Open Digital Cultural Heritage Conference

Congresso Rospigliosi
25 & 26th February 2008
EPOCH in context: Perspectives on an inter-disciplinary project

David Arnold
University of Brighton
• EPOCH’s Objectives
• Reflections on from Research in Computer Aided Architectural Design
  ▪ Data in – modelling, capture, reconstruction
  ▪ Analysis – structures, physical processes, image generation and visualisation
  ▪ The Changing Profession – how far and fast do we change. - what does it take to change us.
• The role of use-inspired basic research
• Introduction to some highlights where EPOCH has contributed to basic research
- **EPOCH** is the EU FP6 Network of Excellence on the Applications of ICT to tangible Cultural Heritage (2004-2008)
- About 95 Partners including
  - Universities & Research Centres
  - Cultural Institutions & Museums
  - Antiquity & Monument Authorities
  - Other associated organisations
What did we set out to change?

• “The network will promote the integration of research efforts in five vital subfields:
  ▪ Field Recording and Data Capture
  ▪ Data Organisation, Provenance and Standards
  ▪ Reconstruction and Visualisation
  ▪ Heritage Education and Communication
  ▪ Planning for sustainability of heritage projects”

• You will see evidence of all these here
How have we been trying to do it?

• By structuring the development of tools to address a pipeline of processing from data acquisition to dissemination
• By seeking to develop a more holistic view of CH data at different stages
• By interaction, bringing technologists, CH practitioners, governmental organisations and others together – to develop a better inter-disciplinary understanding of working together
• By developing better understanding of how to evaluate the importance of CH to society

David Arnold, University of Brighton
“A major objective of the network is to continually re-emphasis the holistic, interdisciplinary view of the role of all disciplines contributing to a sustainable market sector to the benefit of the quality of life in Europe and of its citizens.”

There is always more to be done, but EPOCH has definitely brought together a wide range of groups across disciplines.
How far might we have hoped to get?

- Really no answer to that question, but we might get pointers from other fields.
- Disciplinary groups are separated by culture as much as content:
  - The way we work (e.g. publishing before or after an event)
  - The support we enjoy (ICTs attract support, CH is much worse off)
  - Timescales are different (e.g. preservation v expected rate of change)
- Lessons from CAAD – why Architecture?

David Arnold, University of Brighton
• Overlap in concerns for people and places
• Architecture designs, analyses and builds
• Archaeology records, analyses and reconstructs
• Cultural heritage is much wider than archaeology – intangible and artefacts
• Architecture probably goes further into services, structures, new materials, planning law etc

David Arnold, University of Brighton
• CAAD - One of the earliest areas targeted by IT
  ▪ Sketch interfaces
    • Sketchpad (Sutherland 1963)
    • Constrained drafting – The Interaction Handler (Newman, 1969)
  ▪ Hidden surface algorithms (60’s-70’s)
  ▪ Novel analysis techniques (e.g. FEM, Heat-loss analysis (Stibbs and Hawkes), Acoustics in concert halls (Evans)
  ▪ Photorealistic images (70’s-80’s) (particularly radiosity, but also ray-tracing and e.g. Sunlight and Daylight, Arnold 1974)
  ▪ System Building systems (e.g. OXSYS, RUCAPS)
Sketchpad and the Interaction Handler

Video
Constraint based modelling

- Intelligent tools for “easy” input (cf kitchen design systems – e.g. IKEA)
  - “Snap-to-grid”
  - Constrained relationships
  - Can cause frustration – creativity stretches rules to produce new effects – can you produce custom units for your kitchen?
- Rule-Based Grammars & Parameterised Procedural Modelling
- Modelling “what will be” is different from compact description of “what is” or evidence-based modelling of “what was”
• Experiments from the 70’s
  • Yessios – SIPLAN system
  • Grammar describing prototypical housing (e.g. “Streets” or “High Rise”)
  • Definition of target site
  • Procedural mapping using grammar rules and constraints of prototype to site
  • Other experiments in natural language description of form and grammars with 2D elements for production (cf plants later)
Sunlight and Daylight

Arnold 1976
Photorealism – Ray-tracing to Radiosity
• Begin to augment architectural modelling in 80’s
• Simulation models – e.g. Copenhagen Airport visualisation (CADCentre ~1976)
• Carla’s Island (water and natural light; Nelson Max 1981)
• Fire
• Plants (next slide)
• Physics, animation and games engines
• Avatars and Virtual Humans (Norwich VC and Scriptorium)
• Crowds, flocking and collective action
• Long history of L-systems (The Algorithmic Beauty of Plants, 1991(?), Lindmeyer and Prusinkiewicz)

• UK Grand Challenge
  (In viva; in silico)

• CIRAD AMAP
  Landscape Design Software

Prezemyslaw Prusinkiewicz et al, 1998
• Many challenges – but an important part of bringing environments to life
  - **Motion capture** v kinematics (forward and inverse)
  - Capture (e.g. Millennium Dome Avatars)
  - Animation (e.g. Puppeteering)
  - Representation (surface; sub-surface skin-tone and structure; muscle behaviour; etc)
  - Crowds, data volumes and animation speed
  - Real-time and off-line rendering (e.g. Scriptorium)
  - Speech and facial animation
  - Virtual Humans v other avatars (e.g. the Anglepoise lamp)
Computational results associated with CAAD

- Hidden Lines and Surfaces
- Scene sorting for numerical integration – the space buffer -> hemi-cube
- Ray-tracing to radiosity
- Transparency and reflectance
- Modelling – shapes; layers and connectivity
- Adaptive algorithms for real-time visualisation of large data sets
- Further development applied to CH (e.g. Debevec et al “The Parthenon” 2004)

David Arnold, University of Brighton
• Initially targetted at replicating manual processes (e.g. helping CAD drafting)

• New support
  ▪ Providing new analyses (e.g. Structural design tools; Heat loss) for enhanced design
  ▪ Providing new design techniques (e.g. system building – the flat pack building)
  ▪ Linking to other processes
    • Visualisation is integral to planning and marketing
    • Link to GIS, Quantity surveying etc

David Arnold, University of Brighton
Some examples

David Arnold, University of Brighton
Apart from CH, results inspired by CAAD are relevant elsewhere and vice versa

- Games
- Entertainment special effects
- Engineering applications
- Geographic and cartographic applications
- And, of course, Cultural Heritage

David Arnold, University of Brighton
Lessons for Cultural Heritage

• Pattern of development
  - Initial replication/automation of repetitive manual processes – then move to augment human skills
  - New analysis that was not previously possible
  - Move from bespoke to standardised systems
• Misplaced selling for “Economic Production” – more benefit in market advantage
• Interoperability and standardisation take a very long time
• Need to educate the community (cf games 1973 – late 90s for widespread standard games controllers)

David Arnold, University of Brighton
What is use-inspired basic research?

- Approaching topic from the perspective of an Engineer – we make things
- Stages in Use-inspired Basic Research
  - Be inspired – develop and refine a vision – and a direction
  - May quantify benefits (Normally pseudo economic – from experience this is asked for by research sponsors, but, historically, normally inaccurate…)
  - Make progress – and relate it to the theme
  - Over time
    - Get adopters – i.e. trial with “users” – and refine
    - Change normal practice and become embedded
- Observation of and research on systems in practice is also user-based research, but different methodology

David Arnold, University of Brighton
- **Donald Stokes (1997)**

<table>
<thead>
<tr>
<th>Research inspired by:</th>
<th>Considerations of Use?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No</td>
</tr>
<tr>
<td>Quest for fundamental understanding</td>
<td>Yes</td>
</tr>
<tr>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>
Adoption process for new technologies

David Arnold, University of Brighton
Lessons from Architecture

- Rate of adoption is limited by human development not technology development
- Architects can now design differently and can make almost any shape. Do they?
- Actions are required to support adoption
- Professions are intentionally conservative - Changing the way a profession trains and practices is a long term process
- Changing CH professionals is even slower!

David Arnold, University of Brighton
• Again initial work in replicating practice
• CH Processing “pipeline”
  ▪ Data Collection – primary and metadata
  ▪ Data organisation – collection formation
  ▪ Search and research
  ▪ Reconstruction and hypotheses
  ▪ Communication to the public
  ▪ Derivative works
• New techniques and making ideas practical
• Professional practice will change more slowly than technical developments

David Arnold, University of Brighton
• This is what the next two days are about!
• Exhibits in another room
• Significant technical progress over a range of pipeline areas (example on next slide)
• Experimentation with integration and standards
• A community (not just here, but elsewhere)
• Publications which will remain available
• Real advances in understanding and helping develop the business of cultural heritage
Grammar Example: City Engine (ETHZ)

Makes earlier ideas practical – adding 3D and constraints
Currently being used for major project on “Rome Reborn”

building \rightarrow SplitY\{ columns | entablature | I(roof) \} sanctuary

columns \rightarrow RepeatX\{ column \}
column \rightarrow SplitY\{ base | shaft | capital \}
base \rightarrow I(corinthian_base)
shaft \rightarrow S I(corinthian_shaft)
capital \rightarrow I(corinthian_capital)

entablature \rightarrow SplitY\{ architrave | frieze | cornice \}
architrave \rightarrow RepeatX\{ I(architrave_tile) \}
frieze \rightarrow I(frieze)
cornice \rightarrow RepeatX\{ I(cornice_tile) \}

sanctuary : orient == front \rightarrow SplitXY\{ wall | wall \}
sanctuary \rightarrow wall
wall \rightarrow I(quad)

Van Gool et al
ETH Zurich

David Arnold, University of Brighton
In conclusion

• This event is a chance to:
  ▪ Network including with a number of ongoing EU projects in FP6 and FP7
  ▪ Share information on what’s been achieved and what remains to be done
  ▪ Discuss how we take EPOCH’s results forwards
• Above all it is a chance to celebrate 4 years of working together

David Arnold, University of Brighton
Thank you
and
enjoy the next two days.

David Arnold, University of Brighton