

3D Display Systems: University Research and Education in Europe

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Auto-stereoscopic 3D Display

Provide a stereoscopic 3D effect without the user having to wear any special glasses or viewing aids.

LCD

Good, base to add extra optical elements.

Flat displays now outsell CRT monitors in certain markets.



© Philips

(See also Holliman, 2003)

A wireframe sphere and a wireframe cone are visible in the upper left background.

European 3D

History and Theory

3D History

Euclid, ~300 BC, Ancient Greece (Alexandria).
Noted each eye sees a different image.

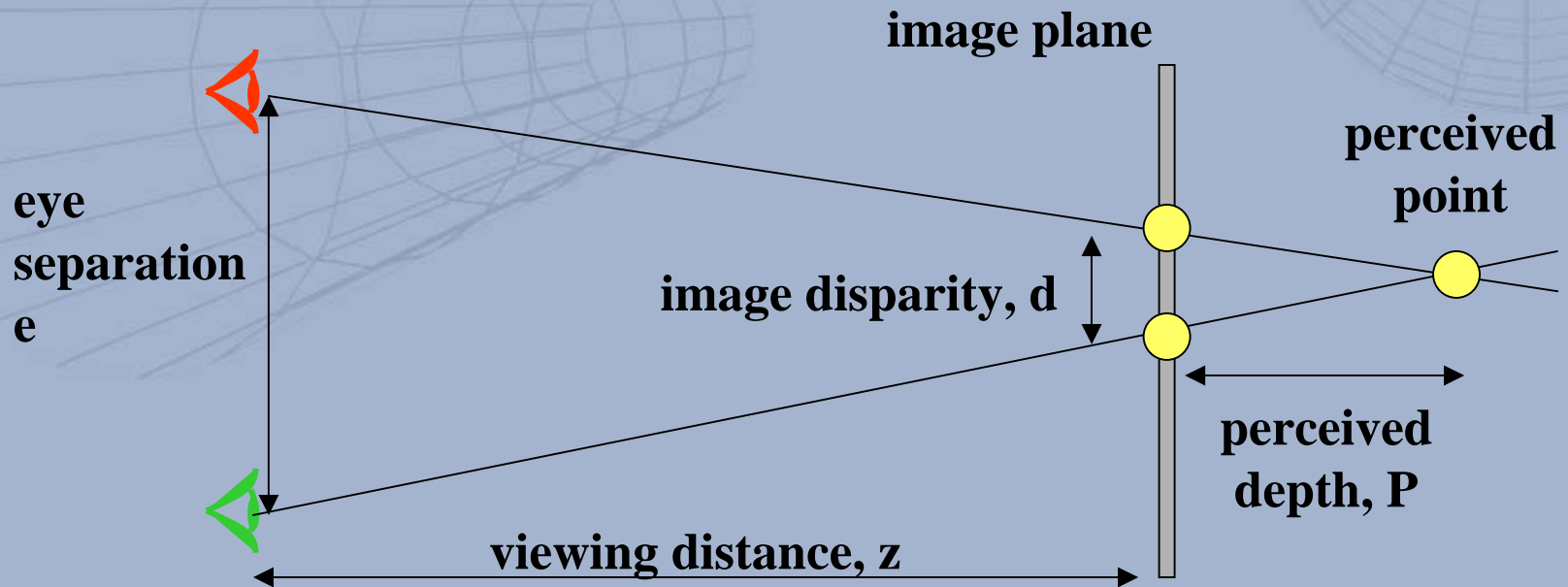
Leonardo da Vinci, 1584, Italy.
Cannot see relief in a painting however good it is.

Charles Wheatstone, 1838, Great Britain.
Demonstrated stereopsis from disparate images.

Brewster, 1844, Great Britain.
Popularised the stereoscope in 1851.

Duboscq, 1850, France.
Persuaded to build a stereoscopic camera.

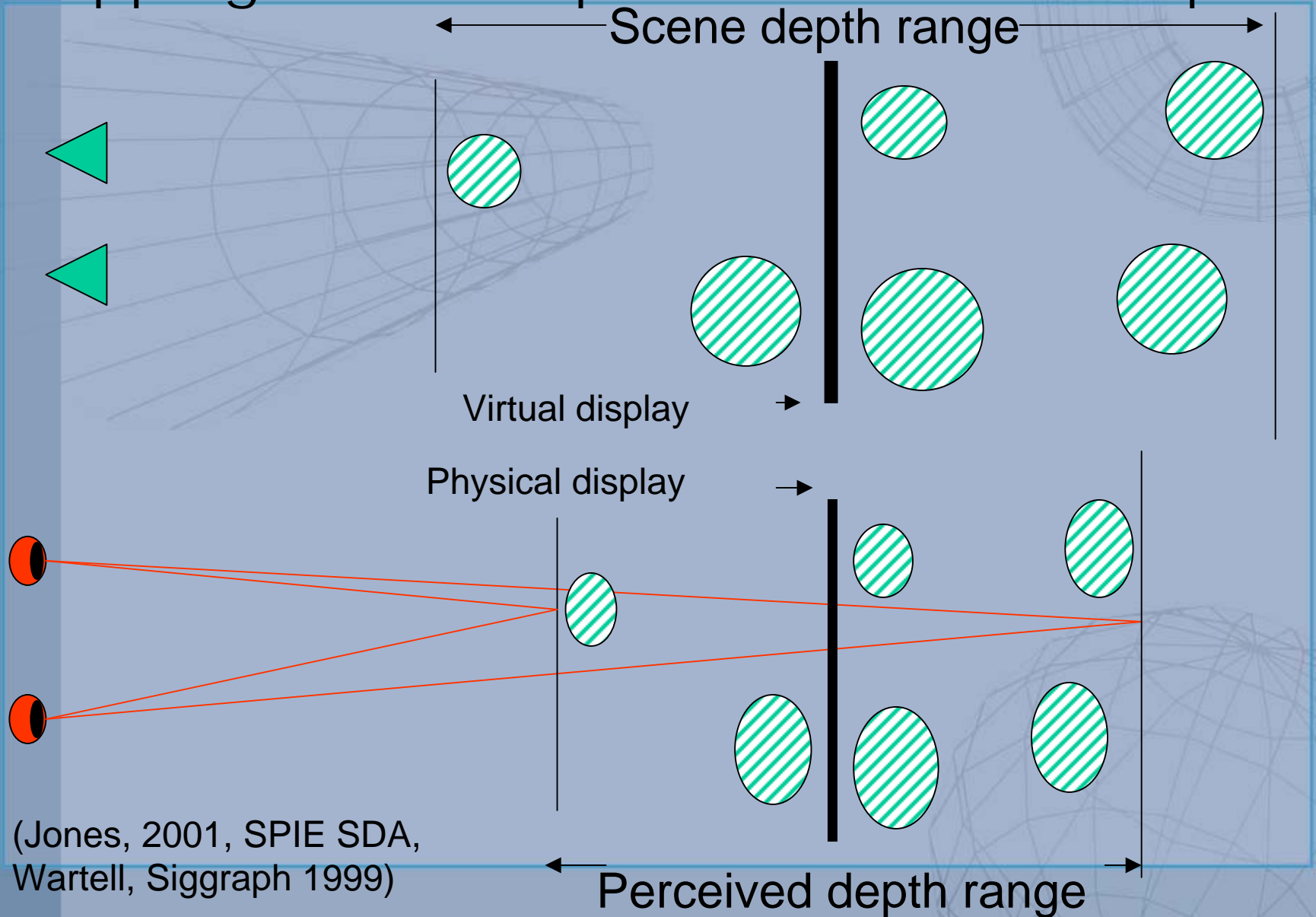
3D Theory: Perceived Depth



$$P = \frac{z}{(e / d) - 1}$$

(See also Helmholtz, 1867,
& Woods, 1993, SPIE SDA)

Mapping Scene Depth to Perceived Depth



A light blue wireframe sphere and a portion of a wireframe torus are visible in the upper left and top right corners of the slide, respectively.

European 3D

Research and Commercialisation

European 3D Research Projects

ATTEST, 3DTV broadcast chain for DVB, 2002-2004
<http://www.iti.gr/db.php/en/projects/ATTEST.html>

ACTS Panorama, 3D Telepresence, 1994-1998
Partners included Universities of Patras, Delft,
Milan, Hannover and Thessaloniki.

RACE DISTIMA 1992-1995, 3D camera and displays.
Partners included Universities of Patras, Delft,
Hannover and Thessaloniki.

COST 230 Action, Stereoscopic Television
Held regular meetings of interested partners.

Research leading to Displays

University of Cambridge, United Kingdom
Multi-view auto-stereoscopic displays.

Heinrich Hertz Institute, Berlin, Germany
Wide range of displays, Carl Zeiss display

University of Dresden, Germany
Two-view displays, ELSA, SeeReal.

3D Tools and Applications

Groups researching how to use & apply 3D displays.

Heinrich Hertz Institute, Berlin, Dr Sigmund Pastoor.
Image quality, tools and applications.

Bristol University, UK, Dr Nishan Canagarajah
Image coding for multi-view video.

Manchester University, UK, Prof Roger Hubbard
Application evaluation, medical imaging.

Durham University, UK, Dr Nick Holliman.
Methods for content creation and distribution.
Image quality definition and testing.
Problem (application) driven research.

A large, faint wireframe sphere and a cone are visible in the background of the slide, rendered in a light blue color.

European 3D

Training and Education

Training and Consultancy

Training, in stereo 3D.

Birmingham, UK, 3 day course “3D Vision for HCI”

<http://web.bham.ac.uk/visionlab/3dvision/>

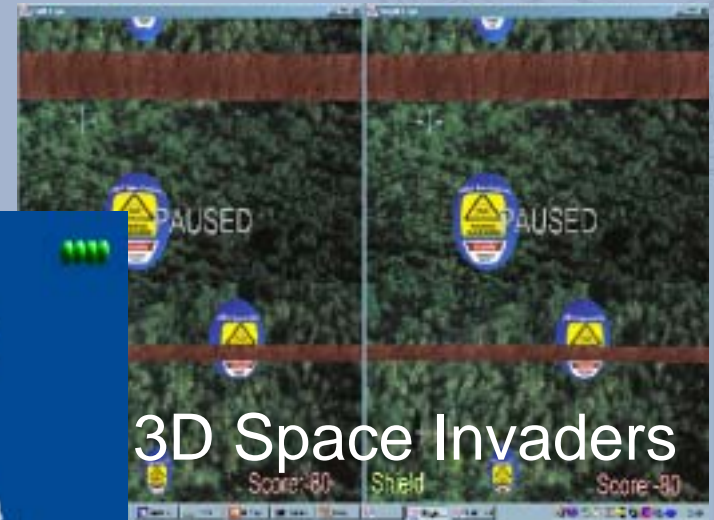
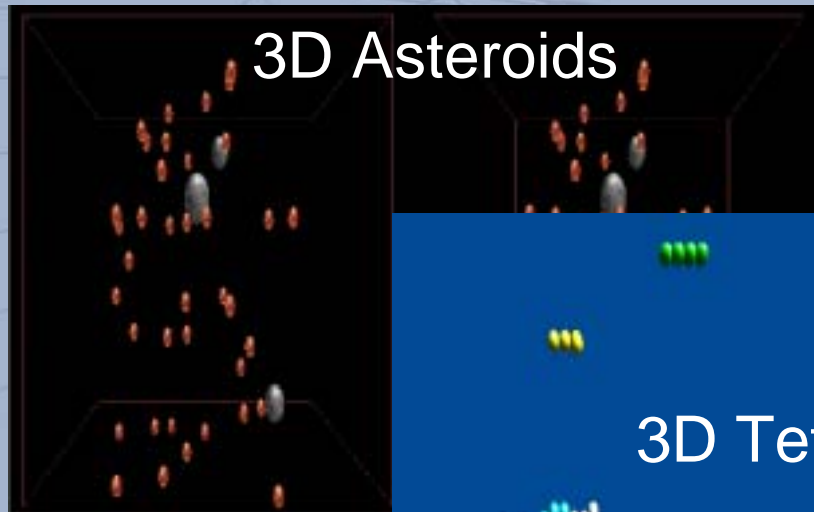
Dundee, Cambridge, Edinburgh, Napier, Oxford and Nottingham Trent offer a Masters degree in displays

<http://www.displaymasters.ac.uk/>

Consultancy, most (all!) Universities

Reading, UK. Psychology Dept. 3D display tests.

Computer Games in Stereo 3D



Durham Bachelors degree students investigated how well stereoscopic 3D works in computer games.

Designed games to work better in stereo 3D mode.

Results show 3D scores higher than 2D scores.

Business Case Studies



Durham Masters degree students: feasibility of starting a stereo 3D business using the web now.
software tools and standards were missing.
they had honest comments on display quality.

A large, light blue wireframe sphere and a cone are visible in the upper left background.

Durham

Problem Driven Research

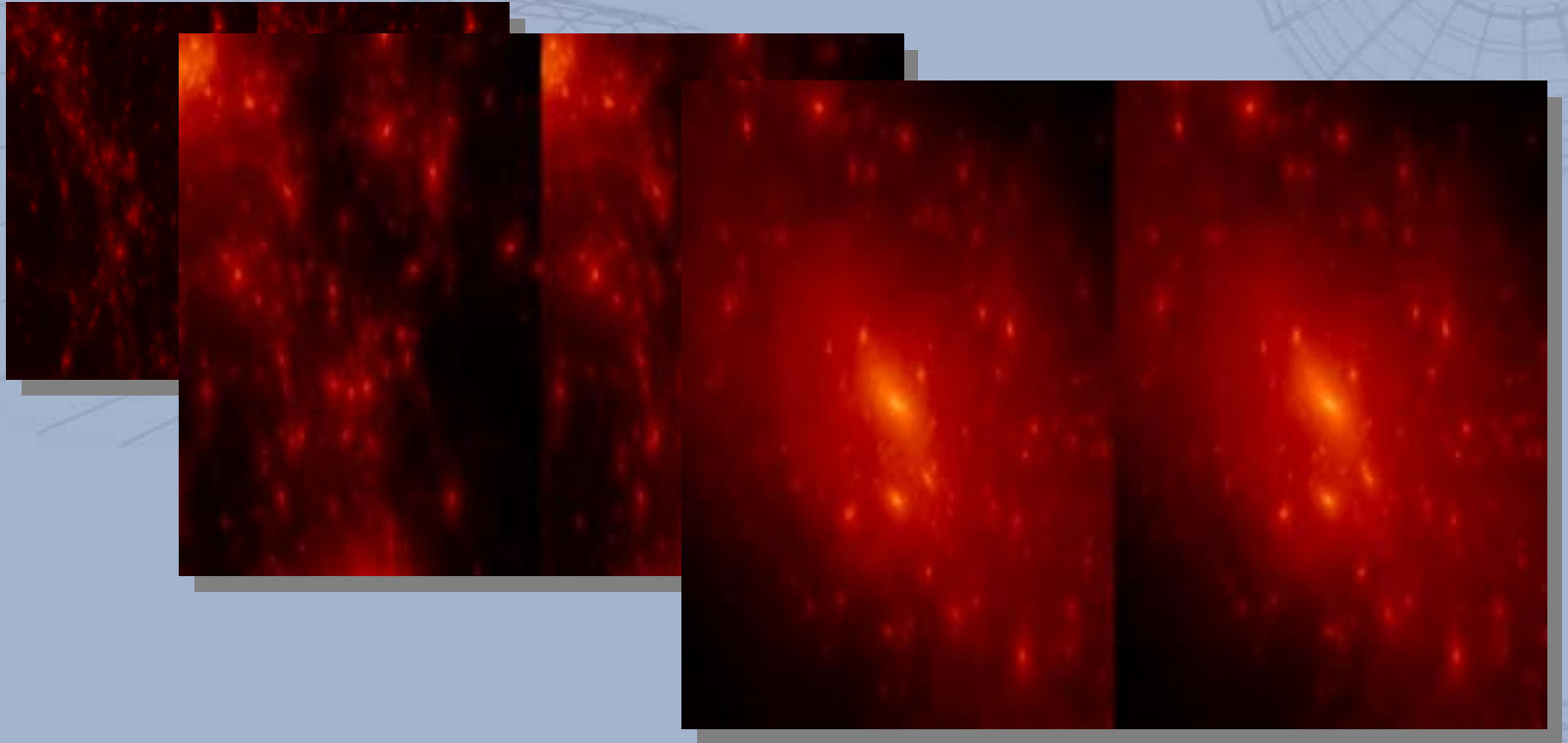
Simulating the Universe in 3D



eScience
Research with
Professor
Carlos Frenk,
Department of
Physics.

Tony Blair viewing 3D displays, opening Durham IPPP, public demonstration of the Sharp 16" 3D LCD display.

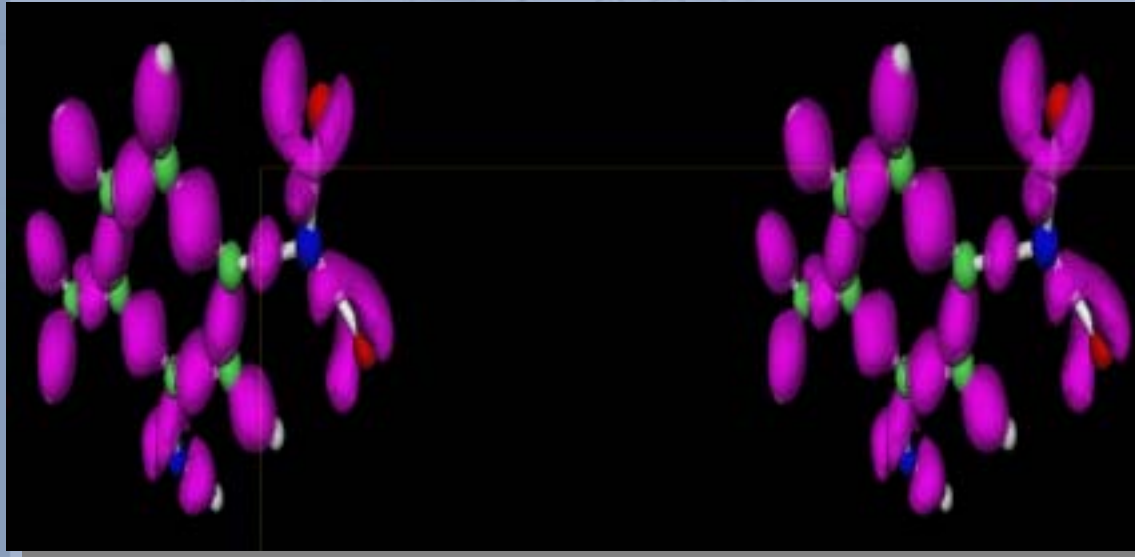
Dark Matter Simulation 3D Movie



QuickTime, dark matter distribution over 10M light yrs
Problem: mapping scene depth to perceived depth.

Next we want to visualise data sets of >15 Terabytes

X-Ray Crystallography in 3D



The traditional ball and stick model is enhanced with a nested iso-surface representation of measured electric field.

Test case for the Durham eDemand project into distributed stereoscopic visualisation on the GRID.

Collaboration with Professor Judith Howard at Durham.

3D Consortium

Enabling a sustainable 3D
display technology market

3D Consortium

When was the last time a low cost, widely available stereo 3D technology was commercially successful?

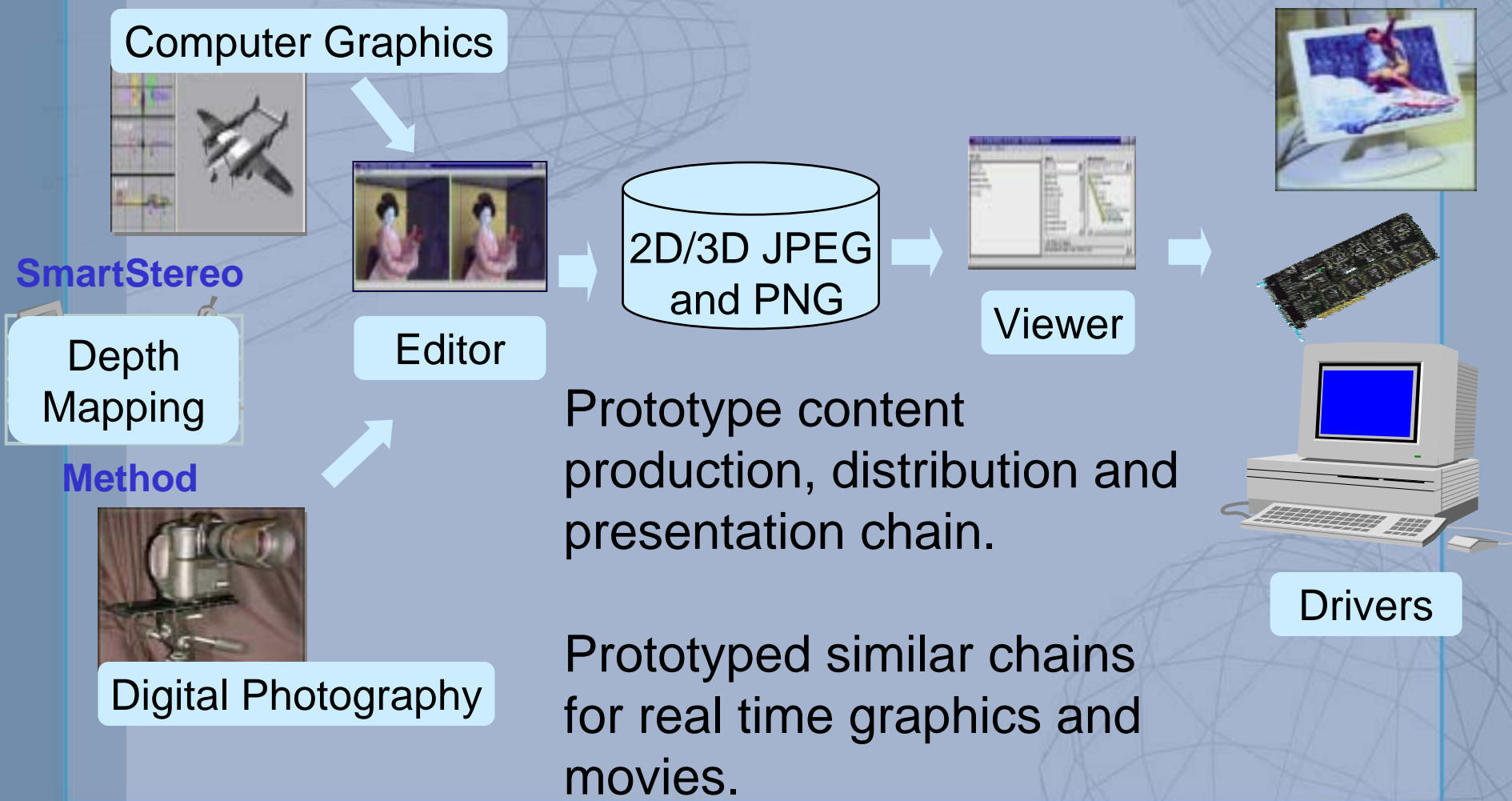
1860 ?

Cheap image viewer easily mass produced.
Brewster stereoscope.

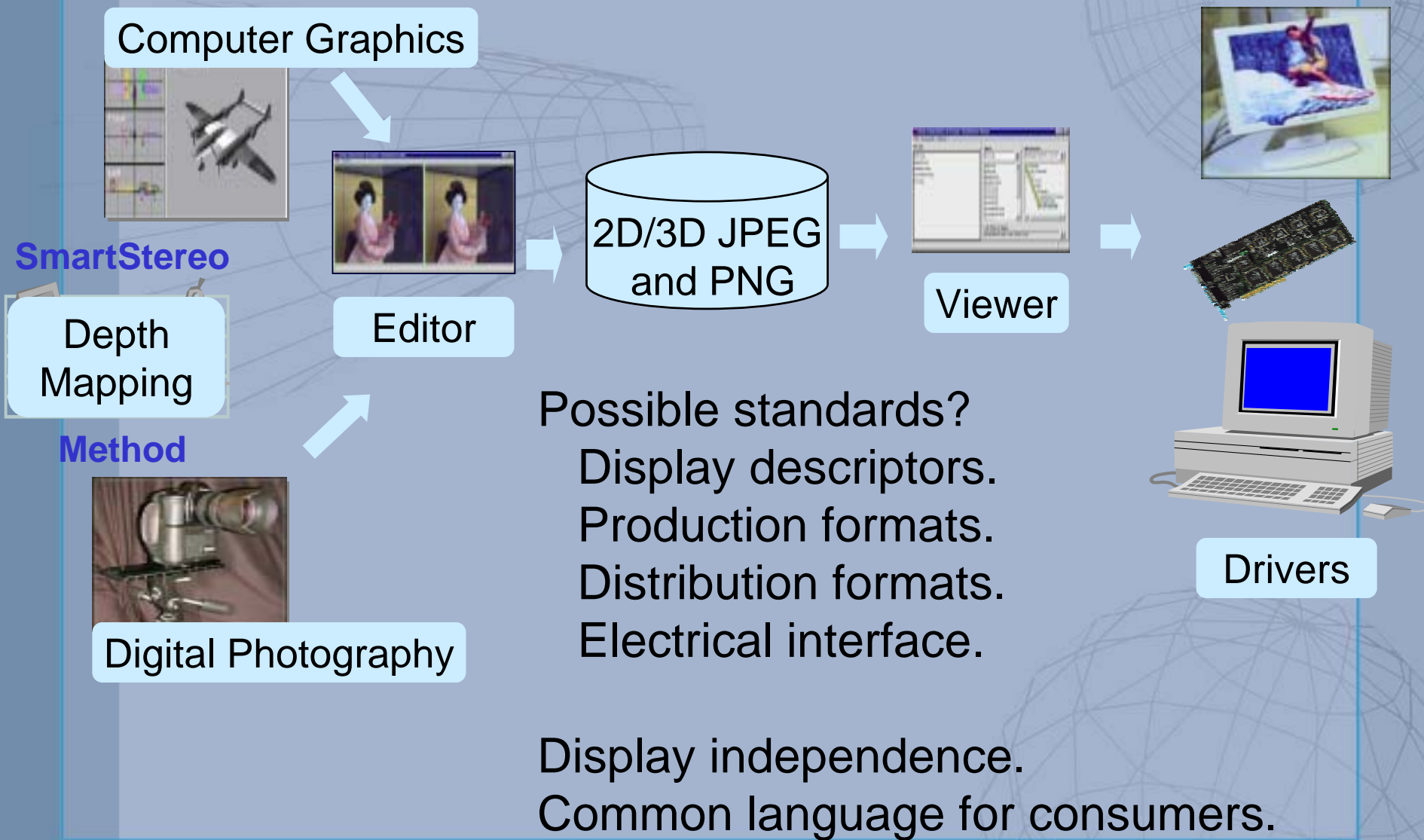
Stereo camera available to professional photographers.
Duboscq camera.

Standard format for distributing images.
Cardboard mounted side-by-side prints.

Example: Still Image Infrastructure



New standards within the chain



3D Consortium: Education

Establish within existing degree courses.

Design new short courses e.g. summer schools.

technical use of stereo - e.g. how to create and control the 3D effect so it is comfortable to view.

creative use of stereo - e.g. how make stereo 3D an important part of game play.

Linking, industry, research centres, universities and end users.

Employment opportunities for students.

References

Helmholtz, 1867, Treatise on Physiological Optics

Woods, 1993, Image distortions in stereoscopic video systems, Proc. SPIE, SDA, Vol. 1915.

Jones, Lee, Holliman, Ezra, Controlling Perceived Depth in Stereoscopic Images, Proc SPIE, SDA, Vol. 4297A.

Holliman, 2003, 3D Display Systems, Institute of Physics Press, draft version <http://www.dur.ac.uk/n.s.holliman>