

OPTI 696b

Practical Optics Seminar

Wednesday, 2:00-3:15, RM305

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Chunyu Zhao
Jim Burge

Instructors

- Chunyu Zhao, assistant research professor
Lab: RM560
Tel: 626-6826
Email: czhao@optics.arizona.edu
- Jim Burge, associate professor
Office: RM733
Tel: 621-8182
Email: jburge@optics.arizona.edu

What do you expect from this class?

- What you learn from your course work is valuable! It is necessary for your success!
- But it takes a lot more than that to succeed in industry!

What optical engineers do in industry?

- Build stuff
 - Application -> specification
 - Design and analysis
 - Procuring
 - Assembly
 - Testwith constraint of budget and schedule!

Hardware is hard!

What does industry value most?

- Experience!
 - Not about knowing more physics
 - It is about knowing what works and what doesn't

Motivation

- We see a gap between what industry needs and what our students can offer
- We want to prepare you better for the real world jobs

Goal

- Bridge the gap between academia and industry.
- Make your transition from students to professional engineer easier.

What is this class?

- A seminar type class. Guest speakers will teach most of the classes (Tucson is Optics Valley! We've got to take advantage of that.)
- All about “practical optics” – how to make things work well and cost effectively in real life.

Website: www.optics.arizona.edu/opti696bx

Topics

- Optical tolerancing
- Optics fabrication
- Optical alignment
- Plastic optics
- Lithography lenses
- Machine vision lenses
- Telescope
- Illumination engineering
- Optics rules of thumb

What you'll learn

- How to translate an application to specification
- How to tolerance an optical system
- How to specify a component
- How to align an optical system
- A full cycle of development of an instrument: from design to manufacturing
- And more.

Example 1

- You need a singlet lens, yet you can't find an off-shelf one. Somebody has to make it for you. How does he know what you want?

You need to provide a lens drawing including following information:

- Material
- Nominal dimensions
- Tolerances
- Coating
- etc.

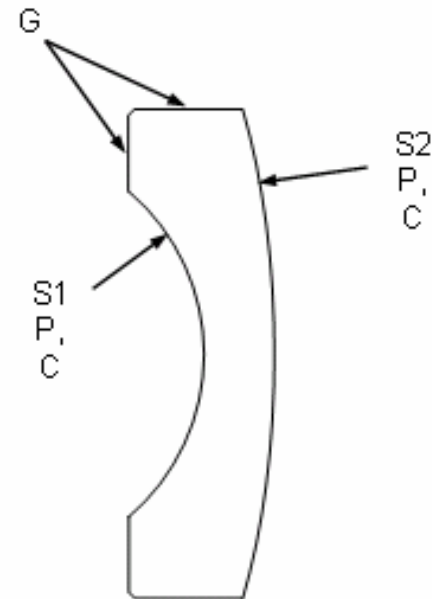
A typical lens drawing

	Radius	Radius tolerance	Power/ Irreg.	Clear aper. diameter.
S	13.589	TPF	5/3	20.6
S	64.643	TPF	5/3	29.0

Edge diameter	Diameter tolerance	CT	Thickness tolerance	Wedge
31.18	±0.05	4.45	±0.05	0.05

Notes:

- All dimensions in inches.
- Material: Optical glass per MIL-G-174 type BK7
Schott No. 517642
 $n_d = 1.5168 \pm 0.0005$ $V = 64.2 \pm 0.8\%$ striae
Grade A, fine anneal
- Surfaces marked "P" polish to power / irregularity indicated
- Manufacturer per mil-0-13830
- Surface quality 60 - 40
- Surfaces marked "C" coat with high efficiency coating with average reflectance per surface $\leq 0.5\%$ from 420 - 680 nm
- Surface marked "G" fine grind and blacken with no buildup
- Bevel edges at 45 degrees to 0.5 max face width
- Diameter to flat is 19.952 (REF) with surface sag of 5.977 ± 0.05 on surface S1



DR	
CHK	
APP	
SCALE -	

Sample Element

SPIE Lens design technical group meeting

- How to specify an aspheric lens?

Example 2

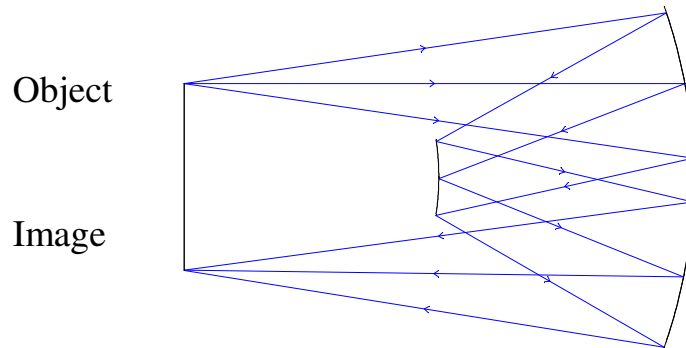
- Aware of the available technologies
 - You need an aspheric lens, how do you make it?
 - Diamond turning
 - Molded glass
 - Molded plastic
 - Diffractive
 - Refractive-Diffractive hybrid
 - What are the pros and cons for each technology

Example 3

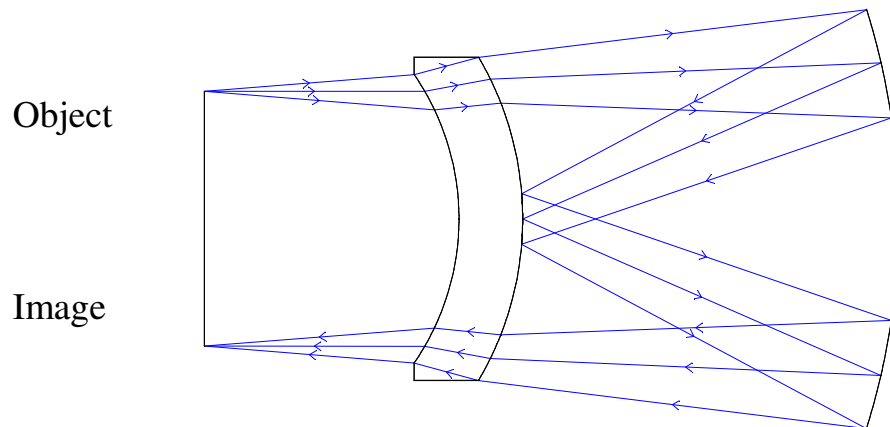
- What is a good optical design?
 - Best performance on paper?
 - Manufacturability
 - Alignment
 - Tolerance

Offner Relay

Offner Relay:



Another design. Slightly better performance, but is it a better design than Offner Relay?



Example 4

- Engineering details: how to make an instrument work as desired at low cost with high yield?
 - Everybody knows how an interferometer works. Not everybody knows how to make one that people would like to pay for. What's the secret?

Example 5

- System engineering: optics must work with mechanics, electronics and software. So we need to look at things on system level.
 - Digital projector
 - Laser barcode scanners
 - CD/DVD pickup lens

Example 6

- Often times we need to quickly estimate an effect
 - Optics rules of thumb

Grading

- 1 page summary for each seminar (total 60 points). Turn it in the beginning of next class.
- A final report and presentation (40 points). Last 2-3 classes will be devoted to in-class presentations.
 - 15 minutes presentation
 - Topics can be
 - Pick a technology not covered in the class and elaborate it
 - How an optical instrument works and identify at least one engineering challenges
 - A practical project you complete
 - Anything else in “practical optics” category