Active Stereo Vision

COMP 4102A
Winter 2013
Gerhard Roth

Why active sensors?

- Project our own texture using light (usually laser)
  - This simplifies correspondence problem (much easier)
- Pluses
  - Can handle different ambient lighting conditions
  - Can get 3d data when there is no natural texture (i.e. white wall)
- Minus
  - Need active source and a way to project it (laser dangerous?)
  - Need more complex hardware
- A number of different systems, but two principles
  - Triangulation (same as stereo but the light source replaces second camera) with camera and light source
  - Time of flight (produce a pulsed beam of light, measure distance by time light takes to return)

Pulsed Time of Flight

Basic idea: send out pulse of light (usually laser), time how long it takes to return

Advantages:

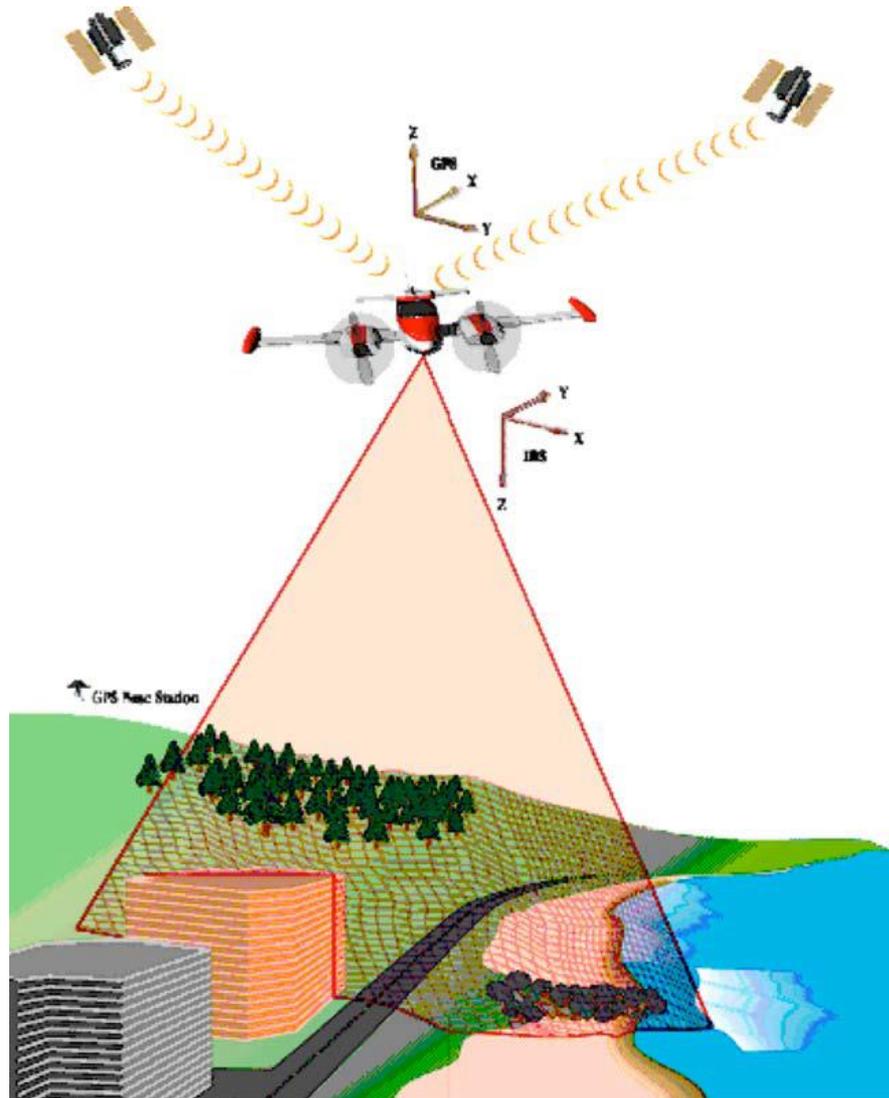- Large working volume (up to from 20 to 1000 m.)

Disadvantages:

- Not-so-great accuracy (at best ~5 mm.)
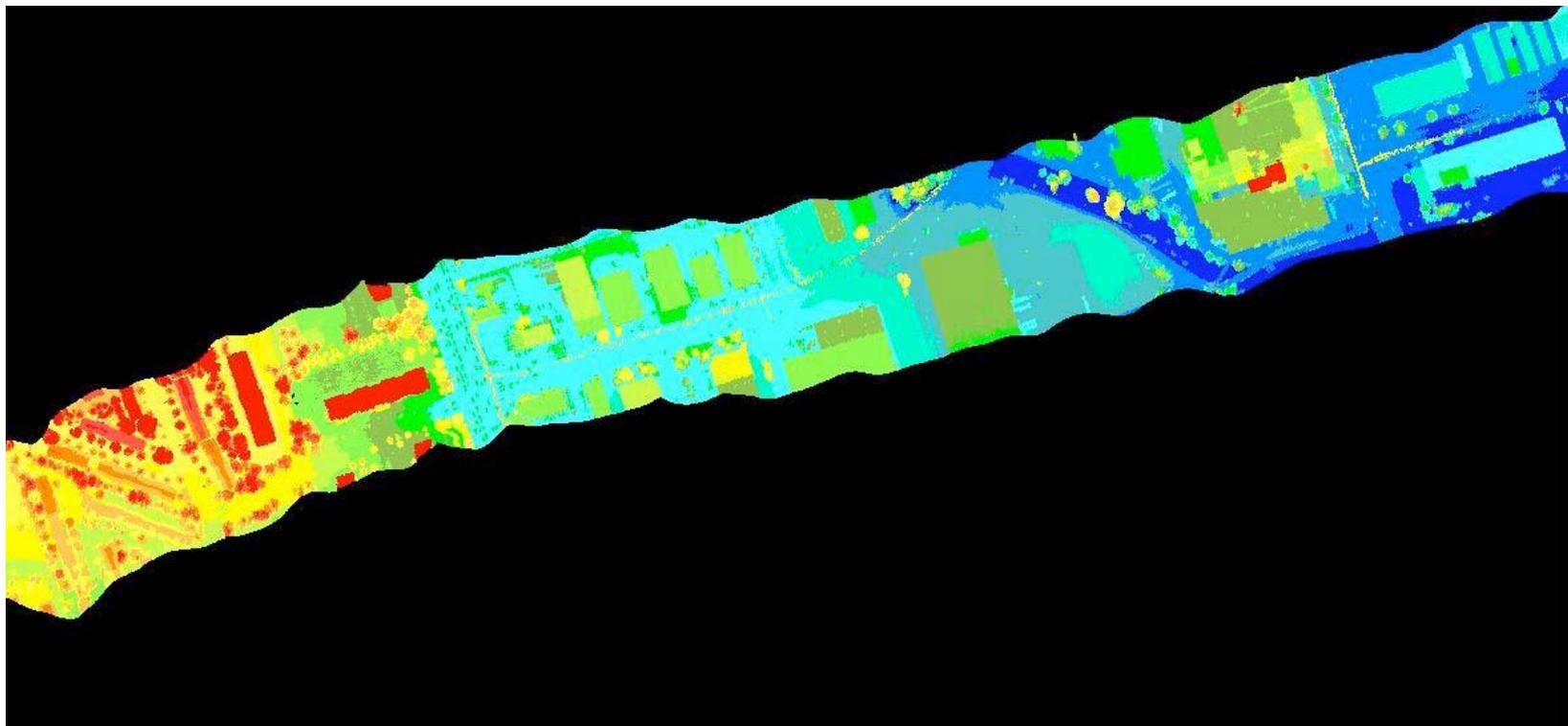 - Requires getting timing to ~30 picoseconds

Often used for scanning buildings, rooms, archeological sites, etc.

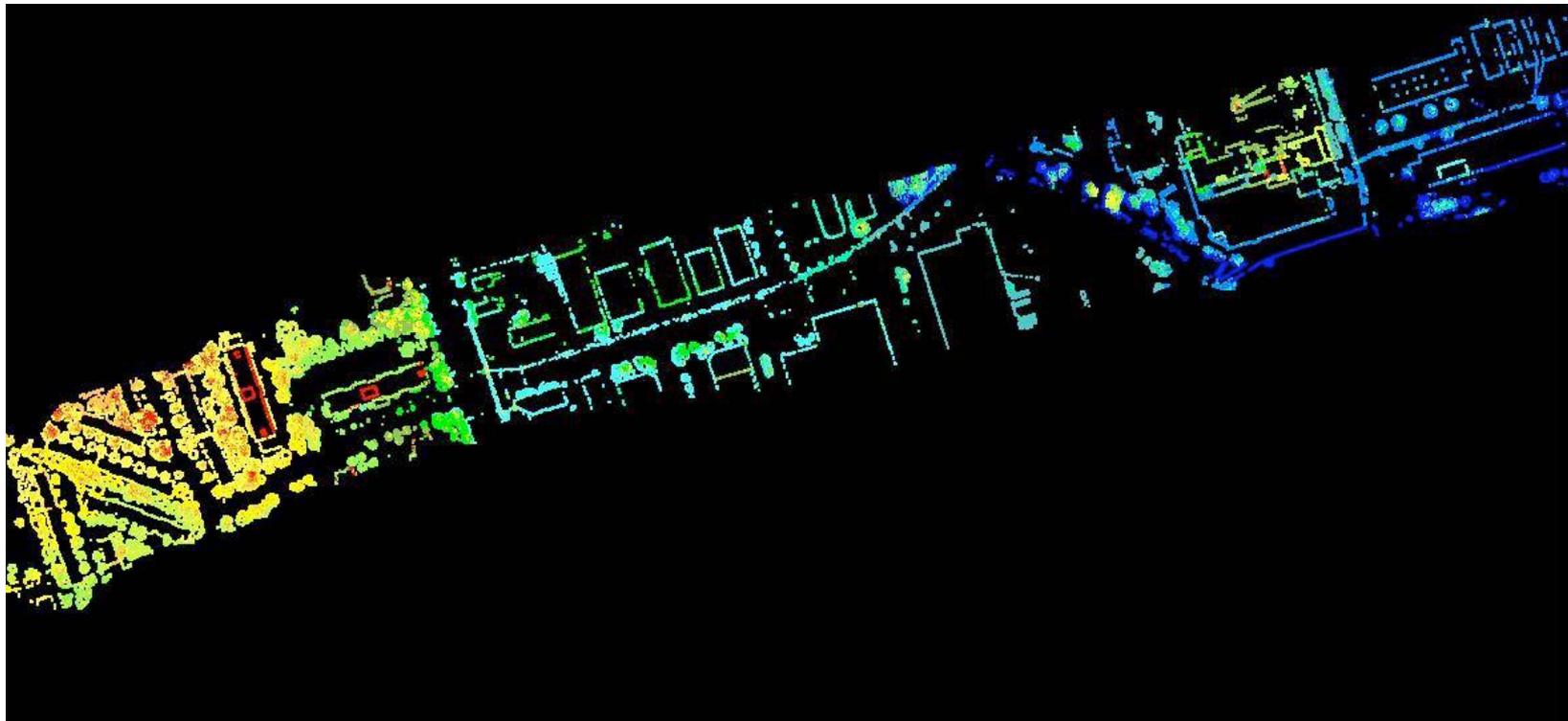The only practical long range measuring technology (triangulation fails over 20 meters)
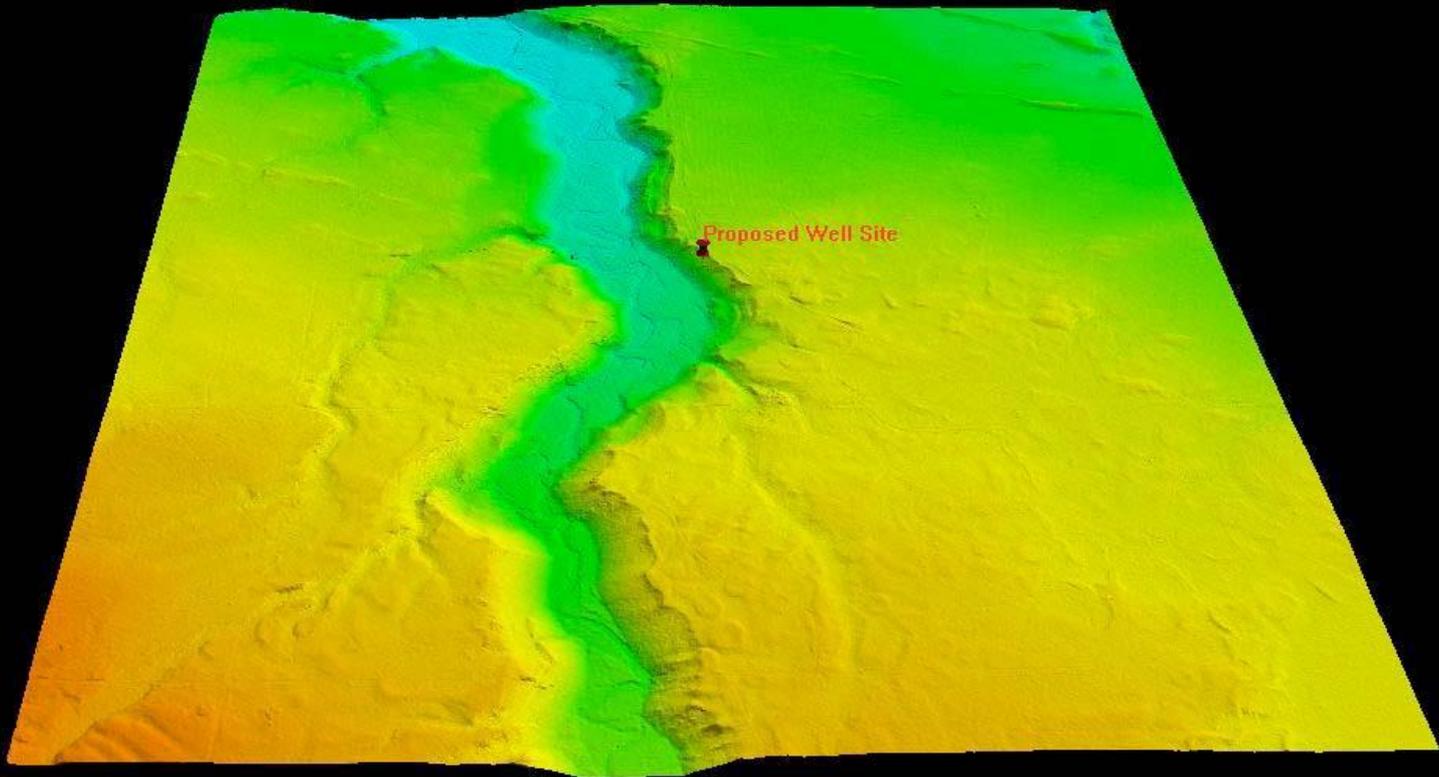
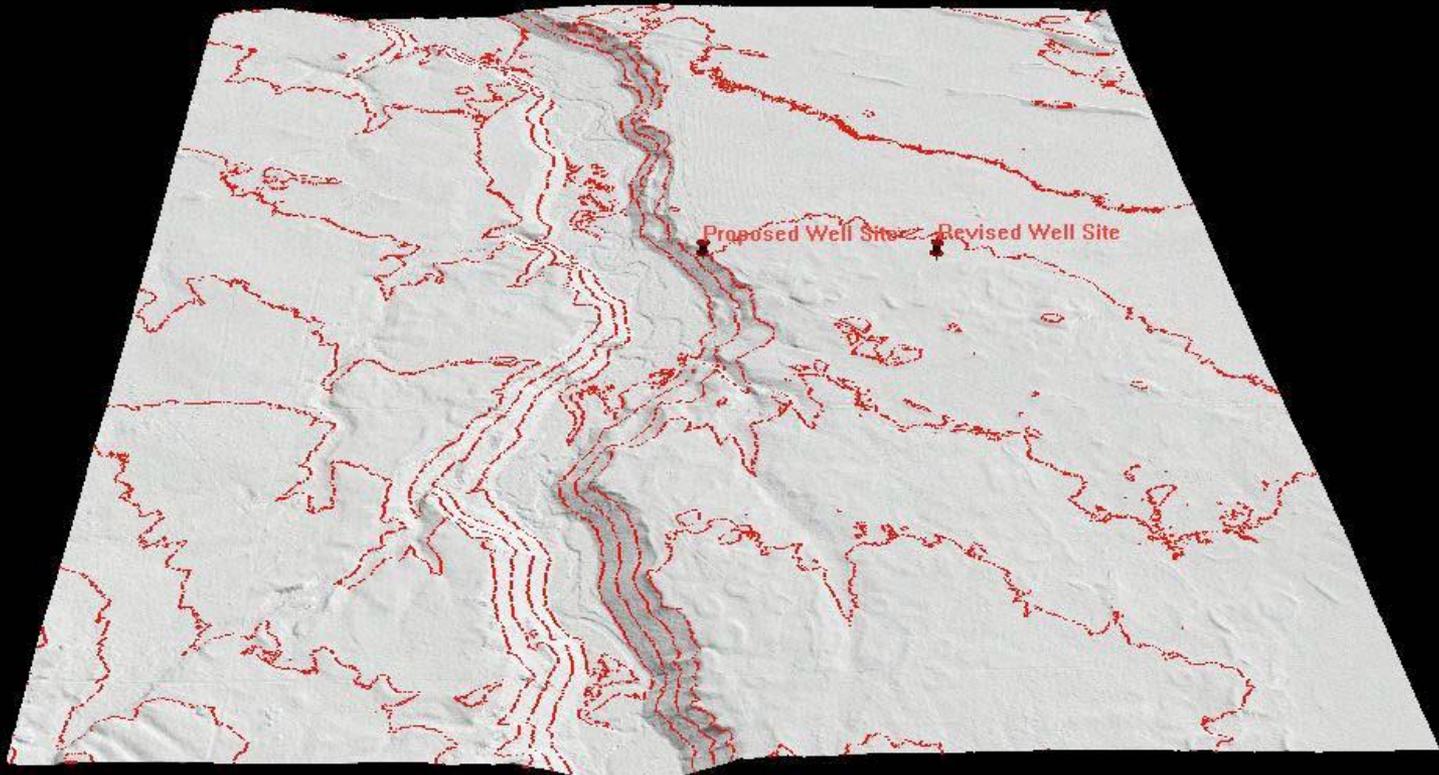# Optech – Airborne Laser Mapping

Raw Image – depth is colour coded

Building, outlines, trees and wires

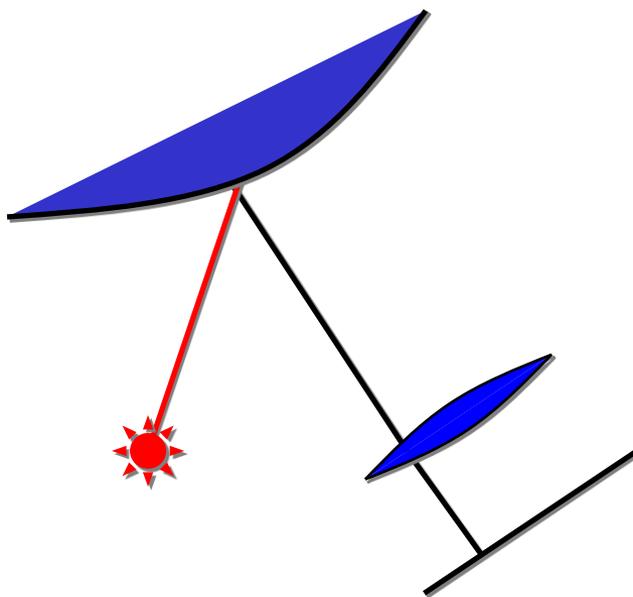# Bare Earth Model

Removing the trees

Triangulation

Like stereo, but one camera and a light source

Many possible light sources and variations

Still use triangulation to find the depth

Simplest possible triangulation system?

Take two calibrated stereo cameras

Use a laser pointer to shine light on where we want the depth

Find that laser spot in both images

This is easy because the laser spot is very bright compared to the rest of the world

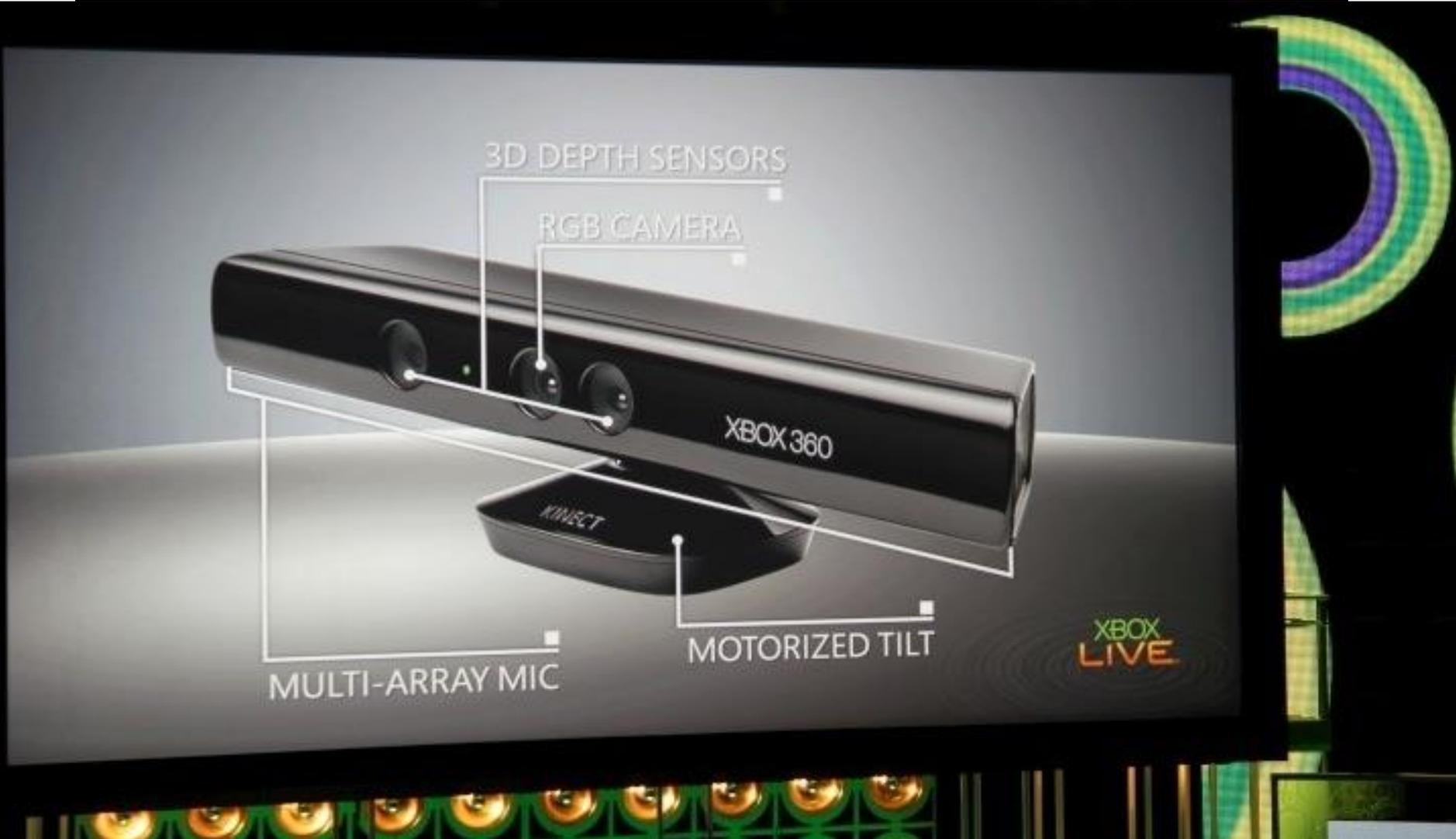This works, but getting data is very slow since you must move around the laser spot

Very easy to build, and to make it work!

Triangulation can be very accurate

Can get accuracy down to 20 microns
(1/50th of a millimeter!)

Kinect Hardware

Microsoft Kinect

A triangulation based system for finding depth

It was designed to interpret motions, not to build accurate 3d models or measure objects

Frequency of infrared projector similar to sun

So can not be used close to a window or be taken outdoors

Still, for Human Computer Interaction, Kinect is a big breakthrough

The first inexpensive and mass produced active sensor for consumers and researchers