Practical Optical Design Seminar, pt. II
The Plot Thickens (duh duh duhhhhhh!)

Wednesday, February 26, 2020   10:56 AM

CubeSat Objective Optic Trade Study
- End goal: Jim Breckenridge Design Cube for CubeSats
  - Give each design a point in the cube
  - Dae Wook gave the OK that this is a needed area of research
- Freeform design
- Joel's voxel index method
- Start w/ spherical design, then move to more advanced things
- Two Approaches
  - All of us attacking the design and then coming together to pick the best one
  - OR, we split the group in half and BRAWL (fight over best design)
- Also, could explore 2U or 3U, or 3U+ (3U + TUNA CAN in the front, extra disk)
  - Jaren currently prototyping a 3U+ design

AVENGERS (Jaren)
- The Avengers have contacted us, and we must build CubeSats to look for enemy ships
- Timeline
  - Simple modeling this semester
  - W/in the next couple weeks, could constrain design space
- UV, Optical, IR objectives for CubeSats
  - Must still be defined
- Currently, interest at LPL and Steward to make transit photometry CS
  - Jaren developing two-mirror co phase solution
- Design space severely limited when we go to the UV
  - Refractive space miniature, but reflective designs possible
- In the coming 1-2 meetings, proposing different options for different bandwidths
- Minimum goal, start fleshing out a design cube
- CubeSat symposium has identified that there is substantial interest in prototyping a REAL CUBESAT
  - Potential student-designed CubeSat for space
- Jaren's wish: to see a design paper detailing design space

Smartphone Cameras: Adjustable Aperture Add-On (Alex)
- Most current smartphone add-on's do not allow for adjustable aperture
- Jaren: could optimize smartphone lens based on existing designs
- Could optimize full setup with current smartphone lens design + add-on
- There are zoomable setups, but they suck
- Edmund Optics has compact, focusable imaging lenses, which may be used for this
- Large amount of explorable design space for add-on's or the smartphone camera itself
- Consider working alongside

Zemax Macro/Python Package (Alex)
- Create OAP given a set of parameters
- Macro could be used to generate OAP
- Could be extended to another complicated topic
- Macro could streamline this process substantially
- MyZemax articles

OctoPODS PrPODSject PrPODSposal (Maryam)

- Optical system to image everything on a conveyer belt… ALL AT ONCE
- Image barcodes on food on a conveyer belt
- Checkout process
- May be applied to taking inventory
- Not yet familiar with imaging things that are all of different shapes
- Wide FOV that may image hi-spatial frequency
- Incredibly difficult, but super fun and worth doing
- Would also require some image processing
- Also, all objects would be tilted, so would have a challenging time projecting
    - Could potentially place scanning system on conveyer belt itself
- Possible barcode shapes are infinite
    - Can be made in Excel
    - Maybe ask Dr. Mike… or maybe don't if you want to talk for an hour
- Very entrepreneurial oriented
- Single wavelength laser diode currently used
- Are current systems F-Theta Scan lenses (telecentric for large scan angles)?
- Joels + Maryam: crazy random star patterns that will have a high probability of running across the barcode to readout
    - Wrigley's gum was the first thing to be scanned with a barcode
- Goals: Make barcode underpants and wear them to the presentation

OSC Optics (Trent)
- Could base this on Dave Schaffer's (philosophy PhD) and his crazy lithography system
- Making optics in the shape of the OSC logo
- Dae Wook willing to pay for trophy for us to duke it out with RIT

Extreme Solar Imager
- Need to come up with new way to look at very bright sources
- In the ESA Solar Orbiter, there is a ton of shit that probably doesn't need to be there
- Koshel suggested a redesign to make this whole thing way, way better
    - Not sure how yet, but we want to make something crazy and new to do a new thing with difficult sources
    - Remove things like internal occulters
- Could pair this up with current work at DKIST with their optical problems

Freeform Index Optics (Joel)
- Maybe not best for PODS b/c design hasn't been considered yet, but just maybe
- Joel doing lots of research right now in 3D printed optics
    - LLNL using silica glass to extrude optics
        - Can place different index anywhere in bulk optical element, just by changing ink
        - May place different index, Abbe, anywhere in optic
        - May make any optic with a flat piece of glass
            - Could tackle all aberrations in a 7-8 element system into 1-2 optics
    - OSC using lasers to print optics (Liang)
- FOV of GRIN lenses sucks, and massive FIE CUR
    - If you can control infinitesimal glass units could destroy these problems
- What is actually possible? What can be made in the next 5-10 years?
    - LLNL making silica ink, may be doped with GeO_2 or TiO_2 to change weight
        - Could make LUT with the different index, Abbe number options
        - 10,20,30,40% weights of dopant, which may then be utilized to make optics

- - - Feature size: 100 microns currently
      - Future: Down to 10 microns
    - Currently focusing on making bigger optics
      - Cracking occurring in the sintering process (50% shrinkage)
      - Lots of CTE mismatch inside optic
      - Liang also having this problem
- Not yet sure how to start designing this
  - Joel pursuing this in his personal research
  - Going to share his knowledge with us as he goes along
- May incorporate into our PODS designs

Stereo Microscope w/ Zoomable Afocal in Between (Yanqi)
- Jaren has tools for zoom solutions
- Non-axial symmetry, b/c taking sections of pupil and transferring to both eyes
- Designing objective, afocal system, and eyepiece
- Stereo microscopy

VOTING:
- Right now
- Will push to Slack after this
  - Things for every project:
    - Macro
    - 3D index

(1 'I' == 1 vote)

- CubeSat
  - IIIII
- Smartphone Add-On
  -
- Scan ALL THE THINGS w/ an Octopus
  - I
- Stereomicroscope
  - I
- EXTREME
  - IIII
- OSC Lens
  -

Next Phase:
- Specbuilding Soap Box by Jaren