Blender and Immersive Gaming in Hemispherical Domes

Paul Bourke
WASP / iVEC
University of Western Australia

Dalai Felinto
EUA / Universidade Federal Fuminense
Rio de Janeiro

Contents

Introduction: Stereoscopy vs peripheral vision

- How to increase engagement and immersion in games?
- Many games support stereoscopic 3D projection.
  Stereoscopy is difficult to present with low eye strain in a budget conscious environment.
- Argue that the gaming advantage from stereoscopy is minimal.
  Rarely do games present depth accurate stereoscopy.
- A sense of immersion is better achieved by engaging the users peripheral vision.
- Peripheral vision evolved to enable earlier threat detection, hence likely advantages for game play (at least for certain genres).
- No eye strain and often credited with our sense of "being there" (presence).
- Often a strong sensation of 3D depth perception arising from :
  - Motion cues.
  - An invisible screen surface.
  - Nothing from the real world (picture frame) is visible.
- Most common hemispherical viewing environment is a planetarium.
- We have developed the "iDome", a small personal hemispherical projection system.

iDome

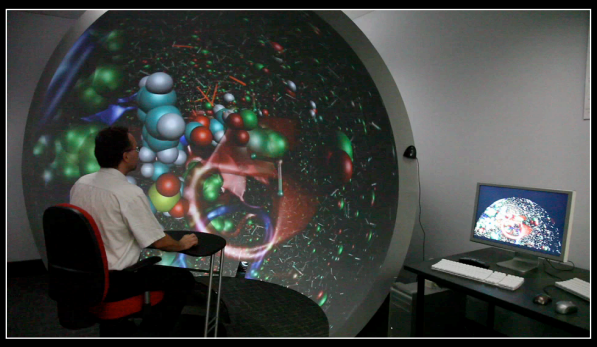
- Similar systems in the past were developed by Elumens, called the VisionStation.
- iDome jointly developed by iCinema (UNSW) and WASP (UWA).
- A single person immersive environment.
- Does support 2-3 persons comfortably without undue image distortion.
- Designed to fit in a standard height room.
  3m wide and truncated to be 2.7m high.
- Used at UWA for science visualisation and virtual environments.

http://local.wasp.uwa.edu.au/~pbourke/miscellaneous/domemirror/iDome/

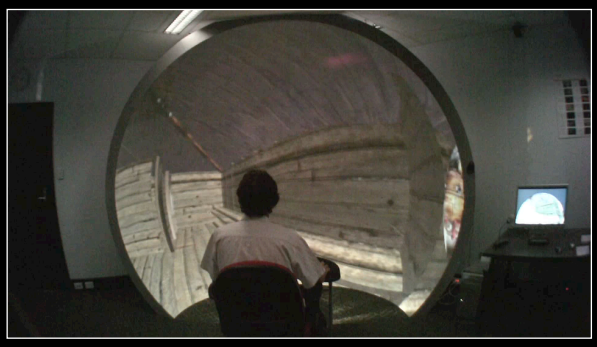
Application examples

Science education

Remote operations (mining)



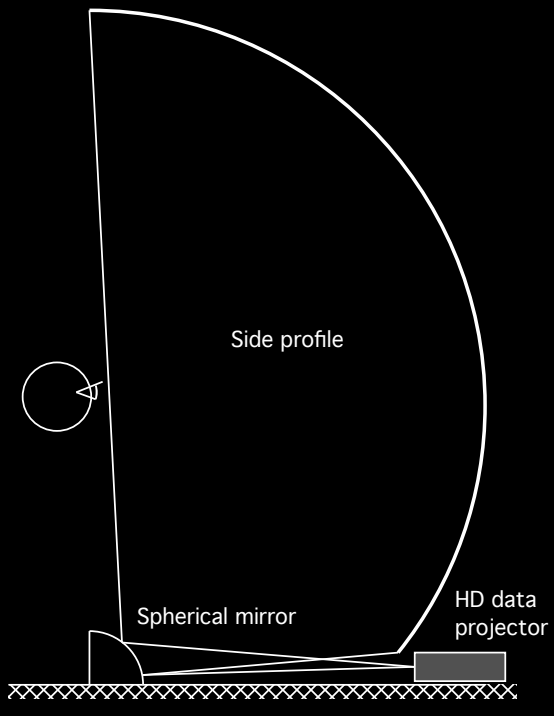
Science visualisation



Virtual heritage

Projection optics

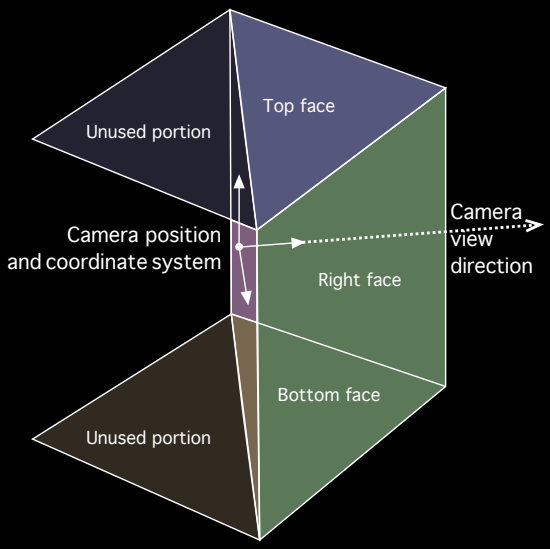
- Employes a single high definition data projector.
- Traditional approach uses a fisheye lens attached to a data projector. Has a high associated cost and the projector/fisheye occupies the best position, the position where the human should sit.
- Uses a projection technology developed by the author based upon a spherical mirror.
- Conveniently separates the projection hardware from the optics.
- The projection system is out of the way, often not noticed at all.
- Capable of image quality that rivals the fisheye option.
- Requires an image warping to compensate for the distortion introduced by the mirror, performed in realtime.



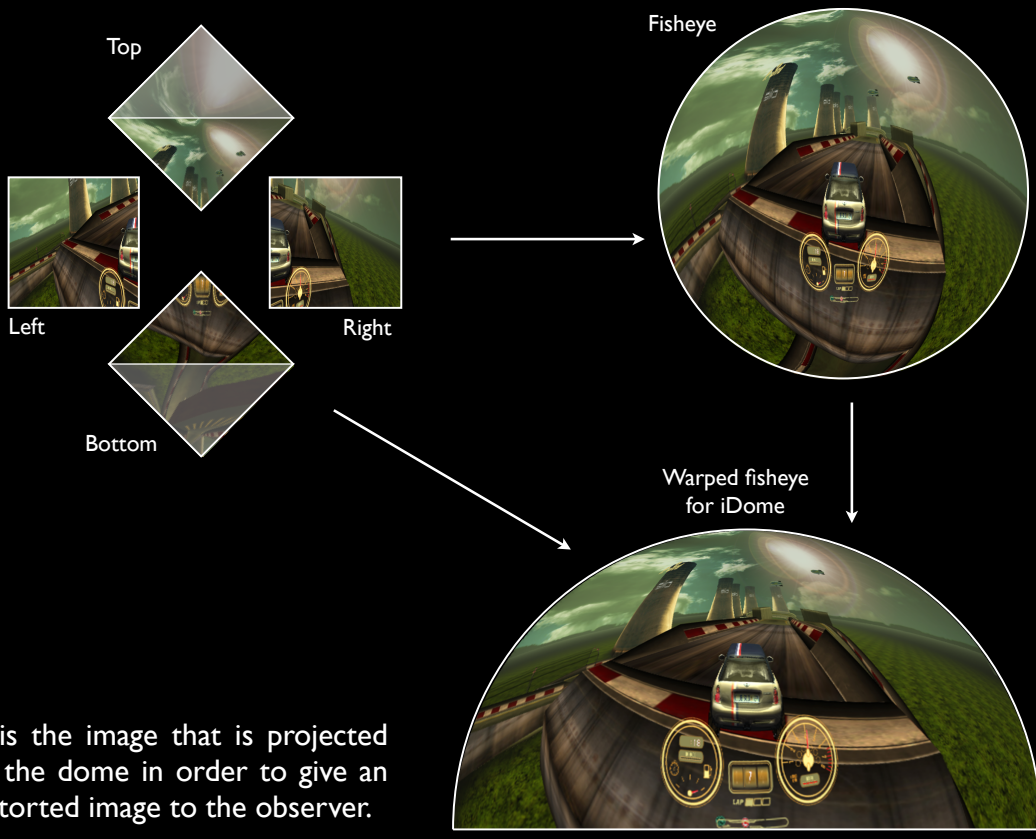
http://local.wasp.uwa.edu.au/~pbourke/papers/graphite2005/

Realtime fisheye generation: Multipass rendering

- A single perspective projection is insufficient to create the field of view (FOV) required for a dome. The limit is about 120 degrees, the iDome requires 180 degrees FOV.
- Approach used here is to render 4 views, frustums through the vertices of 4 faces of a cube centred at the camera.
- These 4 images are applied as textures to form either a fisheye image (for fisheye lens projection system) or warped fisheye (for spherical mirror based projection system).
- The image transformations required are derived from simulation software that is based upon the geometric/optical configuration.
- Relatively straight forward to integrate into an existing rendering pipeline.



Rendering pipeline overview



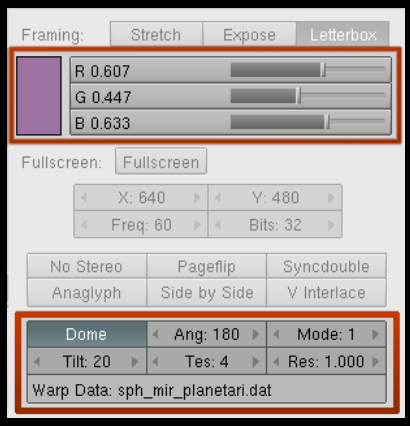
This is the image that is projected onto the dome in order to give an undistorted image to the observer.

Implementation in BGE (Blender Game Engine)

- Many are familiar with the Blender modeller/render/ animation package, less so with the game engine.

- Features
  - Leverages Blenders existing modellng front end.
  - Open source (hence the possibilities demonstrated here).
  - Cross platform (Linux, Mac OS-X, MSWindows).
  - Physics engine.
  - Pervasive Python scripting.
  - Audio.
  - GLSL shader 2.0.
  - ....

- Dome support
  - "Mode" includes support for fisheye, truncated fisheye, environment (cube) maps, and spherical panorama.
  - "Tilt" rotates the camera to locate the sweet spot in the right place for tilted domes.
  - "Tessellation" and "Res" provide a performance/accuracy tradeoff.



Blender examples

ClubSilo by Luma Labs

Yo Frankie

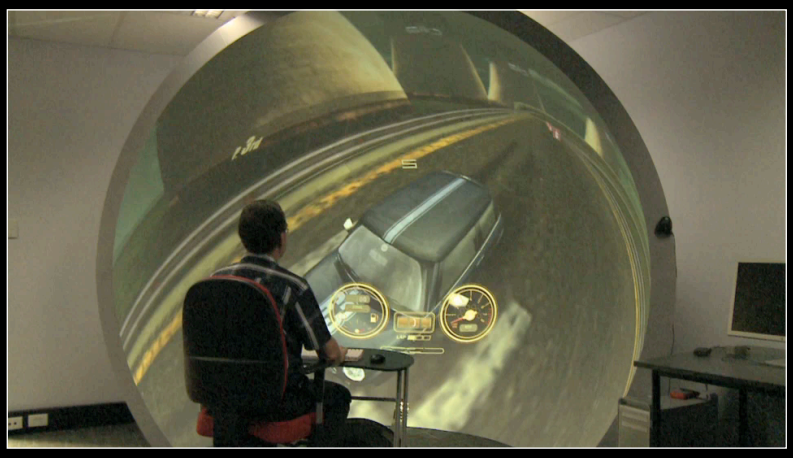
- Integrated into Blender 2.49.

- Employs the same warp mesh file format used by other spherical mirror based projection software.

- Subsequent development will also include an integrated mesh calibration tool.

Performance

- Performance hit is approximately a factor of 2.5
- On current graphics cards the texture passes are negligible.
- Important to match the resolution of the 4 rendered textures to the final fisheye and/or warped fisheye resolution.
- Care must be taken at every stage of the pipeline to optimise image quality.



Summary

- Support for more exotic projections, as required for immersive environments. In particular, fisheye projections for planetariums and hemispherical domes based upon fisheye lens projection.
- Additionally, warping for hemispherical domes employing the spherical mirror projection technique (very common among small dome installations).
- This is now included in the standard distribution of the Blender Game Engine.

Questions?

Further reading material by the author

- Using a spherical mirror for projection into immersive environments.
  http://local.wasp.uwa.edu.au/~pbourke/papers/graphite2005/
  Proceedings of the 3rd international conference on computer graphics and interactive techniques in Australasia and South East Asia, pp 281-284, 2005.

- Low Cost Projection Environment for Immersive Gaming.
  http://local.wasp.uwa.edu.au/~pbourke/papers/jmm/
  JMM (Journal of MultiMedia), Volume 3, Issue 1, pp 41-46, May 2008.

- iDome: Immersive gaming with the Unity game engine.
  http://local.wasp.uwa.edu.au/~pbourke/papers/cgat09b/
  Proceedings of the Computer Games & Allied Technology 09 (CGAT09), Research Publishing Services, ISBN: 978-981-08-3165-3, pp136-143, 2009.