Three-dimensional musical instrument

Mohamed Bourara, Jean Bui-Quang, Jean-Michaël Celerier,
Damien Clergeaud, Marie Immacula Omiscar, Omar Ourhi

Université Bordeaux I, ENSEIRB-MATMECA

12 décembre 2013

1. **Introduction**

2. **Écrans 3D**
   - Two-view 3D displays
   - Horizontal parallax multiview 3D displays
   - Full parallax multiview 3D displays
   - Second categorisation
   - Second categorisation : Visual cues
   - Second categorisation : 3D Display definition
   - Second categorisation : 3D Display taxonomy
   - Second categorisation : Novel points

3. **Le DRILE**

4. **Conclusion**

- **Context** : Conceiving a modern musical instrument that can be used in conjunction with a 3D display.
- **Goals** :
  - Understand 3D displays technologies
  - Implement 3D-enabled visualization methods for two new musical instruments : DRILE and the Aerial Percussion
- **Problem** : There are numerous kind of 3D displays. What is the most adapted to the situation ?
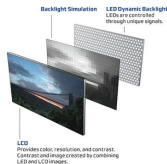
Écrans 3D
Two-view 3D displays

- Wavelength Selective Displays :
    - Each eye receives the image intended for it
    - Images are filtered
- Advantages :
    - Any color display device can be used to present the stereoscopic
- Inconvénient :
    - Each eye is seeing a different color stimulus

Introduction
Écrans 3D
Le DRILE
Conclusion

Two-view 3D displays
Horizontal parallax multiview 3D displays
Full parallax multiview 3D displays
Second categorisation
Second categorisation : Visual cues
Second categorisation : 3D Display definition
Second categorisation : 3D Display taxonomy
Second categorisation : Novel points

- Time-Sequential Two-View Displays :
    - Time-Sequential Polarization :
        - Pair of passive polarizing glasses
        - Each lens is polarized in one direction
        - The image displayed on the screen is actually composed of two images
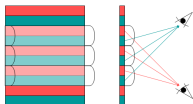
- Time-Sequential Two-View Displays :
  - Time-Sequential Backlight :
    - Auto-stereoscopic technology
    - Backlight technique
    - Having a light source in each side of the screen with a waveguide surface between them.

Backlight Simulation LED Dynamic Backlight
LEDs are controlled
through unique signals.

LCD
Provides color, resolution, and contrast.
Contrast and image created by combining
LED and LCD images.

Two-view 3D displays
Horizontal parallax multiview 3D displays
Full parallax multiview 3D displays
Second categorisation
Second categorisation : Visual cues
Second categorisation : 3D Display definition
Second categorisation : 3D Display taxonomy
Second categorisation : Novel points

Écrans 3D
Horizontal parallax multiview 3D displays

- Parallax Barrier Displays :
    - This is an autostereoscopic technique.
    - It provides a terrain vision without wearing glasses.

- the disadvantages :
    - It must be placed precisely in relation to the screen.
    - Must be stable.
    - It does not allow viewing of the stereoscopic image at the same time several viewers.

Introduction
Écrans 3D
Le DRILE
Conclusion

Two-view 3D displays
Horizontal parallax multiview 3D displays
Full parallax multiview 3D displays
Second categorisation
Second categorisation : Visual cues
Second categorisation : 3D Display definition
Second categorisation : 3D Display taxonomy
Second categorisation : Novel points

- Multi-Projector Displays :
  This technique involves a position in a circle several video projectors displaying all an angle different image after these images are projected on a special screen.
- Advantage :
  - Size of the 3D image can be much larger it is no limit.
- the disadvantages :
  - Multiple projectors are needed (projector view)
  - Headlamps must be accurately aligned.

Introduction
Écrans 3D
Le DRILE
Conclusion

Two-view 3D displays
Horizontal parallax multiview 3D displays
Full parallax multiview 3D displays
Second categorisation
Second categorisation : Visual cues
Second categorisation : 3D Display definition
Second categorisation : 3D Display taxonomy
Second categorisation : Novel points

Écrans 3D
Full parallax multiview 3D displays

This type of display allows viewers to view a 3D scene from any angle.

- Integral Imaging Displays :
  - It is a way of auto-stereoscopic 3D display, which was originally proposed by Lippmann in 1908.
  - This technique consists in using a network of micro-lenses in front of each lens where the image is different depending on the viewing angle.

Analyse

- For a 3D display :
    - Eye position
    - Resolution (pixels) display area
    - Constraints on the position of the head

- Application :
    - cinema
    - reporting and advertising
    - 3D for mobile devices

- The Stereoscopic Stereoscopic technologies and
- holography

Introduction
Écrans 3D
Le DRILE
Conclusion

Two-view 3D displays
Horizontal parallax multiview 3D displays
Full parallax multiview 3D displays
Second categorisation
Second categorisation : Visual cues
Second categorisation : 3D Display definition
Second categorisation : 3D Display taxonomy
Second categorisation : Novel points

- Based on "A Comprehensive Taxonomy for Three-dimensional displays".
- Paper problematic :

  Profusion of technologies $\implies$ Classification difficult.

1. First part : visual cues used by the human brain to define 3D vision.
2. Second part : Definition of the properties of 3D screens.
3. Third part : Presentation of the taxonomy created in this article.

Introduction
Écrans 3D
Le DRILE
Conclusion

Two-view 3D displays
Horizontal parallax multiview 3D displays
Full parallax multiview 3D displays
Second categorisation
Second categorisation : Visual cues
Second categorisation : 3D Display definition
Second categorisation : 3D Display taxonomy
Second categorisation : Novel points

Physiological cues	Psychological cues
	Static cues
Binocular disparity	Shades and nuances
Convergence	Occlusion
Accommodation	Perspective
	Dynamic cues
	Movement parallax
	Cinetic depth

A 3D display makes use of at least one physiological cue.

Hence, it cannot be emulated strictly on the software side.

- Two axes
  - Number of views : Duoscopic, multiscopic, omniscopic
  - Depth : Flat, deep
- Two novel points in the article :
  - Multi-directional display : deep multiscopic.
  - Virtual volume display : flat omniscopic.

1. Virtual volume display
   - Either adaptative optics and Pepper Ghost derivatives or holographic systems :
     http ://www.youtube.com/watch ?v=Y1m7xEzlhWA.
   - Only method that is able to present every single physiological cue.
2. Multi-directional display
   - Finite number of subdivisions but up to a 360 deg FoV.
   - Two possibilities :
     - Rotative screen
     - Multiple anisotropic screens. Light has to go in a single direction.

- Drile : an immersive environment for hierarchical live-looping
- Drile : live-looping presentation

- We are currently working on the implementation.
- Some tests already realised with headtracking and 3D rendering library (openFrameworks).
- The chosen technology is the Pepper Ghost technique, with a wavelength selective display if it is available.