Expansion of Laser Light in the Hydrolab

MIDN 3/C Chris Maldonado
MIDN 4/C Matthew Carothers
MIDN 4/C Jonathan Lucas
Professor Svetlana Avramov-Zamurovic
Department of Weapons and Systems Engineering
Professor Reza Malek-Madani
Department of Mathematics

3/C Maldonado

4/C Carothers

4/C Lucas

Experimental Goals

- To examine the propagation of laser light over the length of the hydrolab.
- To make qualitative analysis of the shape, location, and intensity of the beam.
- To examine how these qualities are changed over specific distances.

Procedure

- Set up laser on “beach” of the Hydromechanics Laboratory
- Measure desired intervals
- Reflect laser light using a highly polished mirror back to a sheet of white paper marked with a 1 in^2 square
- Using Thor labs camera, capture picture of laser light on white paper
- Use Matlab to breakdown, and analyze the shots
- Compare shots to make qualitative analysis

Laser used for experimentation:

- Metrologic Neon Laser ML868
- Polarization: Random
- Laser Mode: TEM00
- Input Voltage (V) 110
- Input Current (mA) 80
- Wavelength (nm) 632.8
- Optical Output Power, Nominal mW 1.5 mW / Power, (min/max) mW 1.00 / 2.90 Beam
- Diameter (mm) 0.66 Beam
- Divergence (mRad) 1.25

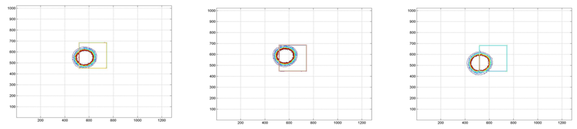
General equation for the spot radius of laser light over distance:

$$w(z) = c\sqrt{(1-\frac{z}{a})^2+\frac{x^2}{y^2}}$$

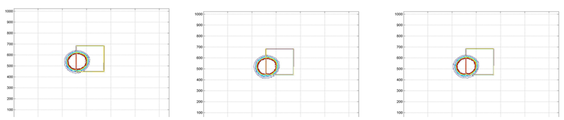
In this equation, a, b, and c relate to amplitude, wavelength, and phase.

Data:

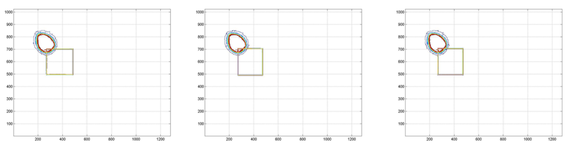
20 ft.



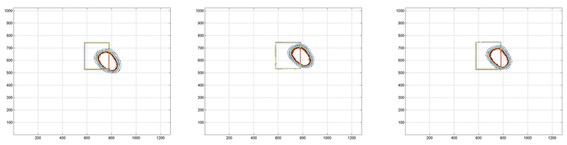
40 ft.



80 ft.

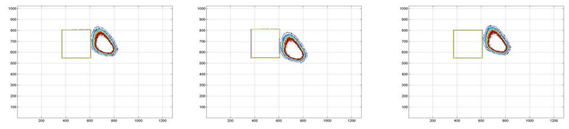


120 ft.

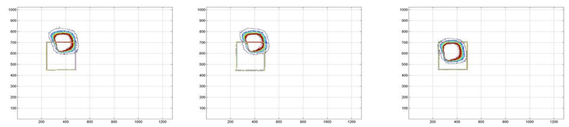


*The boxes added into the Matlab figures represent 1 in^2

160 ft.



200 ft.



Conclusions:

- As distance increased, the radius of the expanded beam increased, and the intensity of the light dramatically decreased.
- At the largest distances, the beam no longer had distinct symmetry or shape.
- Lost distinct qualities mentioned above at around 80 ft.