

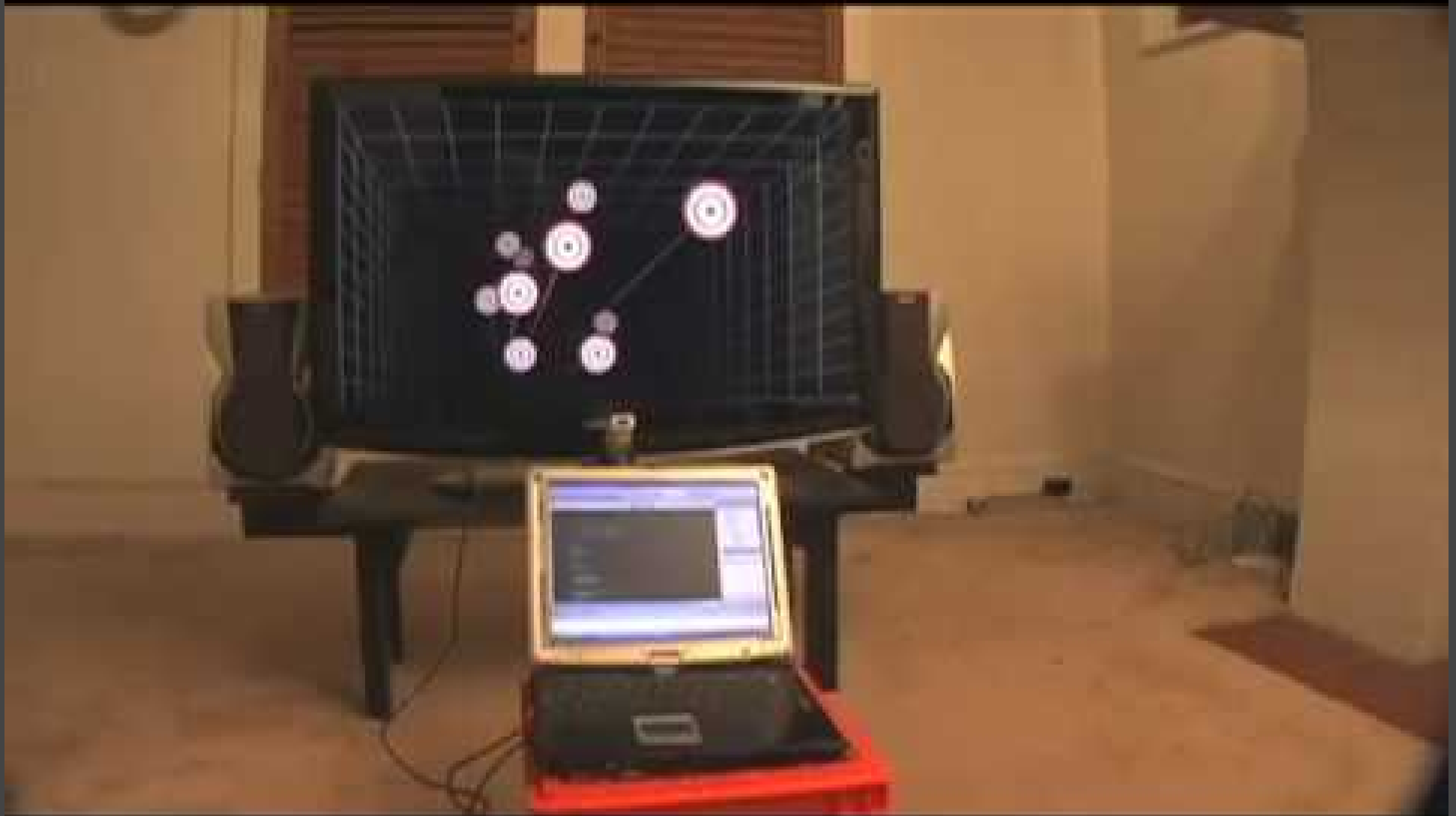
K I N E C T

# Hardware hacking





- Motion sensing (vertical axis, left-right horizontal axis, horizontal rotation)
- Infrared optical sensor
- 8 × Digital buttons
- Digital D-pad



VR Display (with head tracking)

# Hardware hacking

Open Kinect

The Open Kinect project – THE OK PRIZE – get \$2,000  
bounty for Kinect for Xbox 360 open source drivers



Update: We've increased it to \$3,000 – why? [We just read this at CNET...](#)

But Microsoft isn't taking kindly to the bounty offer. Bounty offered for open-source Kinect driver – "Microsoft does not condone the modification of its products," a company spokesperson told CNET. "With Kinect, Microsoft built in numerous hardware and software safeguards designed to reduce the chances of product tampering. Microsoft will continue to make advances in these types of safeguards and work closely with law enforcement and product safety groups to keep Kinect tamper-resistant."

4 Novembre

**Get \$2,000 bounty for Kinect for Xbox 360  
open source drivers**

10 Novembre

**WE HAVE A WINNER – Open Kinect driver  
(s) released**



<http://openkinect.org>

# Microsoft

The first thing to talk about is, Kinect was not actually hacked. **Hacking would mean that someone got to our algorithms that sit inside of the Xbox and was able to actually use them, which hasn't happened.** Or, it means that you put a device between the sensor and the Xbox for means of cheating, which also has not happened. That's what we call hacking, and that's what we have put a ton of work and effort to make sure doesn't actually occur. **What has happened is someone wrote an open-source driver for PCs that essentially opens the USB connection, which we didn't protect, by design,** and reads the inputs from the sensor. The sensor, again, as I talked earlier, has eyes and ears, and that's a whole bunch of noise that someone needs to take and turn into signal.

*Mr. ALEX KIPMAN (Director of Incubation for Xbox at Microsoft)*

# Two other libraries

<http://www.openni.org/>

- by the makers of the Kinect sensor
- supports skeleton detection

<http://codelaboratories.com/nui>

- Windows
- not very developed, but...
- works (partly) with Processing & OpenFrameworks

# Hardware hacking

How-to

Let's first check the connected USB devices with

**system\_profiler SPUSBDataType**

<http://ladyada.net/learn/diykinect/>

# Kinect

Inputs / Outputs

# Kinect

- RGB video
- IR video
- raw distance (11bit = 2048 values)
  - distance as a grayscale picture (8bit = 256 values)

*640x480 @ 30fps*

- 2 accelerometers
- multi-array microphone (*not supported yet*)
- controllable motor

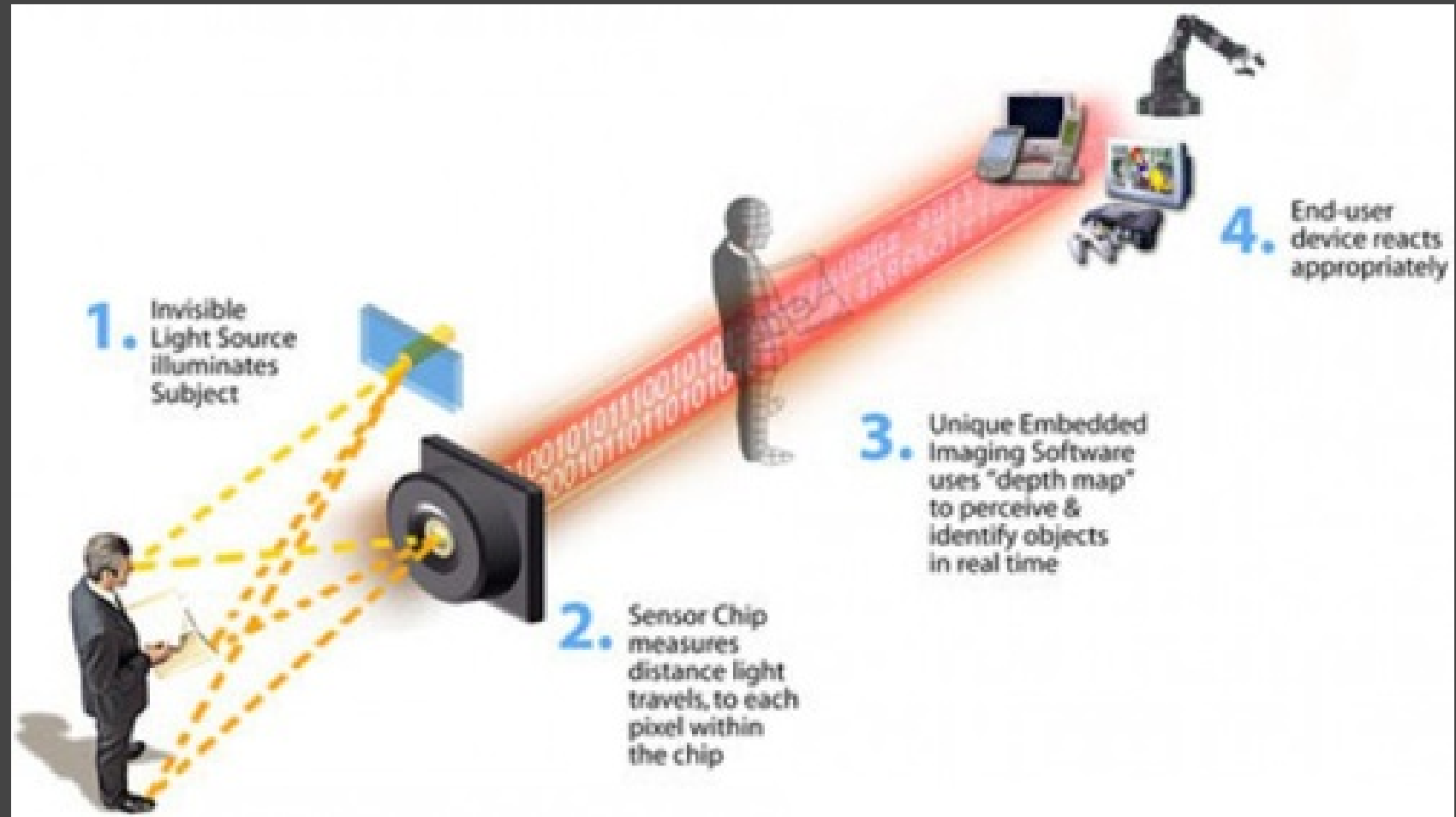
# Kinect: area

- sensor has a field of view of  $57^{\circ} \times 43^{\circ}$
- can detect distances between 80cm - 6m
- practically, the Xbox soft uses a range of 1.2 - 3.5m
- at the minimum distance of 80cm  
the resolution is +/- 1.3mm per pixel
- but there's noise !

How

can the Kinect see in 3D?

# Time-of-flight camera?



# Time-of-flight camera?

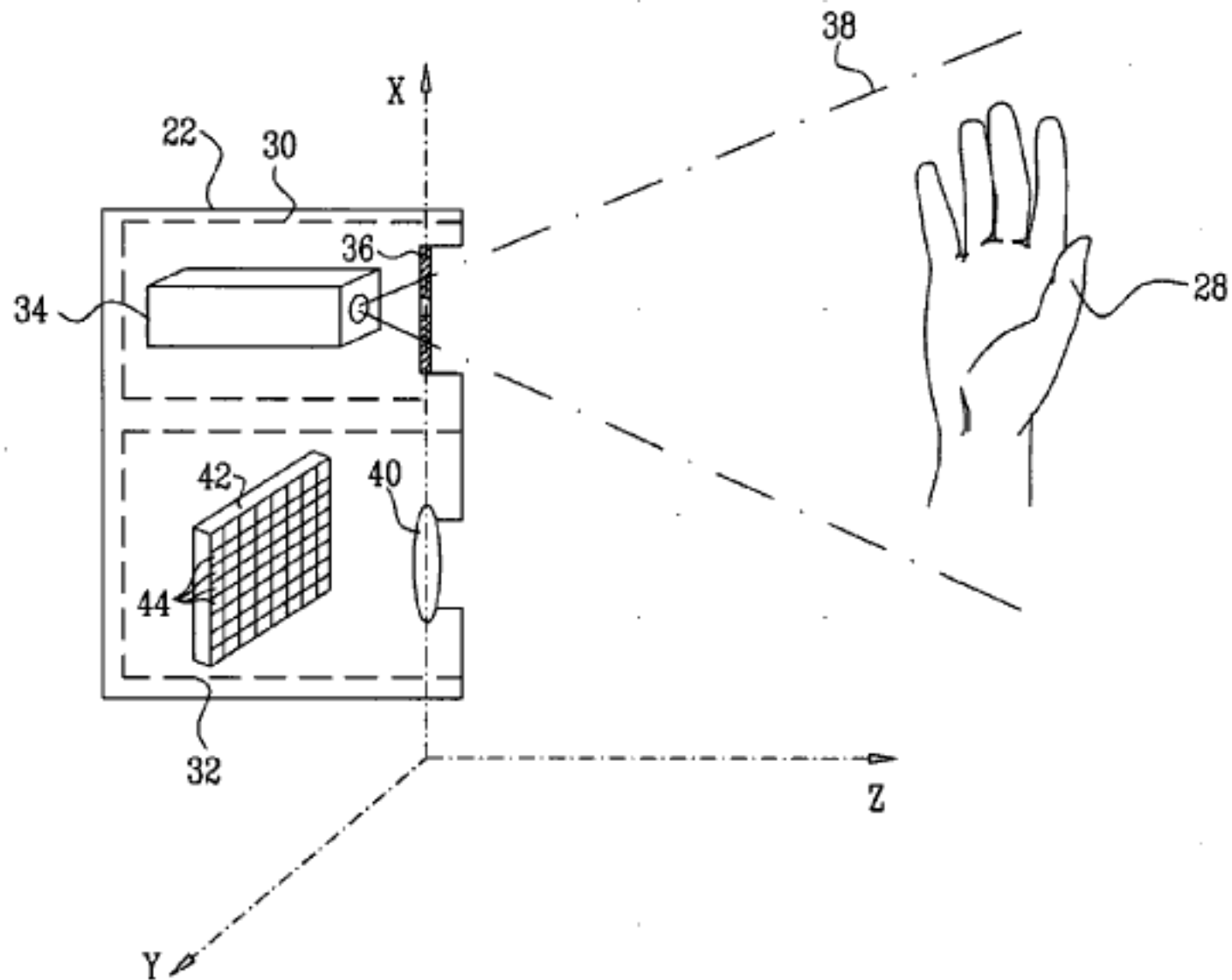
- needs a modulated laser
- and a camera that can measure that "time-of-flight"

# According to PrimeSense

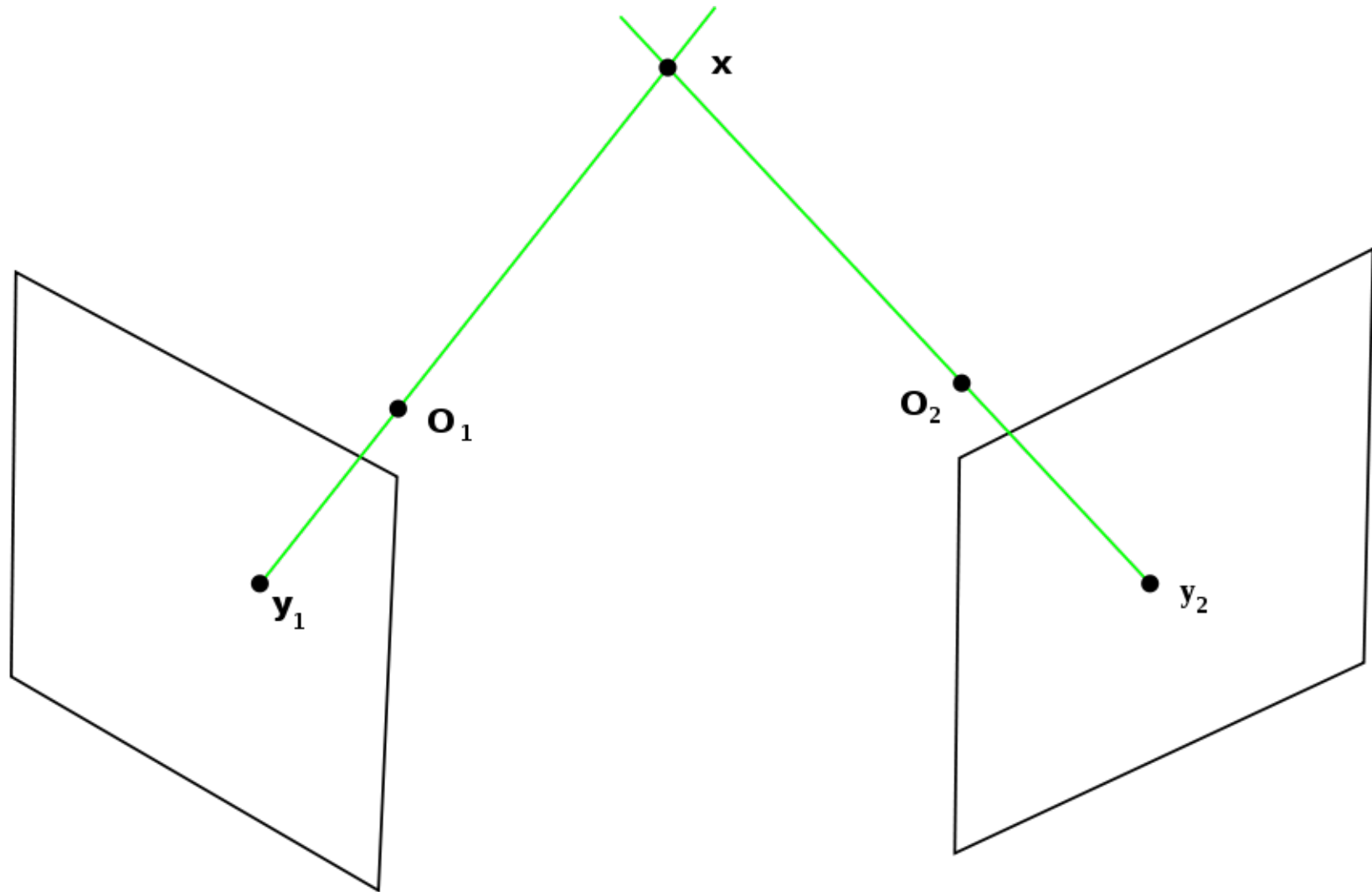
"PrimeSense's technology for acquiring the depth image is based on Light Coding™. Light Coding works by coding the scene volume with near-IR light. The IR Light Coding is invisible to the human eye. The solution then utilizes a **standard off-the-shelf CMOS image sensor** to read the coded light back from the scene. PrimeSense's SoC chip is connected to the CMOS image sensor, and executes a sophisticated parallel computational algorithm to decipher the received light coding and produce a depth image of the scene. The solution is immune to ambient light, and works in any indoor environment."

# The patent [\(click\)](#)

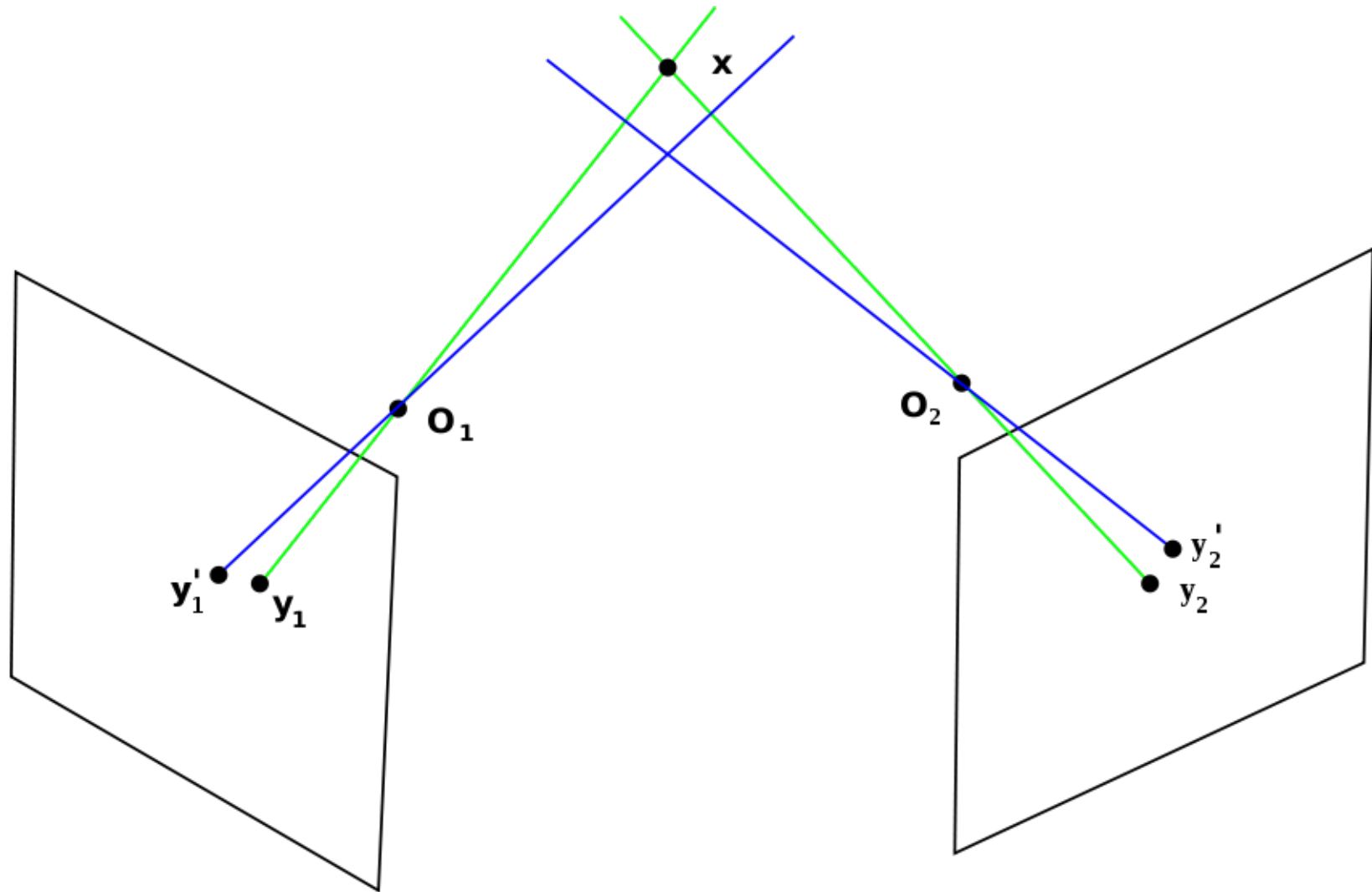
FIG. 2

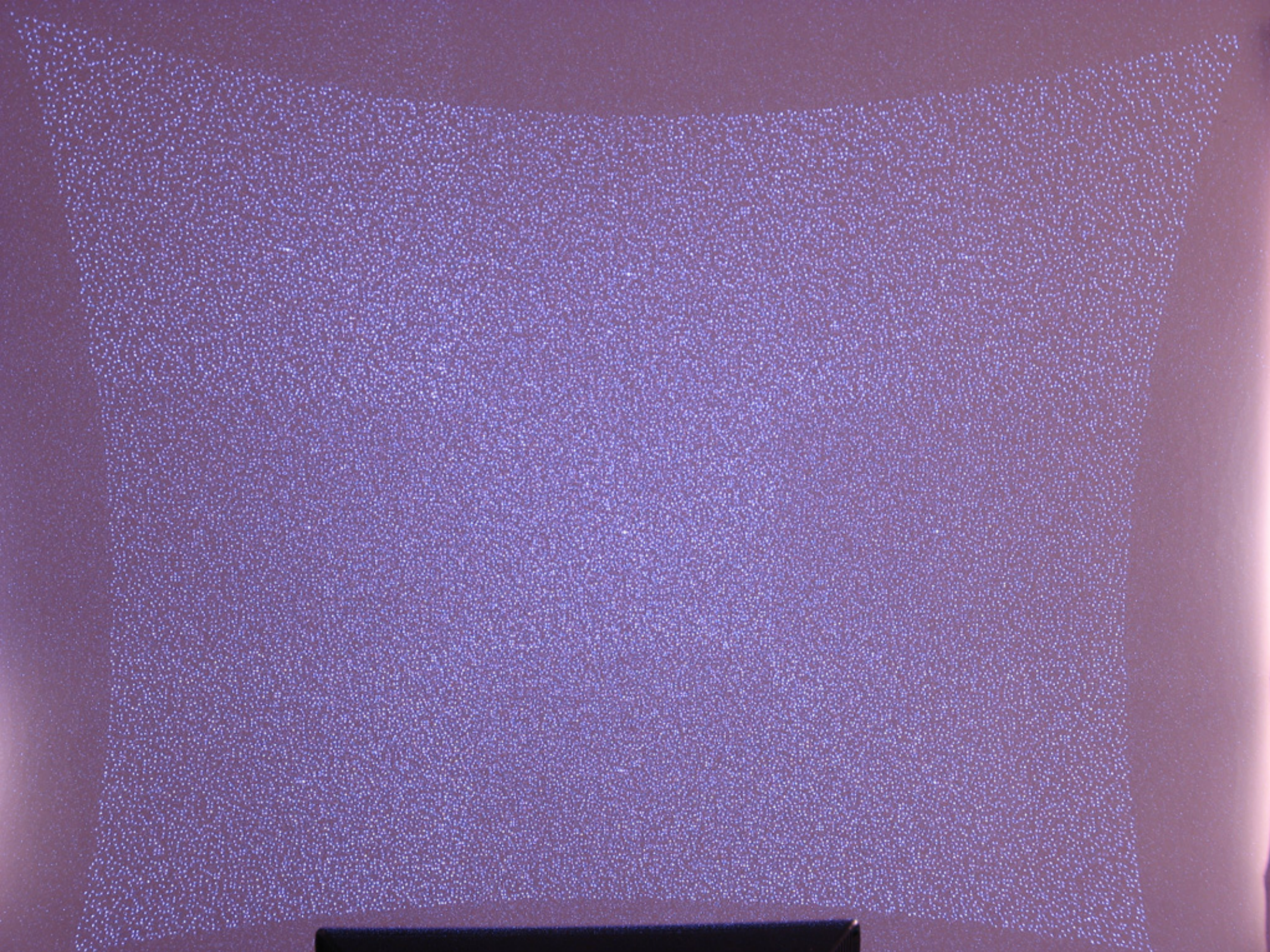


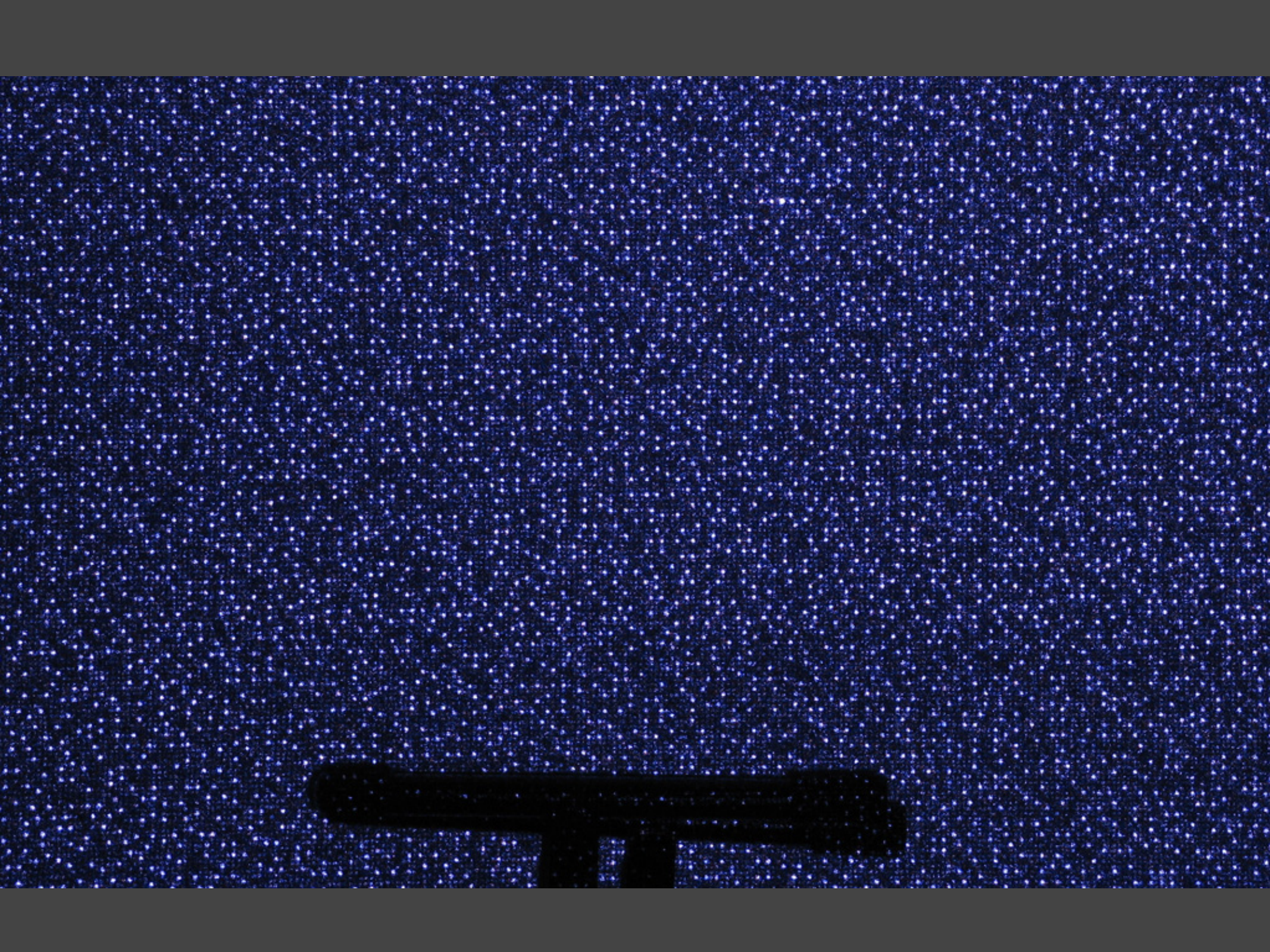
# Stereo triangulation

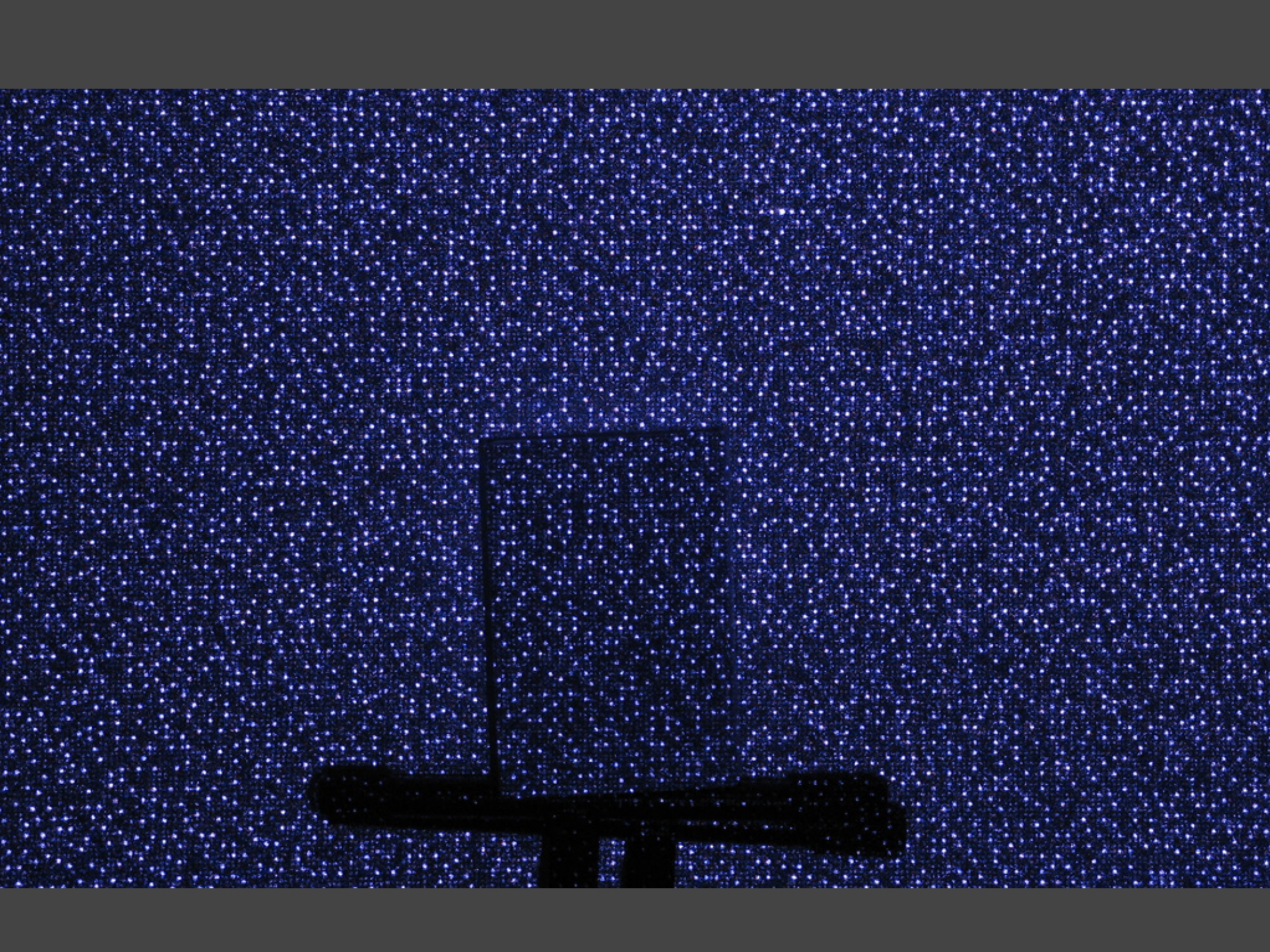


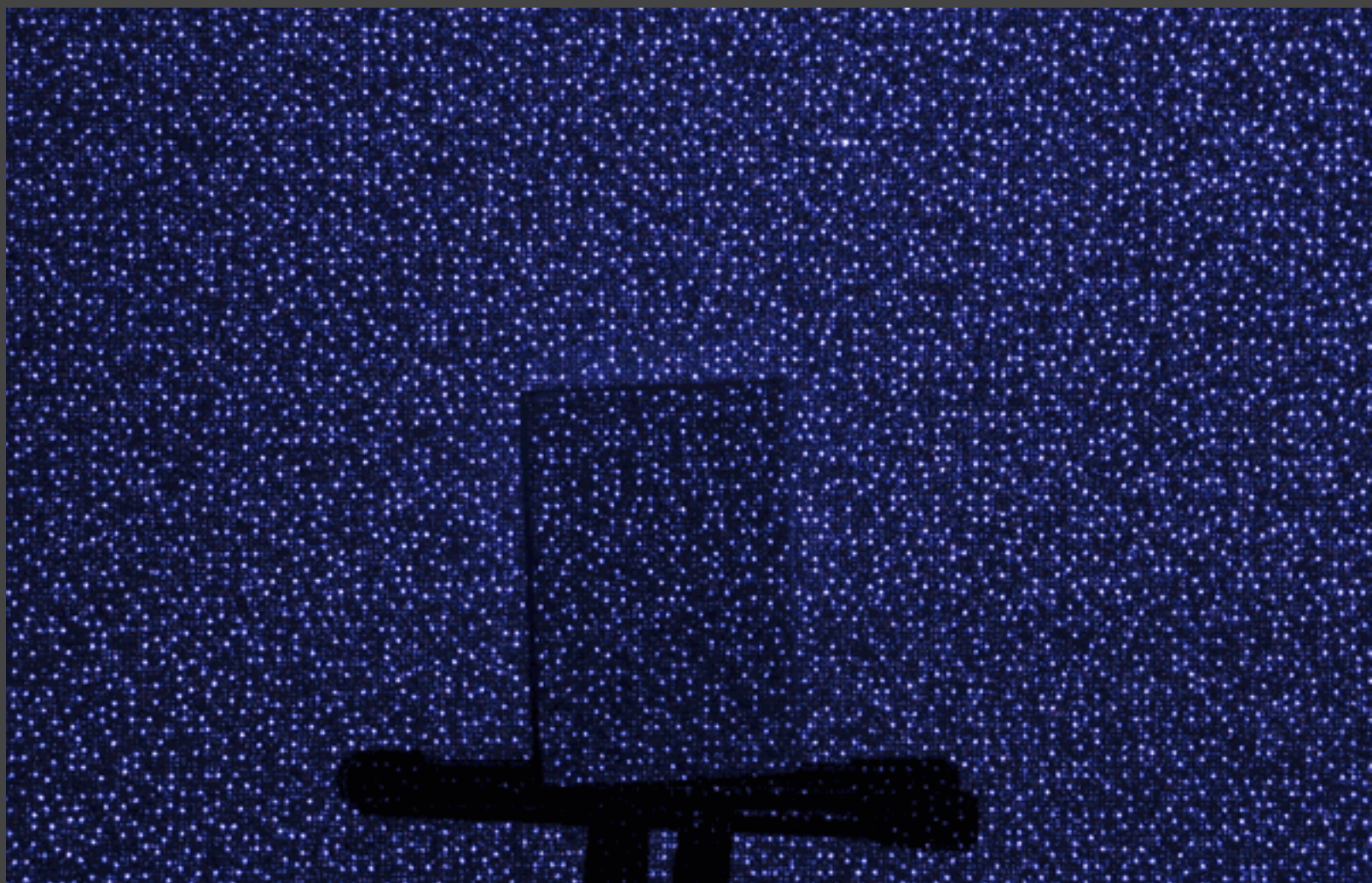
# Stereo triangulation











# Similar to Structured Light



How Kinect helps us

with computer vision



# Demos

- CV
- 3D
- Skeleton
- Multitouch

# Libraries / Tools

## Google Doc

- OS X : OpenFrameworks / Processing?
  - > Libfreenect (OpenKinect)
- Windows?
  - > CL NUI :(
- Skeleton?
  - OSCeleton for everyone