Three-dimensional musical instrument

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- **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 ?

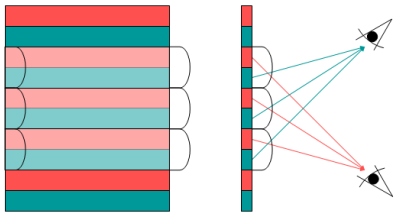
3D Displays
Two-view 3D displays

- Wavelength Selective Displays :
  - Each eye receives the image intended for it
  - Images are filtered
- Advantage :
  - Any color display device can be used to present the stereoscopic

- 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

Écrans 3D
Horizontal parallax multiview 3D displays

- Parallax Barrier Displays :
  - This is an autostereoscopic technical.
  - 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.



- 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.

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 technical consists in using a network of micro-lenses in front of each image.

Analyse

- For a 3D display :
  - Eye position
  - Constraints on the position of the head
- Application :
  - cinema
  - reporting and advertising
  - 3D for mobile devices
- The Stereoscopic and auto-stereoscopic technologies
- holography

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

$$\text{Profusion of technologies} \implies \text{Classification difficult.}$$

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.

Physiological cues
Binocular disparity
Convergence
Accommodation

Psychological cues
Static cues
Shades and nuances
Occlusion
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
State of the art :

- Plumage
- Phase project
- frameWorks 3D

Drile : live-looping presentation

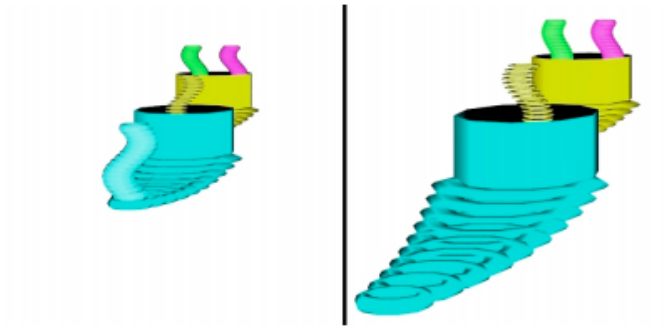


Figure : Worms

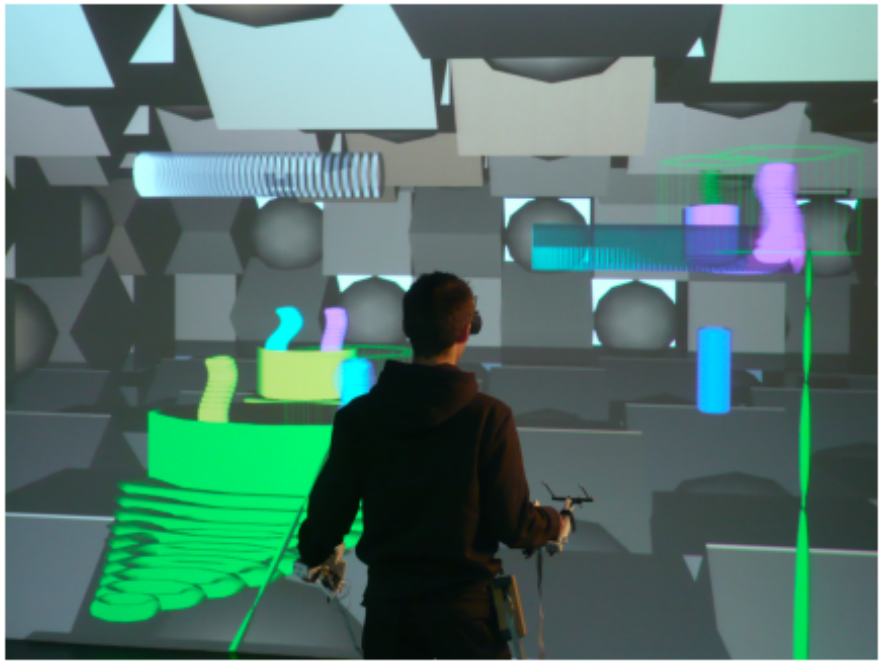


Figure : Drile

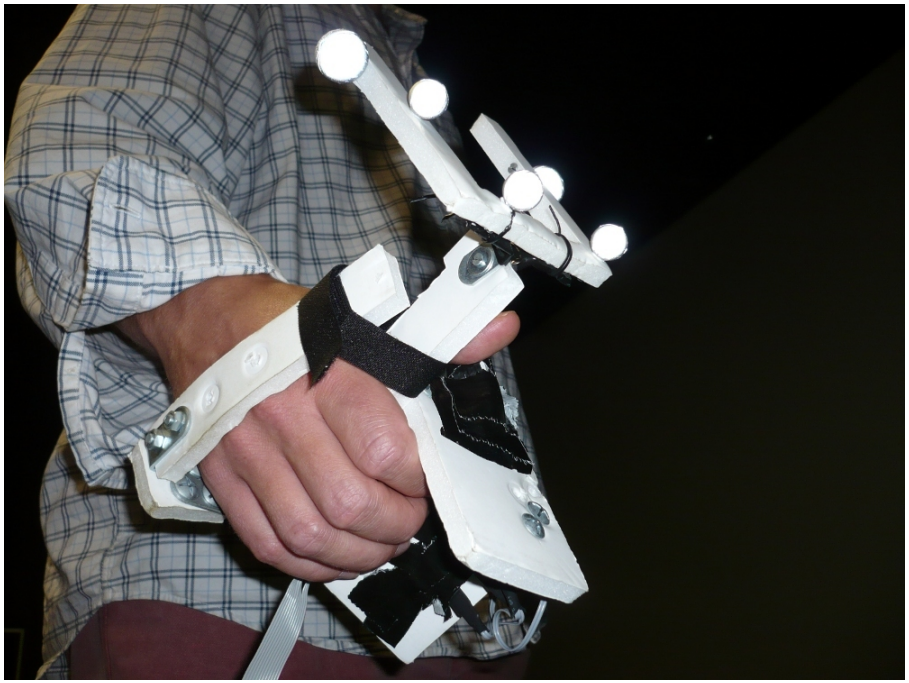


Figure : Piivert

- 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.