to Image Recognition.

Other optional subjects – provided by the Faculty of Mass media are Methods of Media design – Photography and Methods of Media design – Video. In this faculty a new study program Media Design is planned. There will be more subjects dealing with CG applications: Graphics Design, Image processing, Computer Drawing, Video Editing, Computer Animation.

The school is active in forensic and criminology research. Here the applications like – Computer Vision, Data and Information Visualization and Virtual reality are foreseen.

4 Conclusion

Computer Graphics is optional subject at FIIT SUT, one optional and one compulsory subject cover CG partially. Before the introduction of three level study (3 years bachelor, 2 years master and doctoral) we had two CG courses. Compulsory Computer Graphics 1 covered approximately same area as today CG subject. Optional Computer Graphics 2 subject included topics like advanced geometry modeling, positioning and orientation of object in 3D, direct and inverse kinematics, advanced rendering and scientific visualization.

With the introduction of three level study HCI subject was introduced and basic CG module became optional. Another change was in reducing number of hours of Mathematics. This effect merged with the decreasing level of mathematical skills from elementary and secondary schools in Slovakia (see P.I.S.A results [OECD 2008]). This fact causes that the knowledge of CG (where Mathematics knowledge plays important role) in master degree level is lower than in bachelor level, couple years ago. This fact is alarming not only at the CG subject but in general – pupils prefer social and humanity subjects to mathematics and physics, which were traditionally good in Slovakia. Computer Graphics can visualize the non-visible and teaching Mathematics, Physics and other natural and technical sciences with the aid of CG could be a good way how to increase interest in these subjects. To introduce this idea is difficult but this is a big challenge for CG community.

The goal of the Faculty of Informatics is to provide Applied Informatics study program with applications of other areas studied at the Bratislava School of Law and provide informatics oriented subjects for students from other faculties. Computer Graphics related subjects are part of the curricula as well as CG tools are planned to be used for research in application areas provided by other faculties.

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