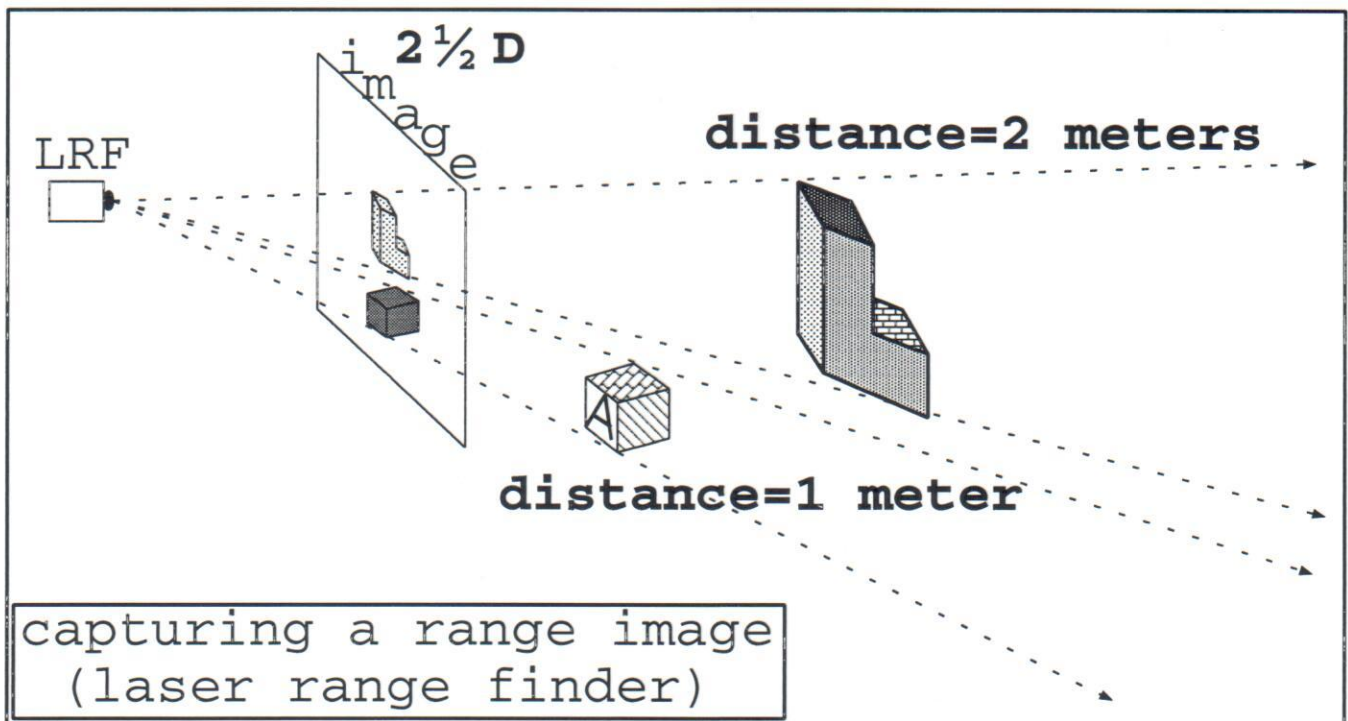
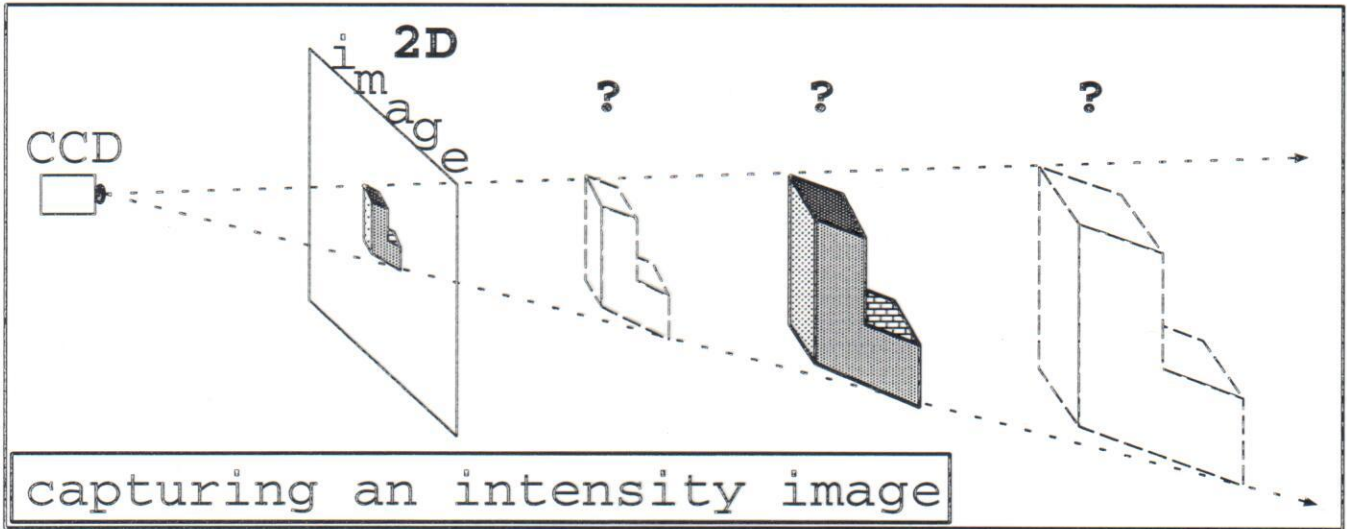


What is range data?



How Range Cameras Work

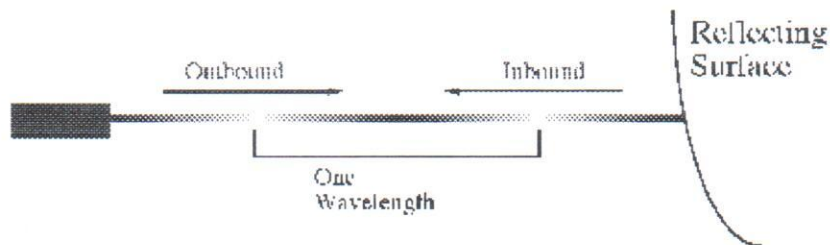
Judson P. Jones

Diffuse Reflection



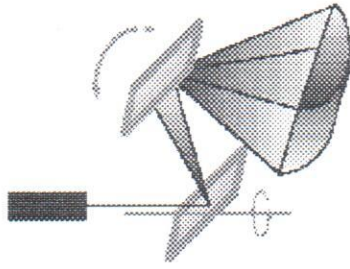
Light emitted from a laser scatters when it hits most objects. Some of the light reflects back in the direction of the laser.

Amplitude Modulation



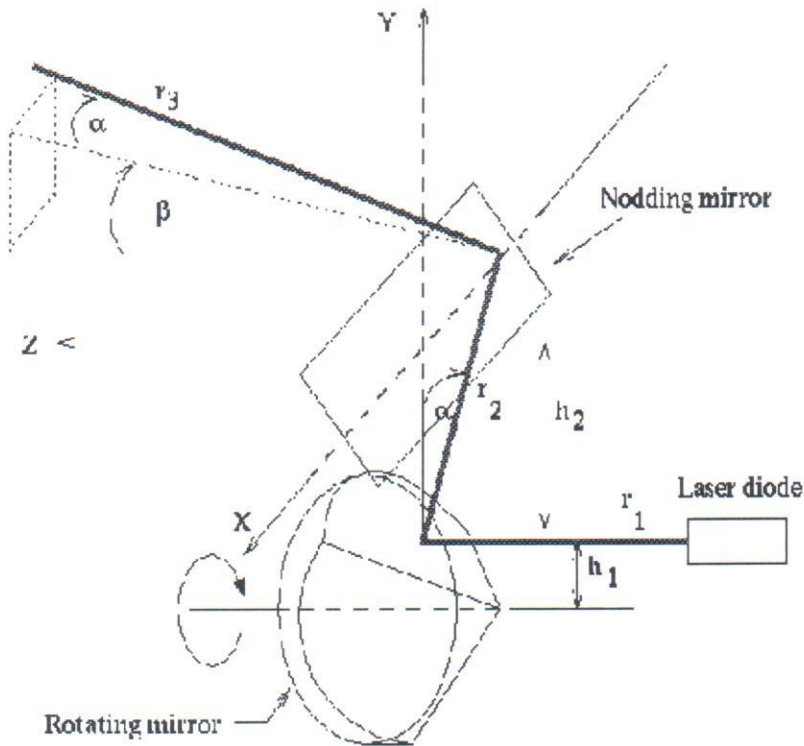
The light is amplitude modulated so that a standing wave is created between the laser and the object of interest. The distance to the object is determined by measuring the relative phase of the outgoing and incoming beam. The reflectance of the object is determined by measuring the relative amplitudes.

Image Formation



Two rotating mirrors sweep the beam over a 60 by 60 degree field of view.

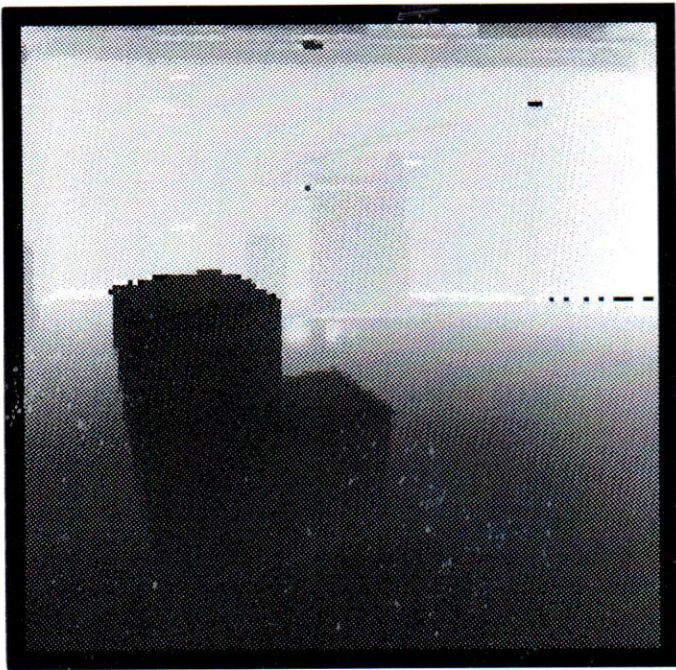
Calibration



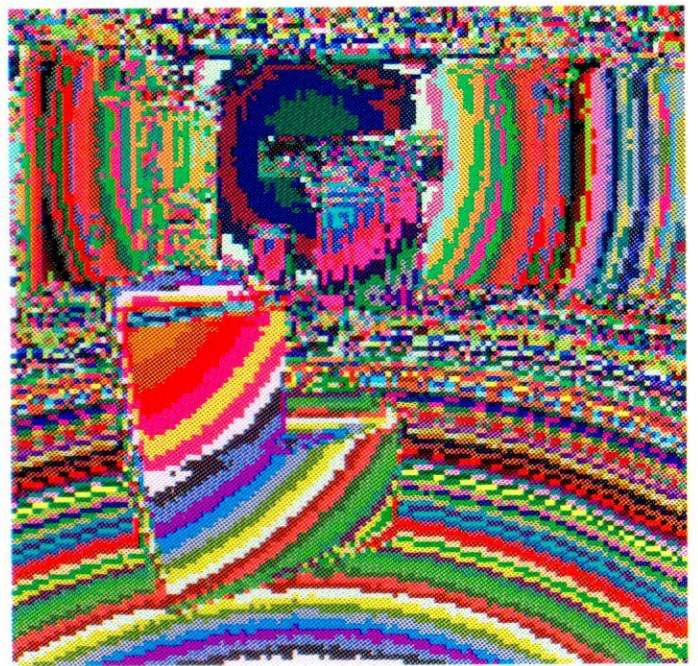
This is not as easy as it looks. Because image formation is not done with a lens, as in conventional cameras, we were forced to develop an explicit mechanical model of the camera, and a new calibration method. See O.H. Dorum, A. Hoover, J.P. Jones (1995) "Calibration and control issues in range imaging for mobile robot navigation." In: *Research in Computer and Robot Vision*, Ed. C. Archibald & P.Kwok, World Scientific Press, Singapore.

A Range Imaging System

Example LRF image



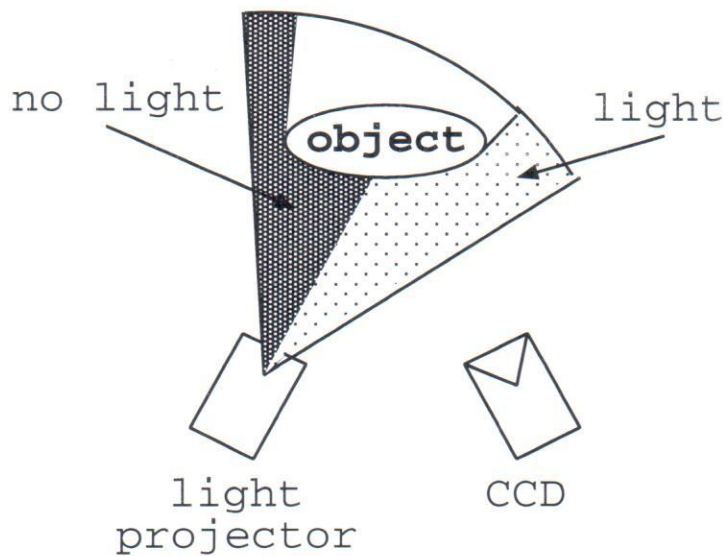
distances coded in greyscale



distances coded in color

How does a structured light type range camera work?

ACQUIRING IMAGE ONE



ACQUIRING IMAGE TWO

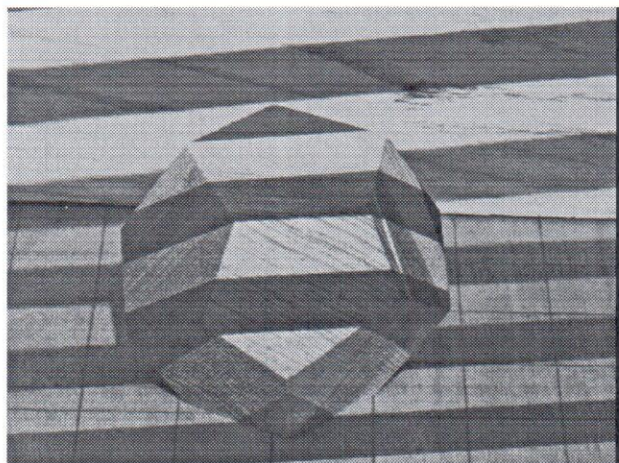
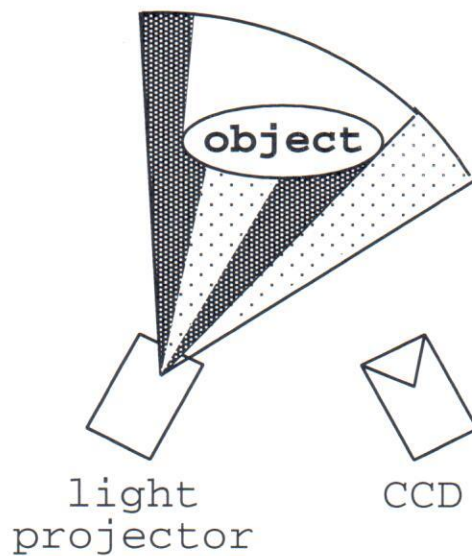


image 3 of 8

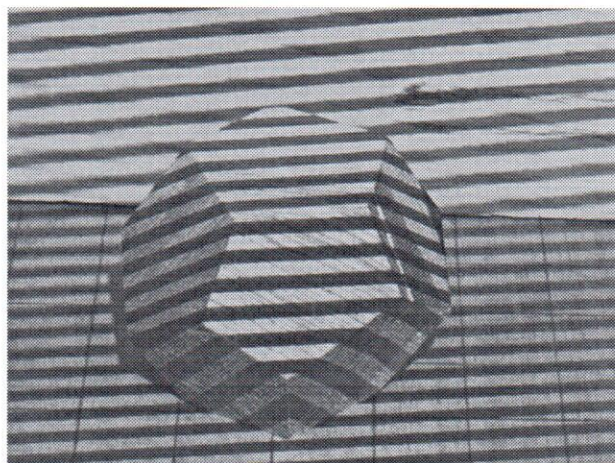
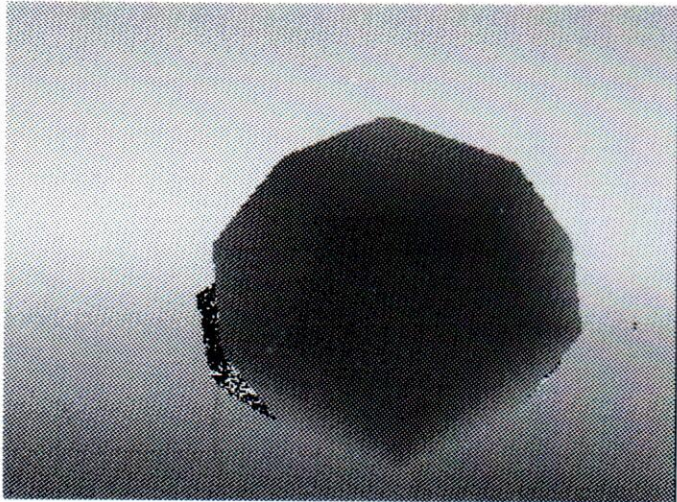
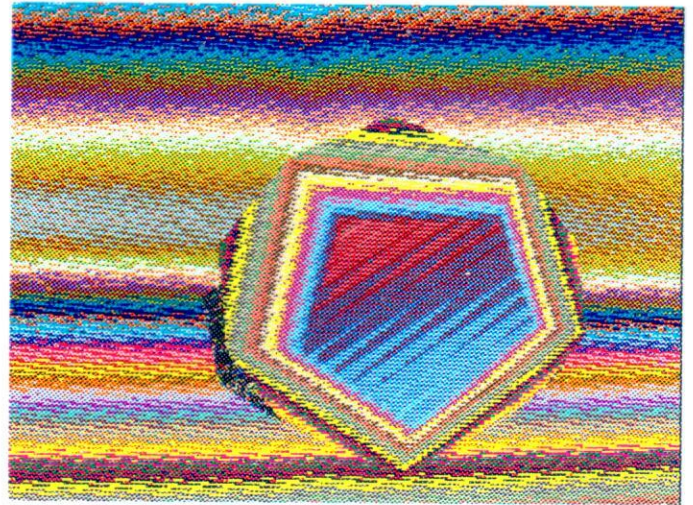


image 5 of 8

Example SLS image

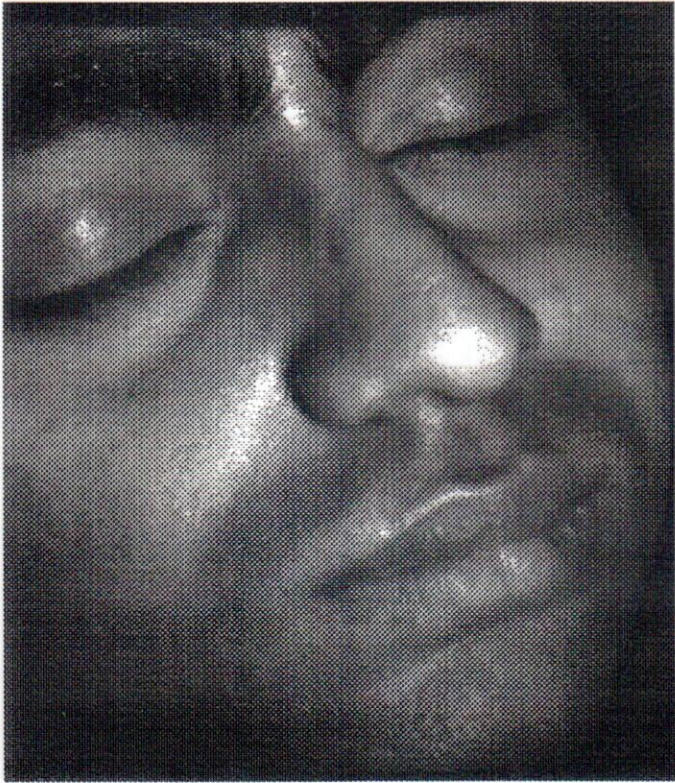


distances coded in greyscale

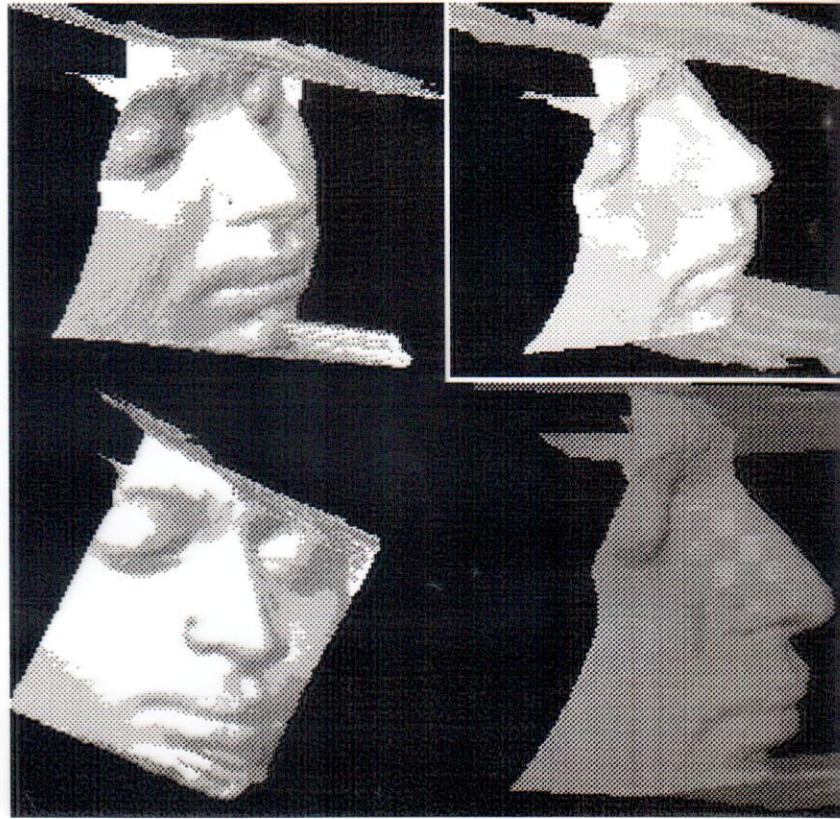


distances coded in color

$2\frac{1}{2}$ -D Data



original image



four views of 3D points