Dual Structured Light 3D using a 1D Sensor

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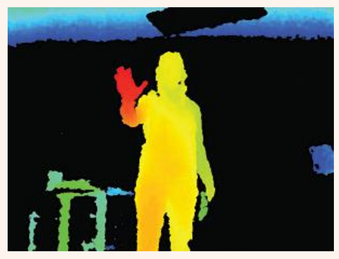
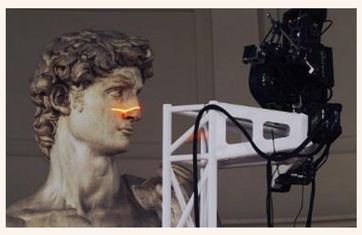
Why Use a 1D Sensor for 3D Scanning?

Pattern on scene



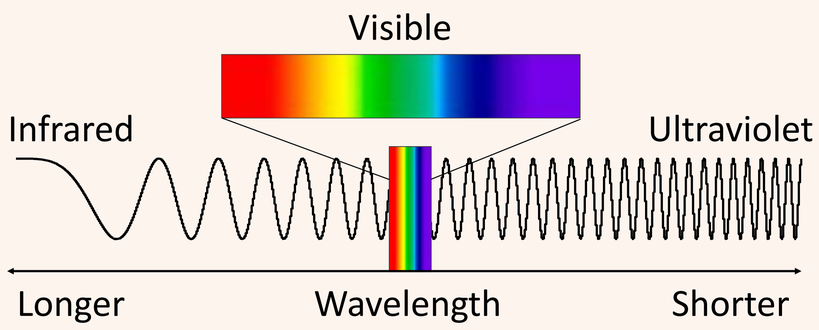
Depth map

Microsoft Kinect

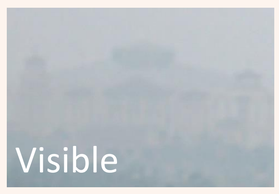


The Digital Michelangelo Project

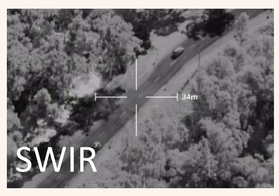
Structured Light 3D Imaging



Short-wave infrared (wavelength 0.9um~2.5um)



Penetrate Atmosphere Obscurants



See through Smoke and Fire

Structured Light Outside Visible Spectrum or Using Special Sensors

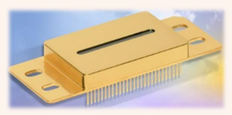
Per-pixel Price

Spectral band	Detector Technology	$/pix
NIR/VIS/NUV	Si	$< 10^{-6}$
SWIR	InGaAs	10^{-1}
Dynamic Vision Sensor		10^{-1}

Case studies:

Cost $100K

2D SWIR Camera
1024×1024

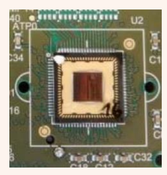


Cost $100

1D SWIR Camera
1024×1

Cost $5K

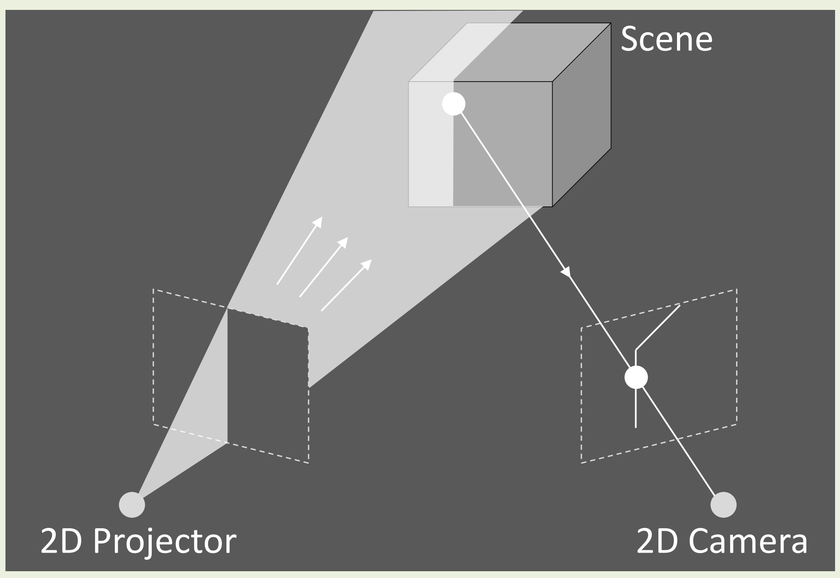
2D DVS Camera
240×180



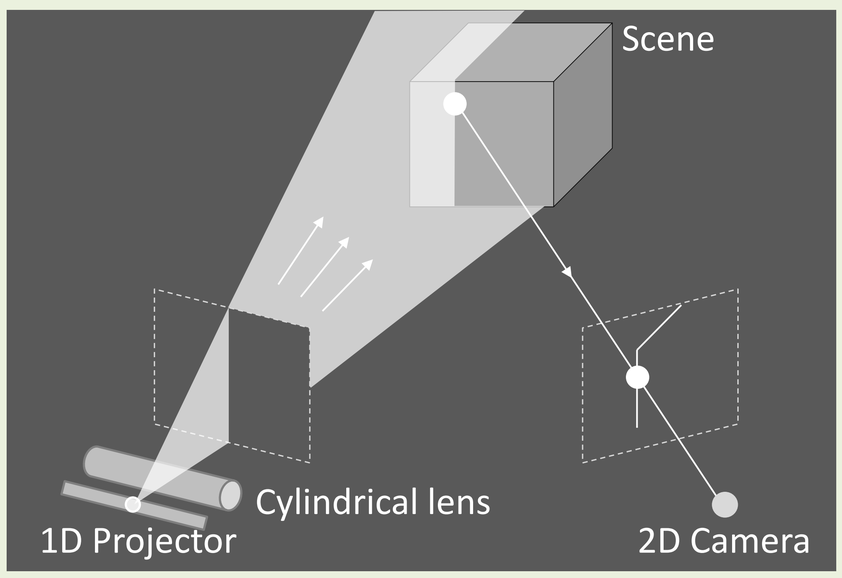
Cost $100

1D DVS Camera
1024×1

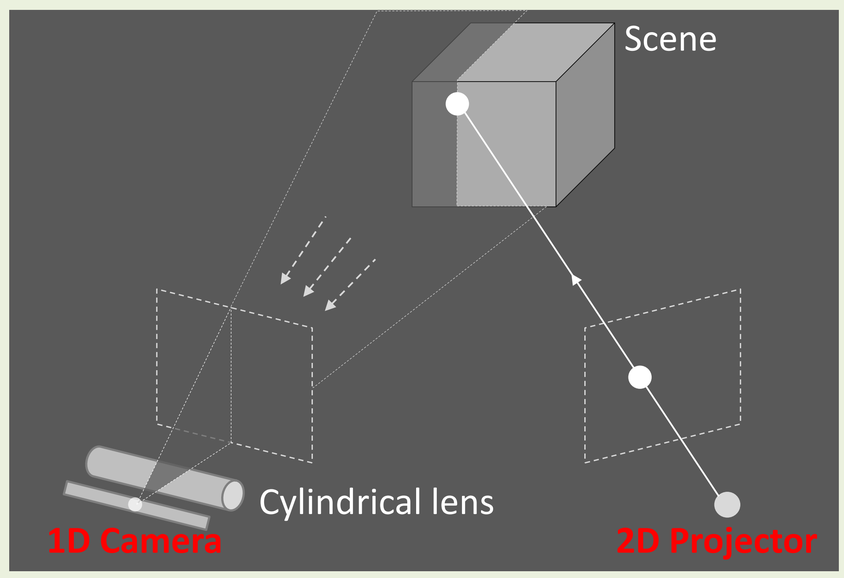
Proposed: Optical Dual of Traditional Structured Light System



3D location obtained by
ray-plane triangulation



Replace the 2D projector by
1D projector + cylindrical lens

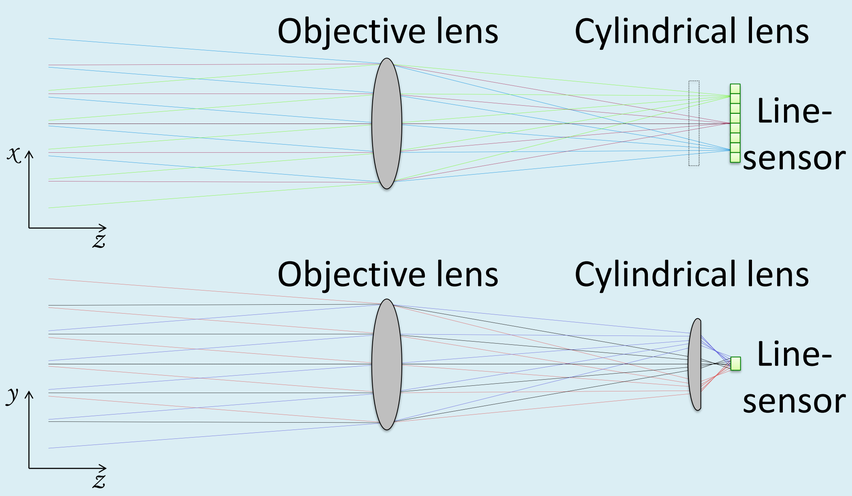


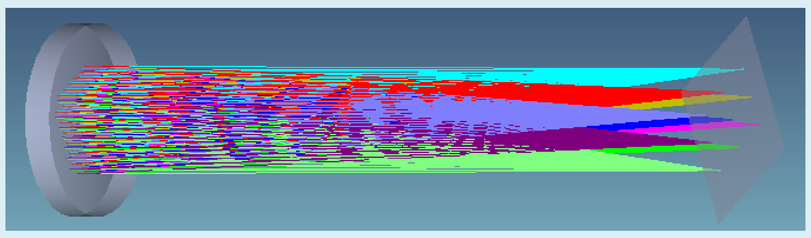
Switch the role of camera
and projector

Conventional Structured Light

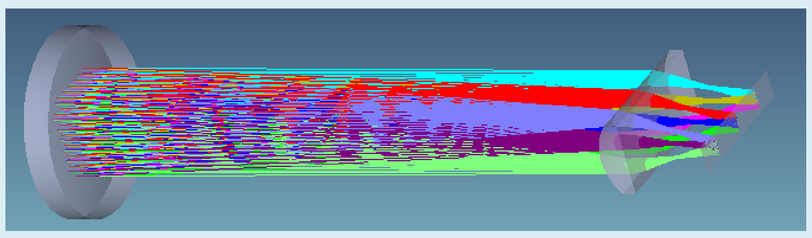
Proposed: Dual Structured Light (DualSL)

Hardware Prototype and Results



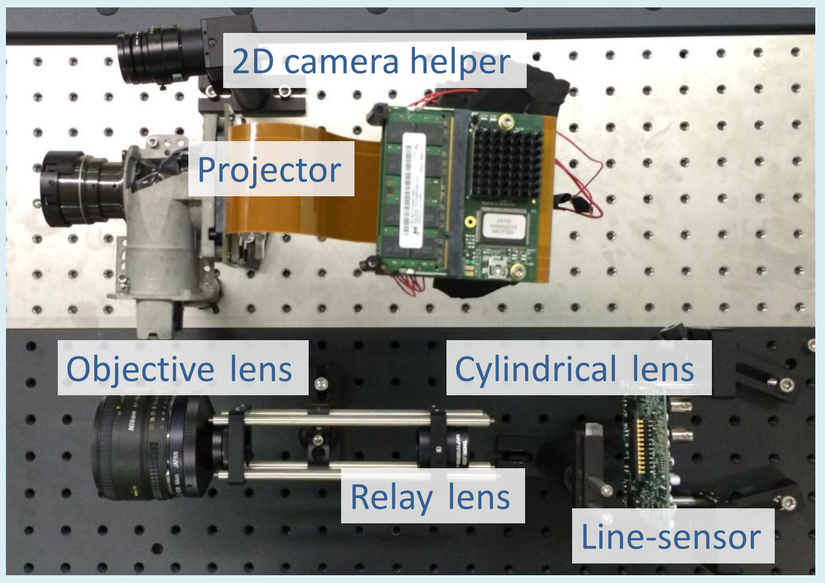


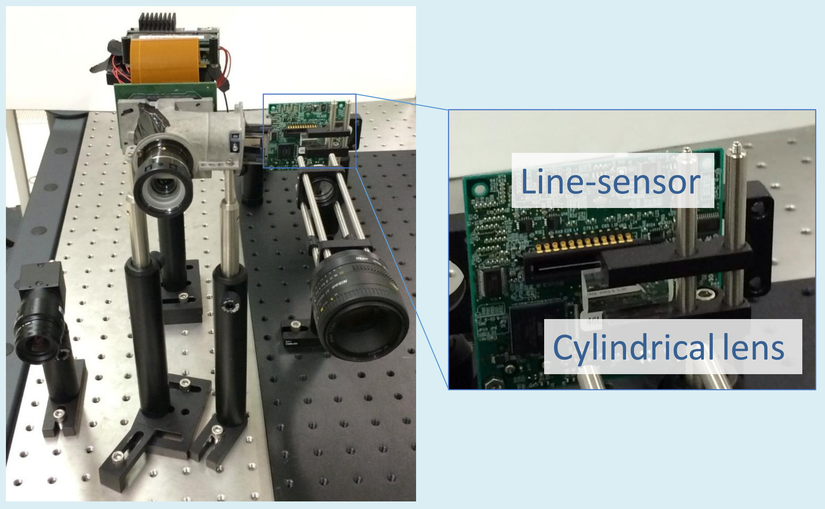
Without cylindrical lens



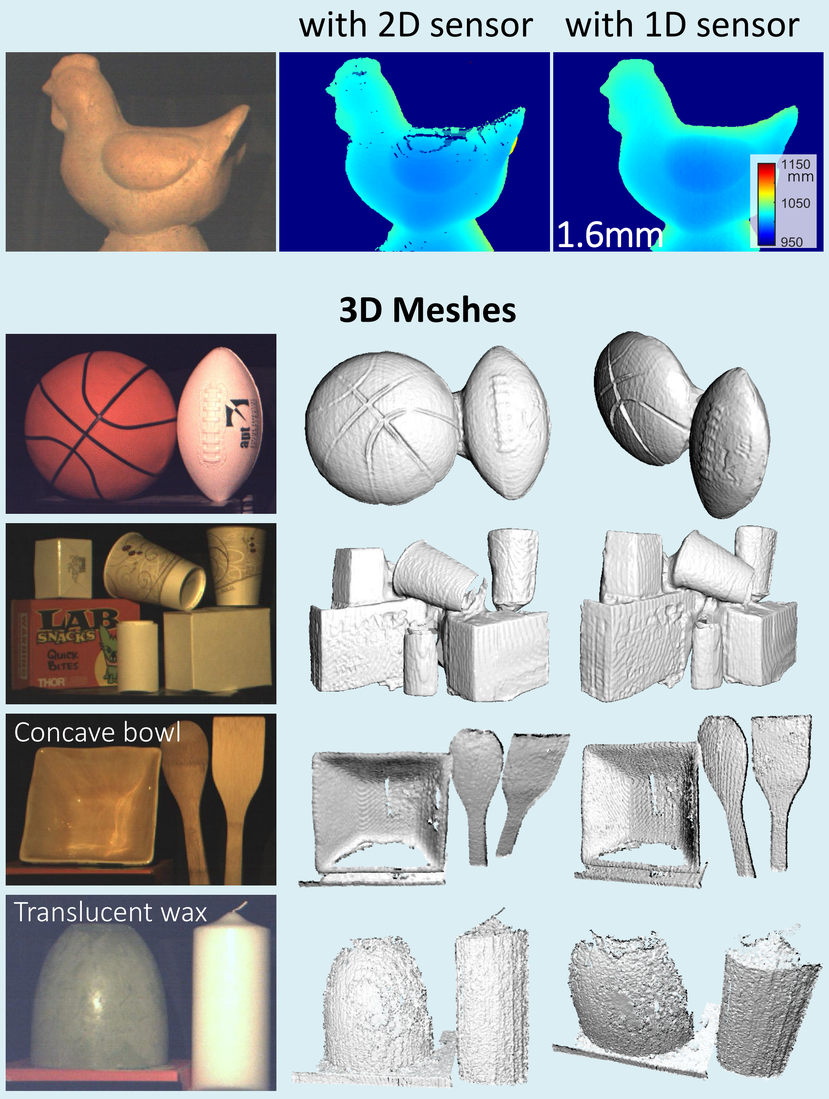
With cylindrical lens

Ray Diagrams of the Optics Design





Hardware Setup



Results