PLazeR

a proposal for a planar laser rangefinder

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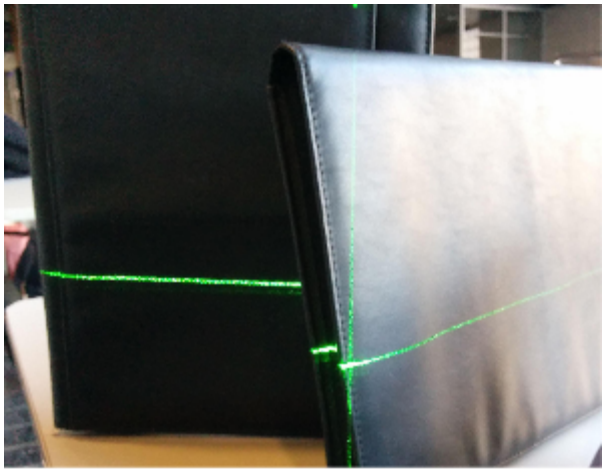
Concept:

Detecting the distance between a sensor and objects in a scene is a useful tool for machine perception and robotics. Most rangefinders use either light or sound as their primary media, and then use triangulation or time of flight to determine distance.



Laser beam visible in scene.

We intend to use a planar laser to build a laser rangefinder that can simultaneously determine the distance to various objects in the scene.

As we can see in the image to the left, the distance of an object is related to the height of the projected laser line. We can detect the laser line at each column in the camera image, and then use that to generate a planar point cloud.

Implementation:

We plan to implement a hardware-software hybrid solution for the image processing part. The USB camera feed (which we expect to be 640x480 at 60fps) will be sent to a digital signal processor implemented on the FPGA to process the frame. The signal processing pipeline can be broken down into the following steps:

- Calibration
  - Determine camera intrinsic matrix to find mapping between scene coordinates and camera pixels
  - Fix camera exposure and framerate so that the intrinsic matrix is roughly invariant
- Sensing
  - Convert camera image into scene coordinates using camera intrinsic matrix
  - Detect position of laser line. The laser is fairly bright, so we can probably do this with a convolutional thresholding system.
  - Find distance to specified point on the plane.

We can then use this distance output in other software to build cool things, like a radar display.