Phys 323 - Lab #2: Fiber Optics

Lab Purpose

To gain experience using fiber optics by: 1) experimenting with coupling laser light into a fiber, 2) demonstrating that fibers have a numerical aperture (NA), 3) exploiting the NA of a fiber by building a fiber-based position sensor, 4) exploiting mode extincting at the core/cladding interface by building a force sensor using a fiber "crush" configuration.

Lab Description

Get a length of black fiber and launch laser light into it. See how much power you get out of the fiber relative to the total power output of your laser. Next see if you can couple more light into the fiber by focusing the laser onto the fiber aperture with a microscope objective lens. Determine the NA of the fiber by mounting its aperture exactly on the axis of rotation of a rotation stage. Plot power coupled in for a variety of angles, and determine the NA of the fiber from this plot. Next, with the lens-coupled fiber, and a precision translation stage, build a calibrated position sensor (see Fig 1). When done, demonstrate to your instructor that you can determine the position of your object from a power reading alone. Lastly, determine the weight of a large gray brick by building a fiber crush sensor (see Fig. 2). You can calibrate it with the small red bricks that are 3.7 pounds each.

Supplies Available

Fibers, power meter, rotation stage, translation stage, laser, optical hardware in drawer, Internet, other students, instructor, book.

Grading Rubric

Points	Condition of your lab report
5	Numerical comparison and written-assessment of your efforts to couple laser light into a fiber. Present your graph (power vs. angle) and reported NA for the fiber. Assessment on why the graph indicates that fibers have an NA. Graph of position sensor calibration data (power vs. distance), with full description on why this is a position sensor and how it works by exploiting the NA of the fiber. Summarize numbers presented to your instructor. Present your calibration function that returns distance as a function of power. Graph of crush sensor calibration and full computation of how the weight of the unknown brick was determined. Present a function that returns weight as a function of power. Report includes a good amount of narrative tying the graphs to the equipment and the optical phenomena exploited for each. An excellent report.
4	Minor shortcomings relative to the 5-point report. At most one item described missing or unclear. Still quite a good report, but falls a bit short of the top grade.
3	Starting to reveal a lack of completeness and clarity to the needed presentation. Ideas and/or work missing or wrong.
2	Several crucial elements outright missing, incomplete, or wrong.
1	Work woefully incomplete or incorrect.

**** Check-out with your instructor before leaving ****

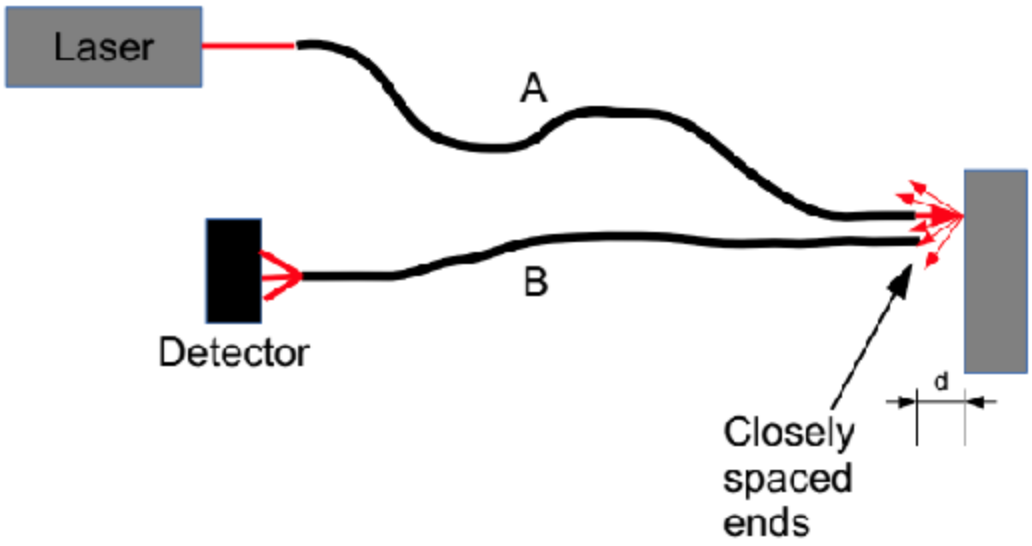

Fig. 1: Fiber optic position sensor

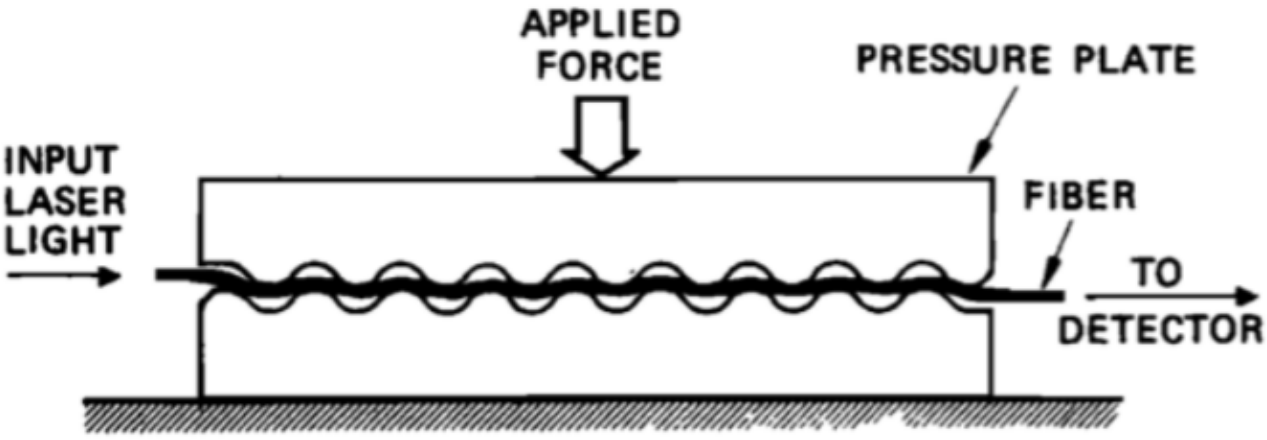

Fig. 2: Fiber optic weight/pressure sensor.