Distributed Computer Graphics

MAPi DOCTORAL PROGRAMME IN COMPUTER SCIENCE

2007

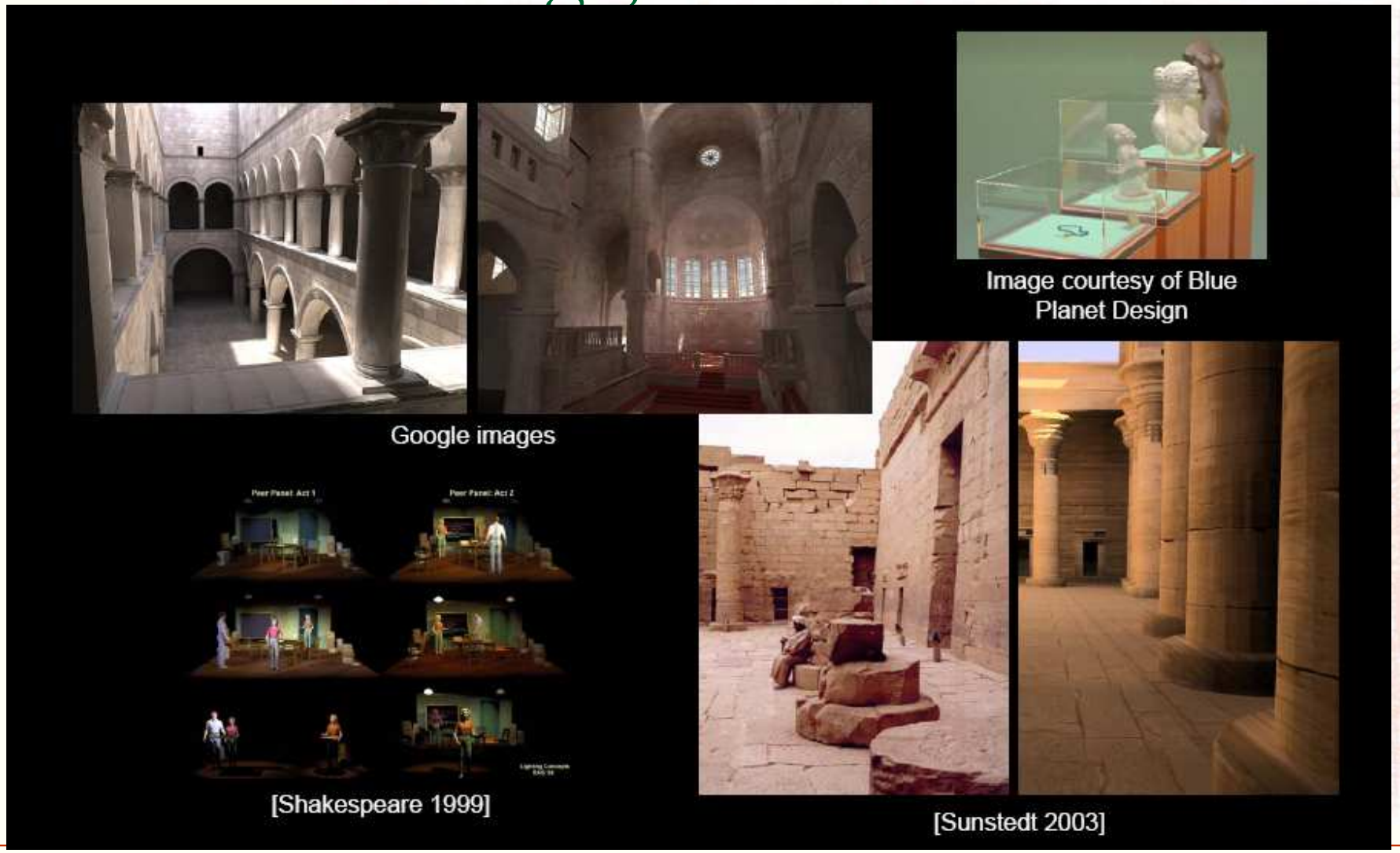
Entertainment

Image courtesy of Andrew Kensler

[Tabellion and Lamorlette 2004]

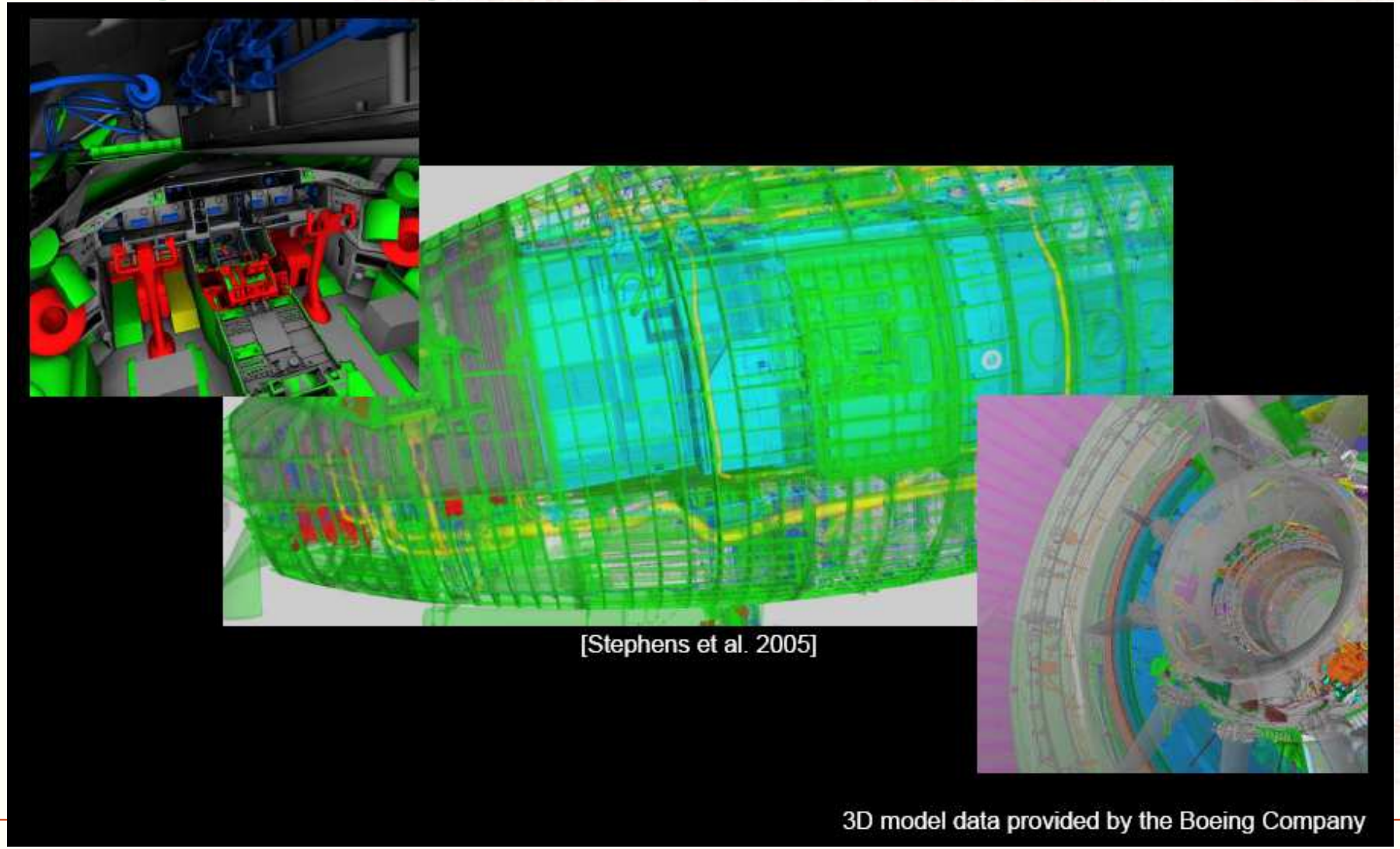
[Pellacini et al. 2005]

Cultural Heritage, Arts

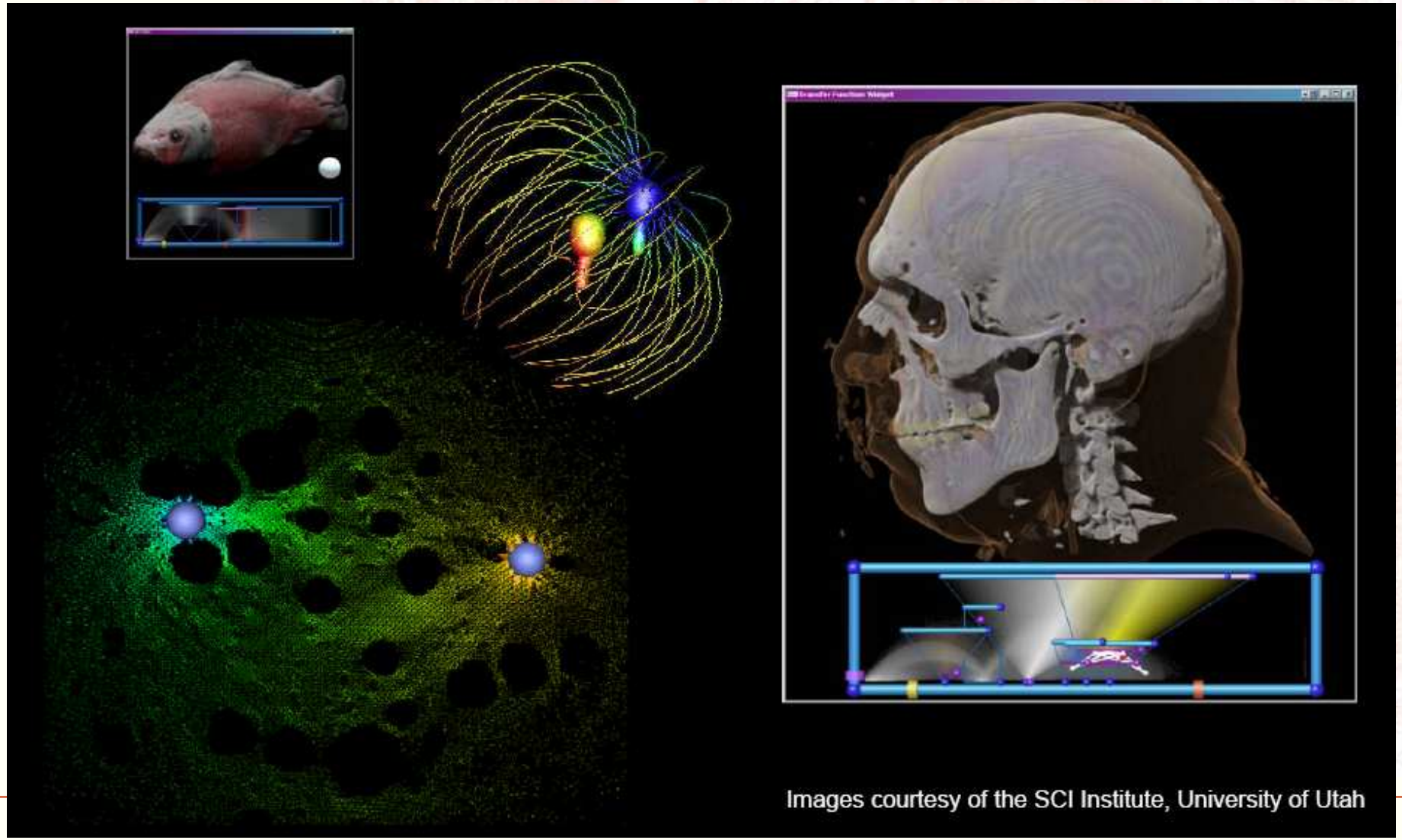


Design, Architecture

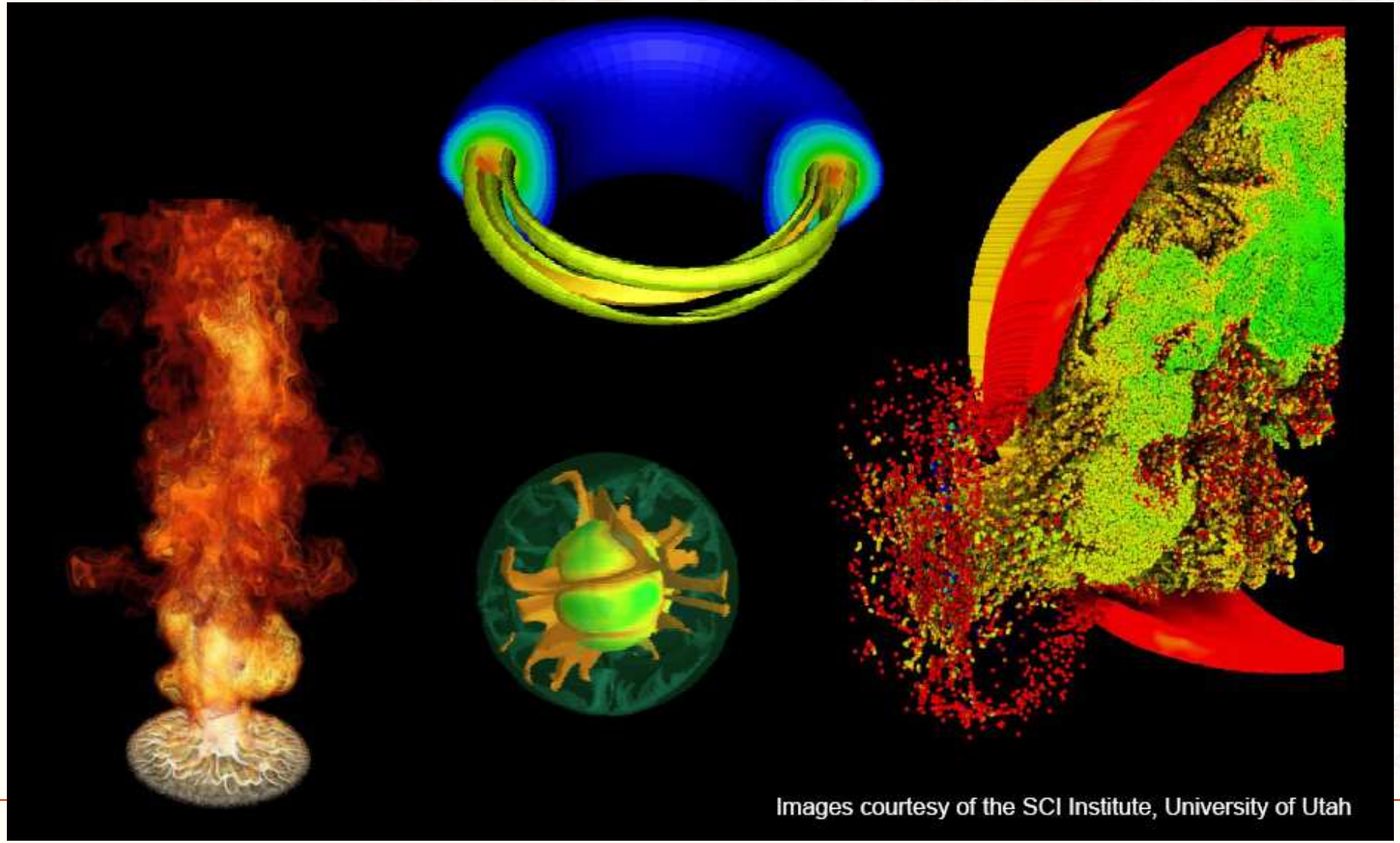
Engineering (all areas)



Science, Medicine



Simulation, Visualization



Goals

- Knowledge Homogenization (PDP, CG)
  - Algorithms
  - Techniques
  - Architectures
- Advanced Computer Graphics
  (and relationship with PDP)
  - Geometric Modelling
  - Image synthesis
  - Visualization
- Applications & Areas of Application
  - Research

Themes (1)

- Distributed computing systems
- Graphics pipeline
- Parallelism
  - Several CPU's
  - GPU and CPU
- Technologies (ex: VRJuggler, OpenSG, OpenSceneGraph or Chromium)

Themes (2)

- Modelling
  - Model partitioning
  - Collaborative modelling
- Image synthesis
  - Photo-realistic algorithms
  - Rendering equation
  - In parallel and distributed systems
- Data and Information Visualization
  - Types of data
  - Characteristics of data
  - Techniques for data visualization

Learning Outcomes

- Modelling
  - Identify, for a certain problem, the more adequate modelling techniques
- Image synthesis
  - Evaluate the computational load and resources
  - Take advantage of the GPU
  - Explore the potential of the parallelism CPU-GPU
  - Define strategies for task and data partitioning
- Visualization
  - Identify the advantages and applicability
    - Distributed Visualization
    - Collaborative Visualization
- Applications
  - …

Detailed Program (1)

1. Topics of Parallel and Distributed Processing
   - Architectures
   - Programming
   - Environments

2. Topics in Computer Graphics
   - 3D Modelling
   - Rendering
   - Visualization

Detailed Program (2)

1. Parallel and Distributed Rendering
   - GPU - Graphics Processor Units
   - Rendering Pipeline & Distributed Technologies

4. High Performance Physically Based Rendering
   - Parallel Ray Tracing
   - Parallel Radiosity
   - Rendering on the Grid
   - Interactive Ray Tracing

Detailed Program (3)

4. Distributed 3D Modelling
   - Geometric modelling in distributed computing systems
   - Collaborative modelling
   - Case studies
5. Distributed Visualization
   - Definition and model
   - Distributed & collaborative Visualization
   - Applications and challenges
6. Applications
   - …

Teaching Methodologies

- Lectures
- Assignments
  - Development of small projects
  - Critical analysis of papers
  - Bibliographic research & Reports
- Assessment
  - Small projects (50%)
  - Papers analysis, Monographs (50%)

Bibliography

- Books (few)
- "Historical" papers
- Recent Papers

Teaching Team

- A. Augusto de Sousa (AAS, UP)
- António F. Coelho (AFC, UP)
- António Ramires Fernandes (ARF, UM)
- Beatriz Sousa Santos (BSS, UA)
- Joaquim Silvestre Madeira (JSM, UA)
- Luis Paulo Santos (LPS, UM)

Curricula

- A. Augusto de Sousa (Associate Professor, FEUP, INESC Porto)
  - PhD Area: Image Synthesis and Parallel Architectures
  - Current Interests: Image Synthesis, Virtual and Augmented Reality
- PhD Supervising (finished)
  - António Manuel Cardoso da Costa; **Illumination Design in Virtual Environments** (Co-supervision with Prof. F. Nunes Ferreira)
  - João Miguel Magno Leitão; **Authonomous Agents in Driving Simulators** (Co-supervision with Prof. F. Nunes Ferreira)
  - António Fernando Coelho; **Expeditious Modelling of Virtual Environments** (Co-supervision with Prof. F. Nunes Ferreira)
- PhD Supervising (in progress)
  - Pedro Vale Moreira; **Efficient Techniques to process High Complexity 3D Environments** (Co-supervision of Luis Paulo Reis)
  - Alexandre Valle de Carvalho; **Visualization of Geographic Information with Spatiotemporal Evolution** (Co-supervision of M. Cristina Ribeiro)
  - José Fernando Martins; **3D Modelling in Augmented Reality Environments** (Co-supervision of Jorge Alves Silva)

Curricula

- António Fernando V. C. C. Coelho (Auxiliar Professor, FEUP)
  - PhD Area: Expeditious Modelling of Virtual Environments
  - Current Interests: Expeditious Modelling, Virtual Reality, Geospatial Systems

- PhD Supervising (in progress):
  - Roberto Marques Rodrigues; ***Intelligent Modelling of Virtual Environments*** (Co-supervision of Luis Paulo Reis)

Curricula

- A. Ramires Fernandes (Auxiliar Professor, UM)
  - PhD Area: Neural Networks
  - Current Interests: Real time 3D Grahpics

- PhD Supervising (finished)
  - Rui Rodrgiues; **3D Reconstruction**

- PhD Supervising (in progress)
  - Leonel Deusdado; **Virtual Environments and Autonomous Agents**
  - Francisco Gaitto Pereira; **Simulação de Envelhecimento de Estruturas Arquitectónicas**

- Projects with society:
  - **Ponte de Lima 3D: www.di.uminho.pt/pl3d**

Curricula

- Beatriz Sousa Santos (Associate Professor, DETI-UA/IEETA)
  - PhD Area: Medical Imaging
  - Current Interests: Medical Imaging, Data Visualization
- PhD Supervising (finished):
  - Óscar Emanuel Mealha; **Processing, Integration and Visualization of Multi-modal Images** (Co-supervisor with António Sousa Pereira)
  - José Silvestre Serra Silva; **Pulmonar Segmentation in Computer Axial Tomography** (Co-supervisor with Augusto Silva)
- PhD Supervising (in progress):
  - Leonor Teixeira; **User Centred Design Methodologies in the development of Health information systems** (Co-supervisor with Carlos Ferreira)
  - Rui Borges Lopes; **Location-routing problems of obnoxious services: models, algorithms and decision support strategies** (Co-supervisor with Carlos Ferreira)
  - Samuel de Sousa Silva; **Model-oriented 4D Co-Registration: Application to cardiac imagiology** (Co-supervisor with Joaquim Madeira)

Curricula

- Joaquim Madeira (Auxiliar Professor, DETI-UA/IEETA)
  - PhD Area: Computer-Assisted 2D Animation (Geometric Modeling + Im. Processing)
  - Current Interests: Mesh Modeling, Visualization

- PhD Supervising (in progress):
  - Samuel de Sousa Silva; **Model-oriented 4D Co-Registration: Application to cardiac imagiology** (Co-supervisor with Beatriz Sousa Santos)

Curricula

- Luis Paulo Santos (Auxiliar Professor, Univ. of Minho)
  - PhD Area: Scheduling on Parallel Distributed Memory Architectures
  - Current Interests: Interactive Physically Based Rendering, Parallel Processing

- Funded Projects:
  - IGIDE - **Interactive Global Illumination within Dynamic Environments** (2008..2010)

- PhD Supervising (in progress):
  - Sérgio Valentim; Interactive Ray Tracing of Dynamic Models