Universities of Minho, Aveiro and Porto

Doctoral Program in Informatics

"Computer Graphics"

(Proposal for a Course)

May, 2012

Conteúdo

A. Program

1. *Purpose and Justification*

This document proposes and describes a Unit Course on technologies, for the MAP-I Doctoral Program. This Unit Course is entitled “Computer Graphics” and will address three major and inter-related areas within the field, namely, modeling, rendering and visualization.

Currently, Computer Graphics is ubiquitous in everyday life and constitutes a major field of research in both industry and academia. Applications of Computer Graphics (CG) range from machine interfaces, electronic games, edutainment, digital photography and video to CAD systems, computer vision based control of processes, urban planning, cultural heritage research and scientific visualization, to cite only a few. In fact, CG applications seem to be limited by imagination only, therefore yet more developments and innovative applications are to be expected in the near future. All these applications create a huge market and, consequently, a constant need of experts in CG. Hence, it is fundamental to ensure that University Graduation Courses in general, and Doctoral Programs in particular, address this theme, either as a self-contained area or connected to other areas of knowledge.

This course will give students some knowledge in the three main areas of Computer Graphics. As a consequence, it is expected that they will be able to design and develop new approaches and systems to solve problems related to CG. And will, hopefully, contribute to foster this field development in Portugal, where the CG industry is growing slowly, but steadily.

The proposed course is aimed at methodologies and techniques related to modeling, rendering and scientific visualization. The theoretical foundations that support these fields will be introduced, followed by state-of-the-art approaches to solve practical problems. Emphasis will be put on discussing current and possible applications. In fact, it is a major goal to stimulate students to explore new application spaces and alternative approaches to CG-related problem solving techniques.

Examples of courses similar to this one can be found in several universities, such as:

- Carnegie-Mellon University:
    - course 15-642: Computer Graphics
    - course 15-864: Advanced Computer Graphics

  which together cover fundamental and advanced topics on modeling, rendering and computer animation.

- Princeton University:
    - cs 426: Computer Graphics
    - cs 526: Advanced Computer Graphics

which, besides modeling, rendering and animation, also include some topics on image processing.

The main difference with respect to the above cited courses is the explicit inclusion of scientific visualization as a topic. This is justified by the continuous improvements that data visualization has experienced over the last few years and by a growing need for effective visualization techniques and experts, due to the ever increasing volume of data being generated by scientific, engineering and industrial simulations.

2. Goals

This course main goals are to give students a thorough understanding of Computer Graphics theoretical foundations/techniques and to empower them with the ability to imagine new application areas and design the respective logical support.

These goals are achieved by presenting current state of the art on three main areas (modeling, rendering and visualization) and by stimulating discussion of both alternative approaches and new applications. These discussions will be encouraged during lectures and during the students' public presentations of their respective monographs, whose themes will mostly address new and emerging application areas.

Modeling will allow students to understand the principles underlying representation, storage and manipulation of curves, surfaces, solids and volumes, through static or time-varying models, using appropriate mathematical formulations and computational data structures. Such models are essential for defining a 3D scene to be rendered through a scene-graph (Computer Graphics) or for representing medical or physical voxel data to be interactively analyzed by expert users (Data Visualization) in a collaborative environment.

The rendering component main goal is to introduce different lighting models, algorithms and technologies. Two different approaches to rendering will be explored: the rasterization model and the physically based approach. Students will be able to select the most appropriate combination of both hardware and rendering technique, given the requisites of the intended application (both functional and performance).

Advances in computer science and technology have produced unprecedented improvements in scientific, biomedical, and engineering research, as well as industrial innovation. Continuing these advancements will require the comprehension of vast amounts of data and information being produced from a multitude of sources. Visualization, helping people explore or explain data through software systems that provide a visual representation, will be critical in achieving this goal. Although well-designed visualizations have the power to help people enormously, naive attempts to create visualizations often result in poorly designed visualizations that are ineffective or misleading. Designing effective visualizations is a complex process that requires understanding of human information processing capabilities and a solid foundation in the considerable body of work of the visualization field. This module intends to introduce the main issues, application areas, and challenges of this scientific discipline.

3. Learning Outcomes

Upon successful conclusion of this unit course students will be able to:

- identify, for a certain problem, the more adequate modeling techniques;
- relate rendering algorithms with the general model supported by the rendering equation, identifying the functional and performance limitations of each algorithm;
- design, implement and evaluate rendering systems, given the available resources and functional/performance requirements;
- describe the main techniques, algorithms and architectures associated to data visualization and to select them according to certain application requirements.

4. Detailed Program

1. **3D Modeling**
    a. Overview of Generic 3D Representations
        i. Polygonal, and Tetrahedral meshes
        ii. Voxel-based representations
        iii. Explicit (functional) representations
    b. Current representation techniques
        i. Multi-resolution and view-dependent meshes
        ii. Constructive Volume Geometry for volume data sets
    c. Procedural Modeling
        i. Definition
        ii. Procedural modeling of virtual environments
        iii. Procedural modeling techniques
2. **Rendering**
    a. Visibility, Textures, Local Illumination
    b. Rendering Pipeline and Graphics Hardware
        i. Acceleration Techniques for the Rendering Pipeline
        ii. Modern use of GPU - Graphics Processor Units
            1. The architecture of the GPU
            2. GPU Programming
            3. Geometry, vertex and fragment shaders
            4. GPU capacities and limitations
    c. Physically Based Rendering (PBR)
        i. The BRDF and the Rendering Equation (RE)
        ii. Numerical Solutions for the RE
            1. Monte Carlo Ray Tracing
            2. Radiosity
        iii. Interactive PB renderers: CPU, GPU and hybrid approaches

3. **Data Visualization**
    a. Definition and goals
    b. Overview of main applications;
    c. Data characteristics;
    d. Taxonomy of techniques;
    e. Algorithms
    f. S/W for Visualization;
    g. Case studies;
    h. Open issues and challenges.
4. **Applications**
    a. 3D Animation
    b. Cultural Heritage
    c. Electronic Games
    d. Medicine
    e. Interactive Systems

5. Teaching Methodology

The course will include theoretic classes that will be taught by professors from the three universities involved, and will be complemented by tutorial meetings between students and professors/researchers, mainly for the advisory related to practical works. The material used by the professors to lecture and support the theoretical classes (slides, videos, notes, etc.) will be made available to the students on the course site.

Practical assignments will be defined at the end of each module and may require either development of simple applications, or writing a report about a given theme with associated bibliographic research. These manuscripts, with a format close to scientific papers, will also serve for their assessment. These can be defined as state-of-the-art reports, position papers, or discussion of publications. It is expected that students make a serious research in this context, using the internationally accepted scientific data bases. Dedicated workshops can also be organized for presentation, in forum environment, of the work done by the students.

Seminal and fundamental papers will be suggested to students as important reading material and some of them will be presented in class, during theoretical presentations, and discussed in tutorial orientation meetings.

The whole course will be supported by video-conference technologies that have already been used in the past by this same team of professors.

Application areas will be presented and discussed. Besides constituting examples of theory usage and allowing the sedimentation of the acquired knowledge as a whole, this is intended as an opportunity for students to exercise their critical abilities and imagine/propose new application spaces.

6. Assessment

Student assessment will be achieved in two main components: one project assignment and one monograph writing, each one with a weight of 50%.

Depending on the topic, the project can be in the form of a software development that aggregates various theoretical components visited or a text that performs critical analysis to a chosen technique, algorithm, application area, etc.

The monograph takes the form of a survey and will be oriented for a deeper discussion of several solutions of the elected problem.

Students that fail to perform on any of the above assignment/tasks shall not be considered for final assessment.

7. Bibliographic References

Hansen, C., C. Jonhson (ed.), The Visualization Handbook, Elsevier, 2005

Schroeder, W., K. Martin, B. Lorensen, The Visulization Toolkit- An Object Oriented Approach to 3D Graphics, 2nd ed., Prentice Hall, 1998

Card, S., J. Mackinlay, B. Schneiderman (ed.), Readings in Information Visualization- Using Vision to Think, Morgan Kaufmann, 1999

Spence, R., Information Visualization, Addison Wesley, 2001

Pharr, Matt, Humphreys, G. "Physically Based Rendering: from Theory to Implementation". Morgan Kaufmann, 2004

Dutré, P., P. Bekaert, and K. Bala. "Advanced Global Illumination". Natick, Massachusetts: A. K. Peters. 2003

B. Team

1. Team presentation

The team will be composed by the following professors belonging to the three participant universities (CVs following):

1. António F. Coelho (AFC, UP)
2. António Ramires Fernandes (ARF, UM)
3. Beatriz Sousa Santos (BSS,UA)
4. Rui Rodrigues (RR,UP)

Additionally, the team will be supported by the 3 professors below, which have participated in previous editions of this course and will support the present one by proposing assignments and monographs, participating in public presentations and giving lectures on specific topics.

1. A. Augusto de Sousa (AAS, UP)
2. Joaquim Silvestre Madeira (JSM, UA)
3. Luís Paulo Santos (LPS, UM)

All the team members have a PhD and have a large experience in teaching and research in Computer Graphics related themes. The relationship between their expertise and course specific areas is described below.

Modeling is the area of expertise of BSS and JSM. AFC and RR have a deep knowledge in Procedural Modeling that complements the topic. BSS and JSM have several publications on polygonal meshes simplification and comparison; AFC published a few papers on using L-systems to expeditiously prototype urban environments.

ARF has produced important work in the area of graphics processing units and their programming to obtain fast special rendering effects and to explore parallelization between them and the CPU. AAS and LPS complement this knowledge with advanced rendering, namely high fidelity physically based approaches, including parallel and interactive systems.

RR main research interests include Computer Graphics, GPU Programming and Natural User Interfaces, and specifically in their usage in interactive systems for visualization, edutainment and entertainment. In particular, he was worked with the industry of interactive systems, thus combining theoretical knowledge of the area with an additional perspective in terms of applications.

Finally, BSS and JSM have done much research work on Data and Scientific Visualization, in particular Medical Data Visualization.

The collaboration of other professors/researchers is also possible, according to their skills and to the course needs.

2. UC Coordinator

This Unit coordinator will be Professor Beatriz Sousa Santos, from Universidade de Aveiro.

3. Curricula Vitae

Team Members

Beatriz Sousa Santos (Unit coordinator)

Beatriz Sousa Santos is Associate Professor at the Department of Electronics, Telecommunications and Informatics of the University of Aveiro. She graduated in Electrical Engineering in 1980 and received a PhD degree, from the University of Aveiro, Portugal. Her current research interests are in the area of Data and Information Visualization, in particular in Medical Imaging. In recent years she has been teaching in the areas of Computer Graphics, Visualization and Human-Computer Interaction, both at graduate and at M.Sc. level. She has supervised several Ph.D and MSc. students in her areas of interest, and currently supervises 4 post-graduation students in the areas of Visualization, Human-Computer Interaction and Information Systems.

Publications

Beatriz Sousa Santos, Carlos Ferreira, José Silvestre Silva, Augusto Silva, Luísa Teixeira, "Quantitative Evaluation of a Pulmonary Contour Segmentation Algorithm in X-ray CT Images", Academic Radiology, Vol. 11, Nº 8, Agosto de 2004, pp. 868-878

Lars Kjelldahl, Beatriz Sousa Santos, "Visual Perception in Computer Graphics Courses", Computer & Graphics, Vol. 28, Nº 3, June 2004, pp. 451-456

José Silvestre Silva, Augusto Silva, Beatriz Sousa Santos, "A volumetric pulmonary CT segmentation method with applications in emphysema assessment", Medical Imaging 2006: Physiology, Function, and Structure from Medical Images, Proc. of SPIE, San Diego, February 2006

Samuel Silva, Beatriz Sousa Santos, Joaquim Madeira, Carlos Ferreira, "Comparing three methods for simplifying mesh models of the lungs: an observer test to assess perceived quality", Medical Imaging 2005: Visualization, Image Guided Procedures and Display, (ed. R. Galloway, K. Cleary), Proc. of SPIE Vol 5744, San Diego, February 2005, pp. 612- 620

Leonor Teixeira, Carlos Ferreira, Beatriz Sousa Santos, "Uma Abordagem ao Processo de Desenvolvimento dos Sistemas de Informação: cuidados a ter ao longo do processo no caso dos SI's tradicionais e SI's distribuídos na Web", Revista Iberoamericana de Sistemas, Cibernética e Informática, Vol. 1, N.º 2, 8 págs. (edição electrónica – ISSN: 1690-8627) (2005).

Leonor Teixeira, Carlos Ferreira, Beatriz Sousa Santos, "Web-enabled System Design for Managing Clinical Information", in Nilmini Wickramasinghe and Elie Geisler (Eds.), Encyclopaedia of Healthcare Information Systems, New York, Medical Information Science Reference: Idea Group, Inc, 2008, pp.1398-1406

Rui Borges Lopes, Sérgio Barreto, Carlos Ferreira, Beatriz Sousa Santos, “A decision-support tool for a capacitated location-routing problem”, Decision Support Systems, Vol. 46, 366–375, 2008

P. Dias, J. Madeira and B. Sousa Santos, “Teaching 3D modelling and visualization using VTK”, Computers & Graphics, Vol. 32, p. 363-370, 2008

B. Sousa Santos, P. Dias, A. Pimentel, J.-W. Baggerman, C. Ferreira, S. Silva and J. Madeira, “Head-mounted display versus desktop for 3D navigation in virtual reality: a user study”, Multimedia Tools and Applications, Vol. 41, N. 1, p. 161-181, 2009

S. Silva, J. Madeira and B. Sousa Santos, “PolyMeCo—An integrated environment for polygonal mesh analysis and comparison”, Computers & Graphics, Vol. 33, p. 181-191, 2009

S. Silva, J. Madeira, B. Sousa Santos and A. Silva. CardioAnalyser: A Software Tool for Segmentation and Analysis of the Left Ventricle from 4D MDCT Images of the Heart. In Proc. 14th Int. Conf. on Information Visualization (IV 2010), pp. 629-634, London, UK, July 2010. Pub. by the IEEE Computer Society

S. Silva, B. Sousa Santos and J. Madeira. “Using color in visualization: A survey” Computers & Graphics, 35, pp. 320-333, 2011

B. Sousa Santos, P. Dias, S. Silva, C. Ferreira and J. Madeira. “Integrating User Studies into Computer Graphics-Related Courses”, IEEE Computer Graphics and Applications, vol. 31, no. 5, p. 14–17, September 2011

L. Teixeira, C. Ferreira, B. Sousa Santos and V. Saavedra. ”Web-enabled registry of inherited bleeding disorders in Portugal: conditions and perception of the patients,” Haemophilia, vol. 18, no. 1, p. 56-62, January 2012

S. Silva, B. Sousa Santos and J. Madeira. “”Exploring Different Parameters to Assess Left Ventricle Global and Regional Functional Analysis from Coronary CT Angiography,2 computer Graphics Forum, vol. 31, no. 1, p. 146-159, February 2012

António F. Coelho

António Fernando Vasconcelos Cunha Castro Coelho is Auxiliary Professor at the Department of Informatics Engineering of the Faculty of Engineering of University of Porto where he teaches in the areas of Computer Graphics, Programming and Digital Games

António Coelho got his PhD in 2006 in the Faculty of Engineering of University of Porto, in the area of Computer Graphics. His research interests are focused in the areas of Computer Graphics, Serious Games and Geospatial Systems.

Publications

Jesus, D.; Coelho, A.; Rebelo, C.; Cardoso, A.; Sousa, A. A.: A pipeline for procedural modelling from geospatial data. In Proceedings of Eurographics 2012 - 33rd Annual Conference of the European Association for Computer Graphics, Cagliari, Sardinia, Italy, 2012.

Silva, Pedro Brandão; Coelho, António; Rodrigues, Rui; Sousa, A. Augusto: A Procedural Geometry Modeling API. In Proceedings of GRAPP 2012 – 7th International Conference in Computer Graphics Theory and Applications, pp. 129-134, 2012.

Brandão Silva, P., & Coelho, A.: Procedural Modeling for Realistic Virtual Worlds Development. Journal Of Virtual Worlds Research, vol. 4, nº 1, 2011.

Available online: https://journals.tdl.org/jvwr/article/view/2109

Jacob, João; Coelho, António: Issues in the Development of Location-Based Games. International Journal of Computer Games Technology, vol. 2011, Article ID 495437, 7 pages, 2011. doi:10.1155/2011/495437.

Coelho, António; Kato, Enrique; Xavier, João; Gonçalves, Ricardo: Serious Game for Introductory Programming. In Proceedings of the Second International Conference on Serious Games Development and Applications (SGDA 2011), Lisbon, Portugal, (September 19-20), Lecture Notes in Computer Science, Vol. 6944, Subseries: Image Processing, Computer Vision, Pattern Recognition, and Graphics, Ma, Minhua; Fradinho Oliveira, Manuel; Madeiras Pereira, Joao (Eds.), pp. 72-82, 2011.

Available online: http://www.hindawi.com/journals/ijcgt/2011/495437/

Freitas, Mário; Sousa, A. Augusto; Coelho, António: A visualization paradigm for 3D map-based mobile services. Communications in Computer and Information Science, vol. 68, pp. 89-103, 2010.

Coelho, António; Coelho, Maximino; Sousa, A. Augusto; Ferreira F. Nunes; Expeditious modeling of virtual urban environments with geospatial L-systems; Computer Graphics Forum, Vol. 26, N. 4, pp. 769–782, 2007.

Bessa, Maximino; Coelho, António; BulasCruz, José; Chalmers, Alan; Selective presentation of perceptually important information to aid rapid orientation and navigation in an urban environment; Número Especial do IJPRAI (International Journal of Pattern Recognition and Artificial Intelligence) "Intelligent Mobile and Embedded Systems", Vol.20 nº 4, pp.467-482, 2006.

António Ramires Fernandes

António Ramires Fernandes is an Auxiliar Professor at the Dept. of Informatics, Universidade do Minho, since 1997, when he finished his PhD from the University of St.Andrews, Scotland. His research activity has been focused on Real Time CGs and HCI and he has published several

papers on international conferences. He has supervised a PhD in image based 3D reconstruction and several MSc in is areas of interest. He currently supervises 6 postgrads, all in Computer Graphics. He has been a Conference Chair of International Conferences and has published papers in a number of international conferences.

He is the head of the Executive Committee of the Master Course on Computer Graphics and Virtual Environments, Universidade do Minho, where he also lectures “Fundamentals of Computer Graphics”, and “Procedural and Graphical Modelling”.

Publications

Efficient Conservative Collision Detection for Populated Virtual Worlds; Ramires Fernandes, A., Deusdado, L. SIACG - Ibero American Symposium in Computer Graphics, Jul. 2006

Rui Rodrigues, António Ramires Fernandes, Kees van Overveld & Fabian Ernst; From Spatiotemporal Curves to Reconstructed Depth. Special Issue of Image and Vision Computing, October 2004.

Rui Rodrigues & António Ramires Fernandes; Accelerated Epipolar Geometry Computation For 3D Reconstruction Using Projective Texturing. SCCG04 - Spring Conferenceon Computer Graphics, Budmerice, Slovakia, ACM Press, April 2004. (2nd Best Presentation Award)

Rui Rodrigues & António Ramires Fernandes; Robust Reconstruction of 3D Points from Images. ICIP - International Conference on Image Processing, IEEE Press, October 2004.

Rui Rodrigues, António Ramires Fernandes, Kees van Overveld & Fabian Ernst; Reconstructing Depth from Spatiotemporal Curves. In D.D. Gorodnichy and H. Zhang, editor(s), 15th International Conference on Vision Interface, pp 252-259, Calgary, Canada, May 2002. (Best Paper Award)

Projects

Project Leader “Ponte de Lima: Terra Rica da Humanidade - A Large Scale 3D Model”, 48000 Euros, 2006.

Member of the research team, “ViAr - Affordable Interactive Virtual Archaeology with Adaptive Cluster Computing”; POSI/CHS/42041/2001; 68.000 euros; 2002...2004

Rui Rodrigues

Rui Rodrigues is currently working at the Department of Informatics Engineering at the Faculty of Engineering of University of Porto (FEUP) as invited assistant professor, being involved in CG and Computer Games courses. His main research interests are Computer Graphics, General-Purpose Graphical Processing Unit (GPGPU) programming, Natural User Interfaces (NUI) and Physical Computing.

His PhD work, concluded in 2005/2006, focused on Hardware-accelerated 3D reconstruction based on images, and it was carried at University of Minho (Braga, Portugal) and the Philips Research Laboratories (Eindhoven, The Netherlands). In the course of this work, he has co-authored two patents.

After concluding his PhD, he became R&D Officer at EDIGMA.COM, focusing in the creation of interactive systems and the coordination of medium-large scale interactive projects, some of which were awarded several international prizes, until he joined FEUP.

Publications

Rui Rodrigues, António Fernandes, Robust reconstruction of 3D points from images, International Conference in Image Processing 2004, p. 3017 - 3020, Singapura, 2004

Rui Rodrigues, António Fernandes, Kees van Overveld, Fabian Ernst, Reconstructing Depth from Spatiotemporal Curves, Vision Interface'02, Calgary, Canada, 2002

Rui Rodrigues, Kees van Overveld, Piotr Wilinski, Depth Reconstruction Based on Irregular Patches, 9º Encontro Português de Computação Gráfica, Marinha Grande, Portugal, 2000

António Ramires Fernandes, Hugo Castelo Pires, Rui Rodrigues, Building Virtual Interactive 3D Galleries, VSMM'98, p. 60 - 65, Gifu, Japan, 1998

António Ramires Fernandes, Hugo Castelo Pires, Rui Rodrigues, A Virtual Interactive Art Gallery, Museums and the Web '98, Toronto, Canada, 1998

Support Members

A. Augusto de Sousa

A. Augusto de Sousa is an Associated Professor in FEUP. He got his PhD in 1996 in the Faculty of Engineering of University of Porto, Portugal, in the area of Computer Graphics/Image Synthesis and Parallel Computing. He has been teaching in the same Faculty since 1983 in areas related to Computer Architectures and Computer Graphics.

He has also been researcher in INESC/INESC Porto in the same areas, since 1985 and was the Coordinator of the Information Systems and Computer Graphics Unit of that institution. Currently he integrates the Unit of Information and Computer Graphics Systems, where he leads the Computer Graphics group.

His expertise is centred in the area of Computer Graphics, namely Image Synthesis, Illumination Design and Virtual Reality, and in the area of Parallel Computing. He supervised two PhD theses and co-advised three PhD theses, under the scope of Computer Graphics and Virtual Reality, as well as several MSc theses. He is currently supervising and co-supervising two PhD theses in Virtual and Augmented Reality and Facial Animation.

He is a member of the European Association for Computer Graphics EUROGRAPHICS and of the ACM SIGGRAPH. He was the chairman of the EUROGRAPHICS Portuguese Chapter since 1998 to 2000.

Publications

José Carlos Miranda, Xenxo Alvarez, João Orvalho, Diego Gutierrez, A. Augusto Sousa, Verónica Orvalho; Sketch express:A sketching interface for facial animation; Computers & Graphics 36 (2012), pp. 585-595 DOI information: 10.1016/j.cag.2012.03.002

Facade Tracking System for Outdoor Augmented Reality; José Martins, Jorge A. Silva, A. Augusto de Sousa; in WSCG 2010 Full Papers Proceedings, pp.113-120, 2010

Evaluation of Visualization Features in Three-Dimensional Location-Based Mobile Services; Mário Freitas, A. Augusto Sousa, António Coelho; in GRAPP 2009, pp.328-336, 2009

JUMPING JACK: A Parallel Algorithm for Non-Monotonic Stream Compaction; Pedro Miguel Moreira, Luis Paulo Reis, António Augusto Sousa; in GRAPP 2009, pp.137-146, 2009

A Temporal Focus + Context Visualization Modelfor Handling Valid-time Spatial Information 2008; Alexandre Valle de Carvalho, A. Augusto Sousa, Cristina Ribeiro; Movement and Change at the AGILE 2008 Conference, Girona, Spain, 5th May, 2008

Expeditious Modelling of Virtual Urban Environments with Geospatial L-systems; COELHO, António; BESSA, Maximino; SOUSA, A. Augusto; FERREIRA F. Nunes; Procedings of SIACG 2006 - 3rd Ibero-American Symposium in Computer Graphics, Universidad de Santiago de Compostela, Santiago de Compostela, Espanha, pp. 109-119, 2006.

Modelling Urban Scenes for LBMS; COELHO, António; SOUSA, A. Augusto; FERREIRA F. Nunes; Proceedings of Web3D 2005 Symposium, University of Wales, Bangor, UK, pp. 37-46, 2005.

A Spatio-Temporal Database System Based on TimeDB and Oracle Spatial Alexandre Carvalho, Cristina Ribeiro, and A. Augusto Sousa, IFIP International Federation for Information Processing, Springer, Vol. 205, ISBN: 0-387-34345-8.

3D Modelling of Large Urban Scenes from Diverse Sources of Information; COELHO, António Fernando; SOUSA, A. Augusto; FERREIRA, Fernando Nunes; ELPU2003-Seventh International Conference on Electronic Publishing, Guimarães, Portugal, 25-28 de Junho de 2003.

A new technique for Spherical Radiance Calculation; COSTA, Antonio; SOUSA, A. Augusto; PARRACHO, Helder; CRUZ, Pedro; Simpósio Ibero-Americano de Computação Gráfica, Guimarães, 2 a 5 de Julho de 2002.

Projects

ERAS: Expeditious Reconstruction of Virtual Cultural Heritage Sites, Projecto FCT PTDC/EIA-EIA/114868/2009 (investigador responsável).

3DWikiU: Wiki 3D para Ambientes Urbanos, Projecto FCT PTDC/EIA-EIA/108982/2008 (investigador responsável).

URBIS - Gestão e visualização eficientes de dados urbanos espaço-temporais, Projecto PTDC/EIA/73531/2006 (investigador responsável).

3DLBMS: 3D for Location Based Mobile Systems, Projecto FCT POSI/CHS/48220/2002 (investigador responsável).

CASSILDE: Design de Iluminação Assistido por Computador, Projecto PRAXIS XXI/EEI/98 (investigador responsável).

IOPGIS: Interoperabilidade em GIS, Projecto PRAXIS XXI/EEI/98 (investigador responsável).

IIRRA: sistema de síntese de imagens com nível crescente de realismo, financiado pela JNICT.

ASI: Análise e síntese de imagem em ambiente rodoviário real e virtual.

ShoeCad: projecto de um sistema de CAD (Computer Aided Design) para a indústria do calçado, financiado por SFS-NATO.

Projects with the industry

Interface Gráfica para o Módulo de Introdução de Dados do Modelo ValorAgua da EDP.

NEC FA-1201 Testing: Sistema de emulação e teste de sistemas de comutação digital (elaboração da interface gráfica).

ScateX: sistema de Automação e Telecontrolo desenvolvido para a EFACEC.

Joaquim Silvestre Madeira

Joaquim Silvestre Madeira is “Professor Auxiliar” at the Department of Electronics, Telecommunications and Informatics of the University of Aveiro, since February 2003. He graduated in Electrical Engineering in 1986 and earned a M.Sc. degree in Computer Science in 1991, both at the University of Coimbra, Portugal; in 1998 he earned a Dr.-Ing. degree in Computer Science at the Technical University of Darmstadt, Germany. He has been lecturing in the Computer Graphics and Geometric Modelling areas since 1989 (prior to 2003, at the University of Coimbra, Portugal), and has recently taught Computer Graphics and Geometric Modelling courses for M.Sc. level. His current main research area is Geometric Modelling using polygonal meshes. He has supervised one Ph.D and several MSc. students in his areas of interest, and currently supervises one post-graduation student in the areas of Geometric Modelling and Visualization.

Publications

S. Silva, B. Sousa Santos and J. Madeira. “”Exploring Different Parameters to Assess Left Ventricle Global and Regional Functional Analysis from Coronary CT Angiography,2 computer Graphics Forum, vol. 31, no. 1, p. 146-159, February 2012

B. Sousa Santos, P. Dias, S. Silva, C. Ferreira and J. Madeira. “Integrating User Studies into Computer Graphics-Related Courses”, IEEE Computer Graphics and Applications, vol. 31, no. 5, p. 14–17, September 2011

S. Silva, B. Sousa Santos and J. Madeira. “Using color in visualization: A survey” Computers & Graphics, 35, pp. 320-333, 2011.

S. Silva, J. Madeira, B. Sousa Santos and A. Silva. CardioAnalyser: A Software Tool for Segmentation and Analysis of the Left Ventricle from 4D MDCT Images of the Heart. In Proc. 14th Int. Conf. on Information Visualization (IV 2010), pp. 629-634, London, UK, July 2010. Pub. by the IEEE Computer Society.

S. Silva, J. Madeira and B. Sousa Santos, “PolyMeCo—An integrated environment for polygonal mesh analysis and comparison”, *Computers & Graphics*, Vol. 33, p. 181-191, 2009.

B. Sousa Santos, P. Dias, A. Pimentel, J.-W. Baggerman, C. Ferreira, S. Silva and J. Madeira, “Head-mounted display versus desktop for 3D navigation in virtual reality: a user study”, *Multimedia Tools and Applications*, Vol. 41, N. 1, p. 161-181, 2009.

P. Dias, J. Madeira and B. Sousa Santos, “Teaching 3D modelling and visualization using VTK”, *Computers & Graphics*, Vol. 32, p. 363-370, 2008.

R. Bidarra, J. Madeira, W. J. Neels and W. F. Bronsvoort. Efficiency of boundary evaluation for a cellular model. *Computer-Aided Design*, 37, pp. 1266-1284, 2005.

S. Silva, J. Madeira and B. Sousa Santos. PolyMeCo — A Polygonal Mesh Comparison Tool. In *Proc. 9th Int. Conf. on Information Visualisation (IV05)*, pp. 842-847, London, England, July 2005. Pub. by the IEEE Computer Society.

B. Sousa Santos, S. Silva, C. Ferreira and J. Madeira. Comparison of Methods for the Simplification of Mesh Models of the Lungs using Quality Indices and an Observer Study. In *Proc. 3rd Int. Conf. on Medical Information Visualisation — BioMedical Visualisation (MediVis 2005)*, pp. 15-21, London, England, July 2005. Pub. by the IEEE Computer Society.

S. Silva, B. Sousa Santos, J. Madeira and C. Ferreira. Comparing three methods for simplifying mesh models of the lungs: an observer test to assess perceived quality. In *Medical Imaging 2005: Image Perception, Observer Performance, and Technology Assessment*, Proc. of SPIE Vol. 5749, pp. 484-495, San Diego, Calif., February 2005.

J. S. Silva, B. Sousa Santos, A. Silva and J. Madeira. A Level-Set Based Volumetric CT Segmentation Technique: A Case Study with Pulmonary Air Bubbles. In *Proc. Int. Conf. Image Analysis and Recognition (ICIAR 2004)*, Part II, pp. 68-75, Porto, Portugal, Sept./Oct. 2004. Pub. by Springer as *LNCS 3212*

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Publications

Fernandes JM, van Hattum-Janssen N, Fonte V, Ribeiro AN, Santos LP, Sousa P; “*An integrated approach to develop professional and technical skills for informatics engineering students*”, European Journal of Engineering Education 37(2):167-177, Taylor & Francis, Londres, Reino Unido, ISSN 0304-3797, mai/2012.

Ferreira, V. and Santos, L.P. and Franzen, M. and Ghouati, O.O. and Simoes, R.; *“Estimating Local Part Thickness in Midplane Meshes for Finite Element Analysis”;* International Journal of Mathematics and Computers In Simulation, Volume 5, Issue 1, pp. 69, 2011

Debattista, Kurt and Dubla, Piotr and Santos, Luís Paulo and Chalmers, Alan; "A Wait Free Shared-Memory Irradiance Caching"; IEEE Computer Graphics and Applications, vol. 31 (5), , 2010

Debattista, Kurt and Dubla, Piotr and Banterle, Francesco and Santos, Luís Paulo and Chalmers, Alan; "Instant Caching for Interactive Global Illumination"; Computer Graphics Forum, 28(8), pp. 2216-2228, December2009

Dubla, Piotr and Banterle, Francesco and Debattista, Kurt and Santos, Luís Paulo and Chalmers, Alan; “Wait-Free Shared-Memory Irradiance Cache”; Eurographics Symposium on Parallel Graphics and Visualization (EGPGV2009); Munique, Alemanha, Março, 2009

Chalmers, Alan and Debattista, Kurt and Mastoropoulou, Georgia and Santos, Luís Paulo; "*There-Reality: Selective Rendering in High Fidelity Virtual Environments*"; Int. Journal of Virtual Reality, Vol. 6(1), IPI Press, March, 2007 (http://www.ijvr.org/issues/issue1-2007/1.pdf)

Chalmers, Alan and Debattista, Kurt and Santos, Luís Paulo; *"Selective Rendering: Computing Only What You See"*; Graphite'2006 (Keynote Paper), pp. 9-18; ACM SIGGRAPH; Malaysia, November, 2006 (The ACM Digital Library: http://doi.acm.org/10.1145/1174429.1174431)

Oliveira, António and Santos, Luís Paulo and Proença, Alberto; *"Refinement Criteria for High Fidelity Interactive Walkthroughs"*; Graphite'2006, pp 453 -460; ACM SIGGRAPH; Malaysia, November, 2006 (The ACM Digital Library: http://doi.acm.org/10.1145/1174429.1174505)

Debattista, Kurt and Santos, Luís Paulo & Chalmers, Alan; *"Accelerating the Irradiance Cache through Parallel Component-Based Rendering"*; EGPGV'06 - 6th Eurographics Symposium on Parallel Graphics and Visualization; In-cooperation with ACM SIGGRAPH, Braga, Portugal, May, 2006 (EG Digital Library: http://www.eg.org/EG/DL/WS/EGPGV/EGPGV06/)

Debattista, Kurt and Sundstedt, Veronica and Santos, Luís Paulo & Chalmers, Alan; *"Selective Component Based Rendering"*; Graphite'2005; ACM SIGGRAPH, New Zealand, December, 2005 (The ACM Digital Library: http://doi.acm.org/10.1145/1101389.1101393)

Projects

Project Leader of "PERFORM: Portability and Performance in Heterogeneous Many Core Systems"; PTDC/EIAEIA/100035/2008; 100.000,00 euros; 2010..2011

Project Leader of "IGIDE: Interactive Global Illumination on Dynamic Environments"; PTDC/EIA/65965/2006; 101.000,00 euros; 2007...2010

"COGNITO - Cognitive Workflow Capturing and Rendering with On-Body Sensor Networks", 4.300.000,00, FP7-ICT-2009-4, 2009..2012

Project Leader by Universidade do Minho on "*SIGMA – Image Aided Mobile GeoReferencing System*", in cooperation with GEONAV, supported by "Agência de Inovação", POCTI 2.3 e POSI 1.3; 165.268,37 euros; 2003 ... 2005