

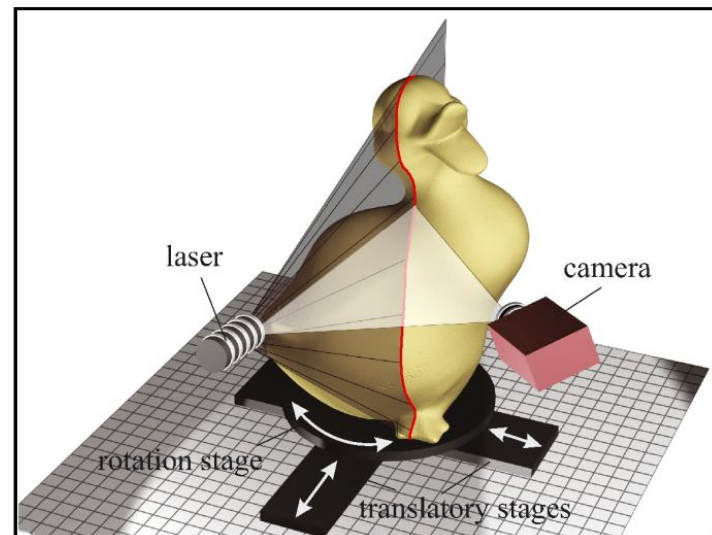
Shuyi Chen

Gaston de Zarraga

Multi-Function 3D Laser Scanner

Motivation

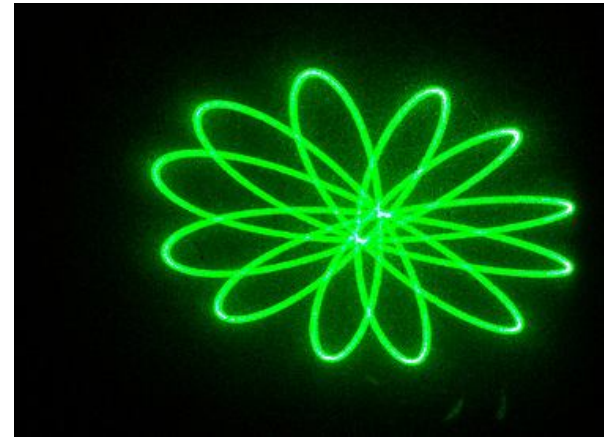
- Simple/fast shape extraction
- Low cost
- Laser to provide precision
 - Swept Plane
 - Structured Light (future project)



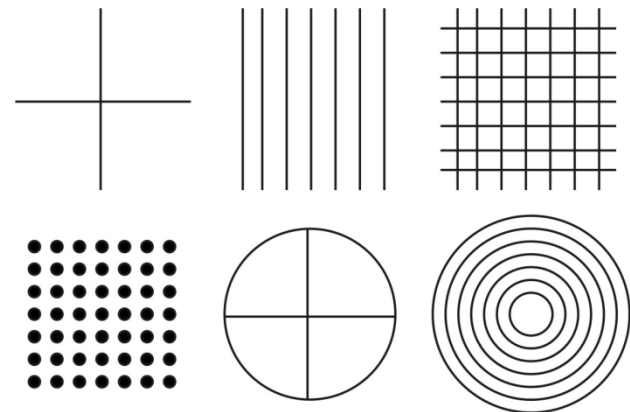
<http://mesh.brown.edu/byo3d/notes/byo3D.pdf>

Overview

- Generate laser patterns
- Play around with laser patterns
 - Mouse
 - Audio
- Scan using swept plane method



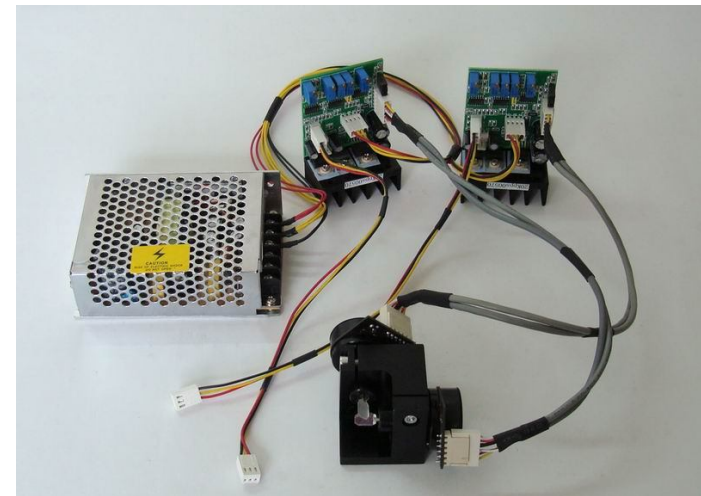
http://farm3.static.flickr.com/2173/2282426425_8a6617d023.jpg



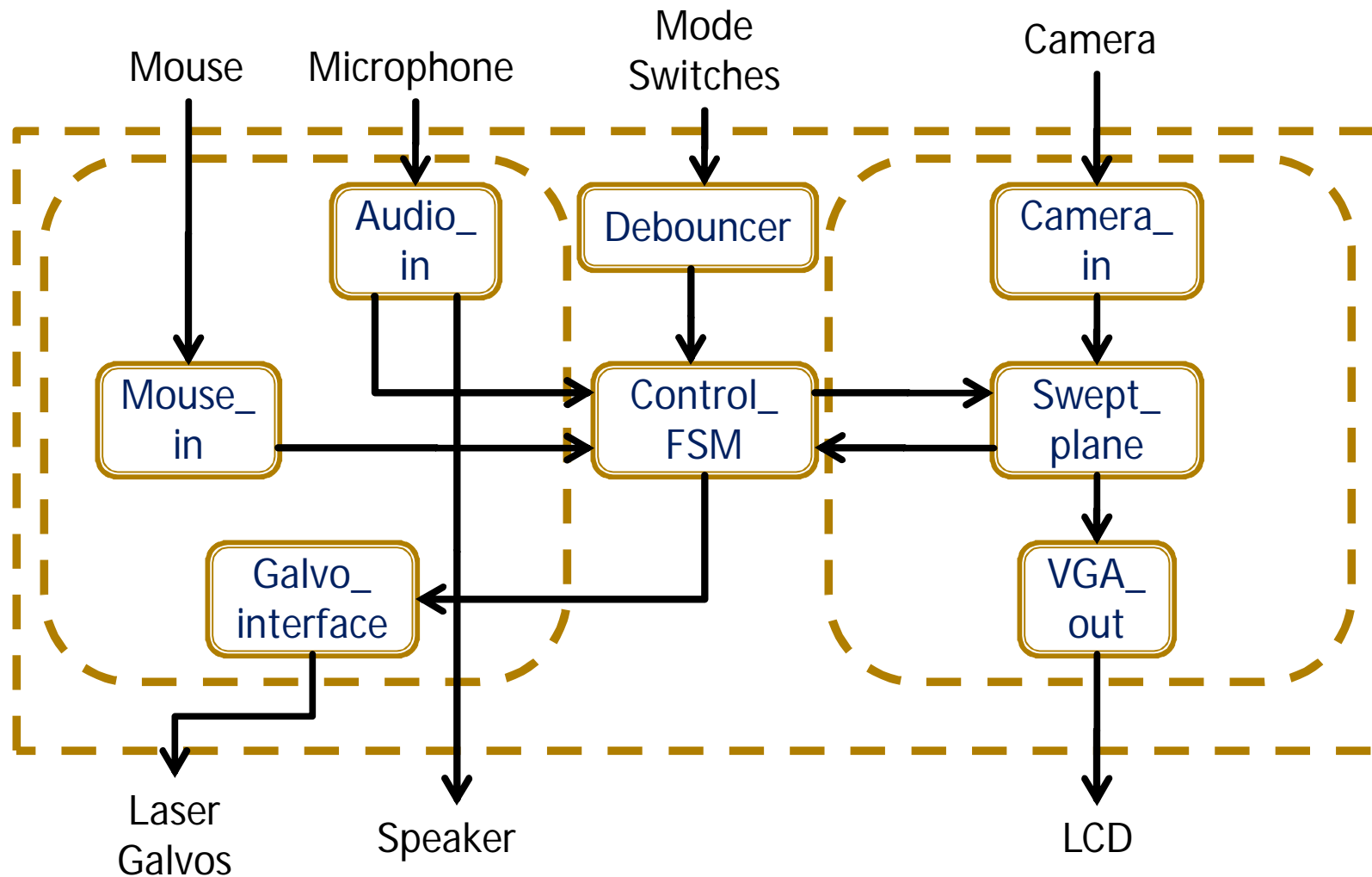
<http://bruce.cs.cf.ac.uk/bruce/LVM/LA%20Method%20170/LA%20170.jpg>

Hardware

- Digital-to-analog converter
- Laser
- Phenix Technology PT-20K scanning galvo
 - 20,000 points per second scanning speed at 20°
- VGA camera

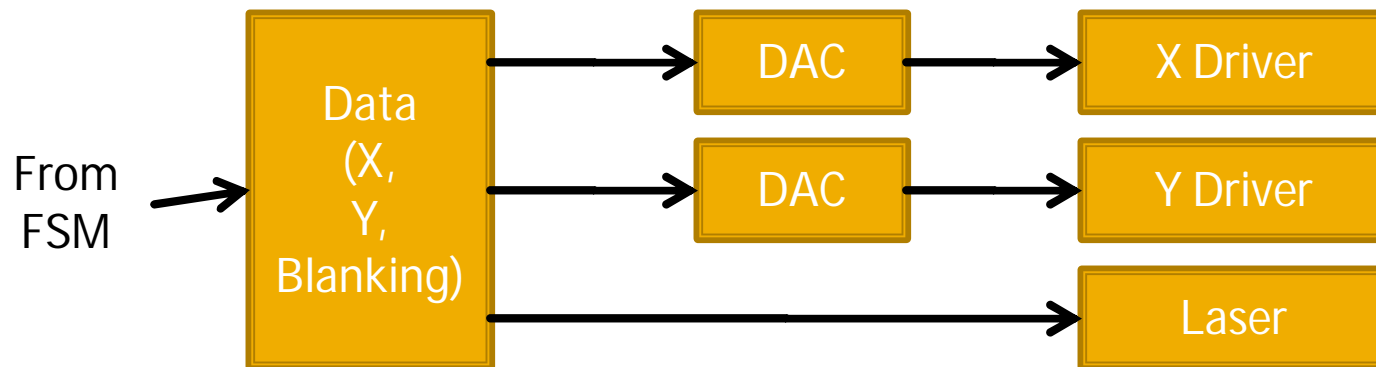


Top Level Block Diagram



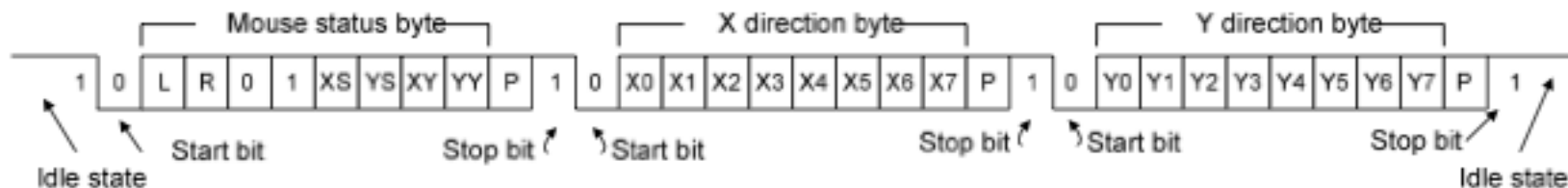
Galvo Interface

- Accepts signed position commands from FSM
- Passes Blanking signal to laser power control



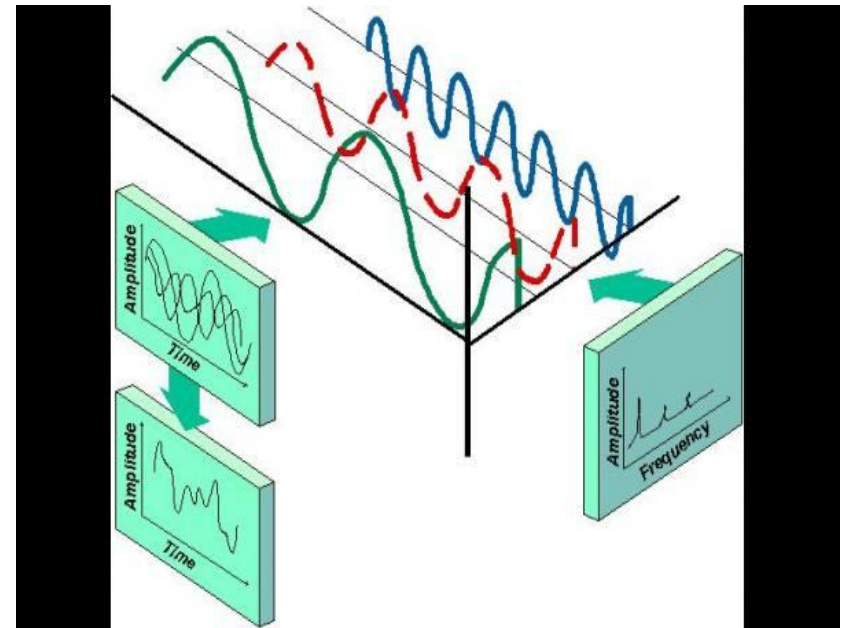
Mouse In

- Scale mouse motion data from PS/2
- Shift cursor coordinates in projector frame
- Record click coordinates and blanking commands to BRAM to draw images



Audio In

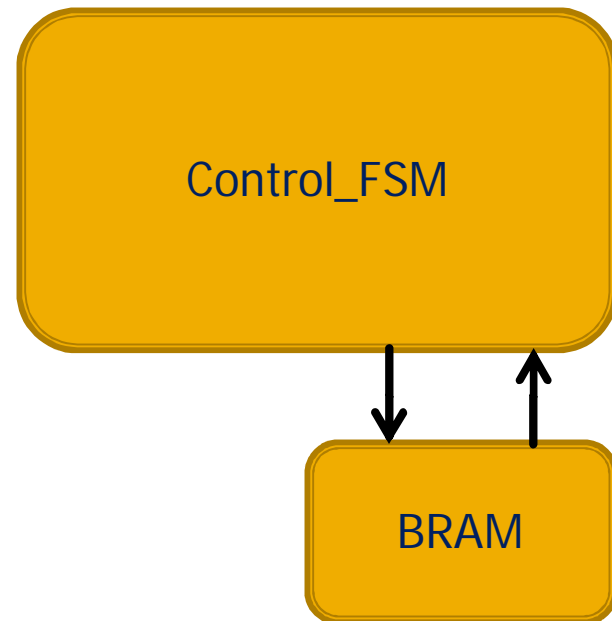
- Fast Fourier Transform to analyze signal
- Spectrum analysis data → Transform to coordinates in time → drive galvo axes



<http://withfriendship.com/images/d/15802/fft-fast-fourier-transform.gif>

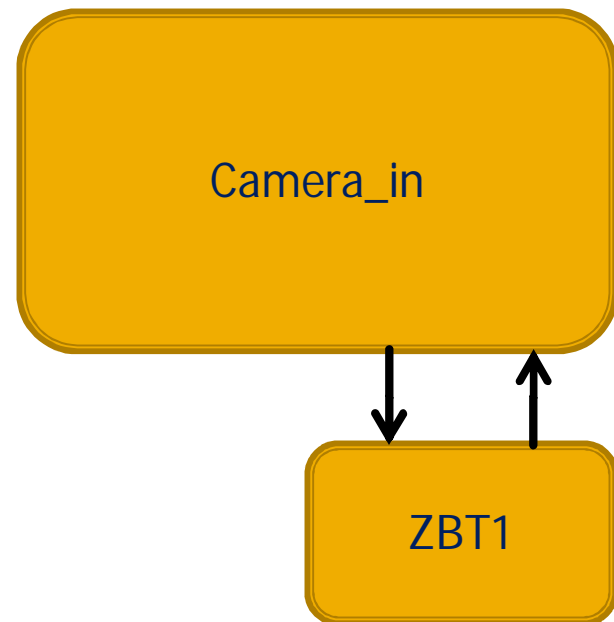
Control FSM

- Mode Select determines what goes to Galvo Interface
- Loop through coordinates from BRAM to produce traced image in Mouse mode



Camera In

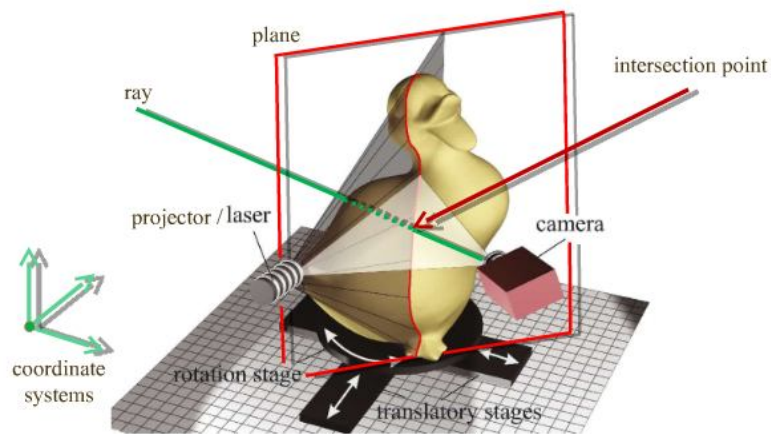
- Decode NTSC data from camera
- Store frame samples into ZBT1



Swept Plane

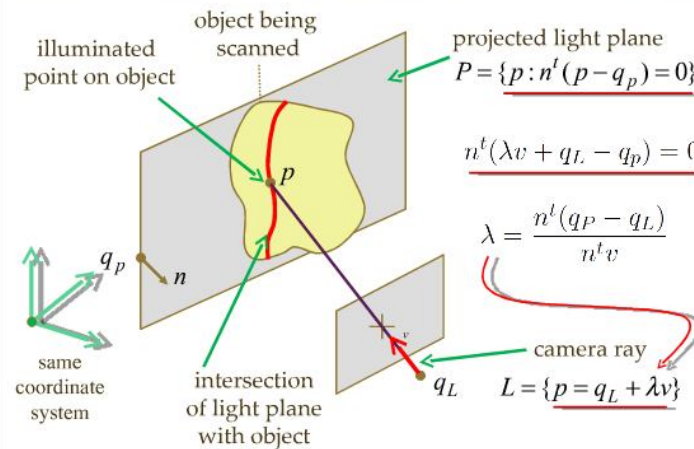
■ Theory

3D Triangulation: plane-ray intersection



<http://mesh.brown.edu/byo3d/slides.html>

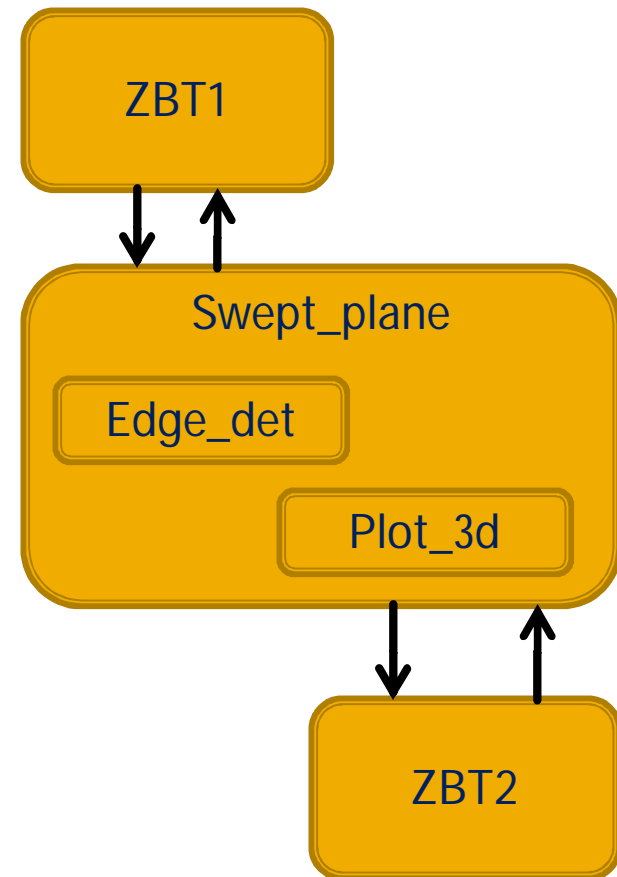
Triangulation by line-plane intersection



<http://mesh.brown.edu/byo3d/slides.html>

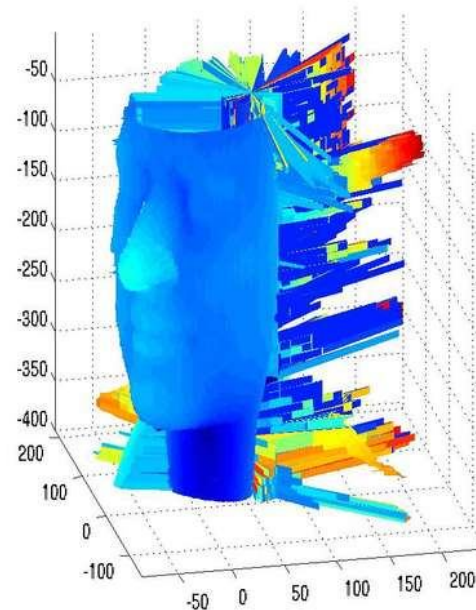
Swept Plane

- Analyze sample in ZBT1
- Detect sharp edges (laser line) and calculate 3d coordinates
- Save coordinates into ZBT2
- Plot coordinates in 3D space



VGA Out

- Accepts frame data from Swept Plane
- Encode as VGA to external monitor
- 640x480



<http://www.instructables.com/image/F8ULIVBQAHEP27QH5T/Process-the-video.jpg>

