JPL/Princeton TPF Review
Pupils: Masking vs. Mapping

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Summary

- Much of our work involves designing pupil masks.
- We have proposed several designs (multipupil, concentric ring, starshape, barcode, checkerboard).
- We plan to design new masks—10^{-7}, smaller iwa, more openings, etc.
- However, much of this past year has been about diffraction analyses of our lab and of pupil mapping.
- **The Big Question: Which is better, shaped pupils and pupil mapping?**

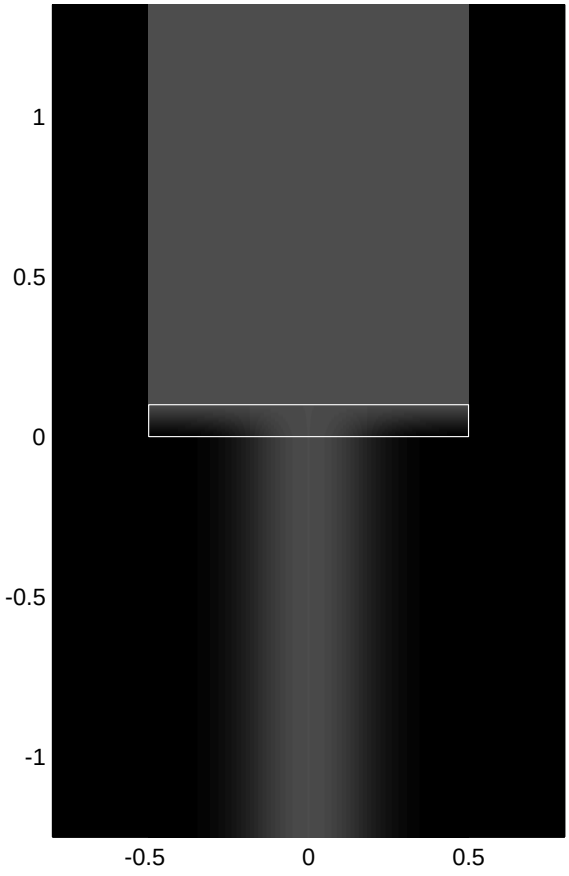
Apodization/Masking

Advantages:

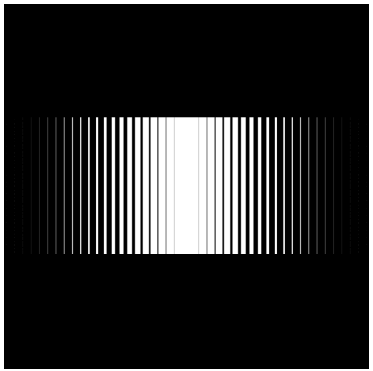
- Manufacturable!!!
- Achieves 10^{-10} contrast.

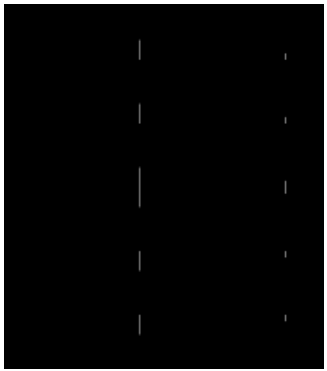
Disadvantages:

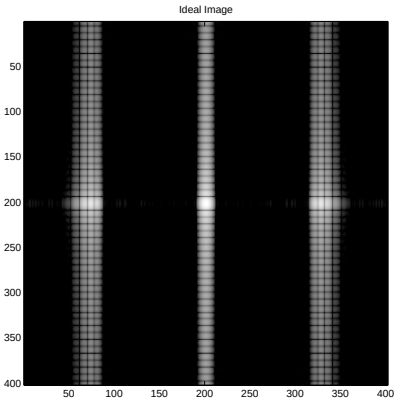
- Throughput is 10%.
- Best inner working angle is $4\lambda/D$.



One New Mask







3.5×8, 0.5 rounded corners, iwa=$4.1\lambda/D$,

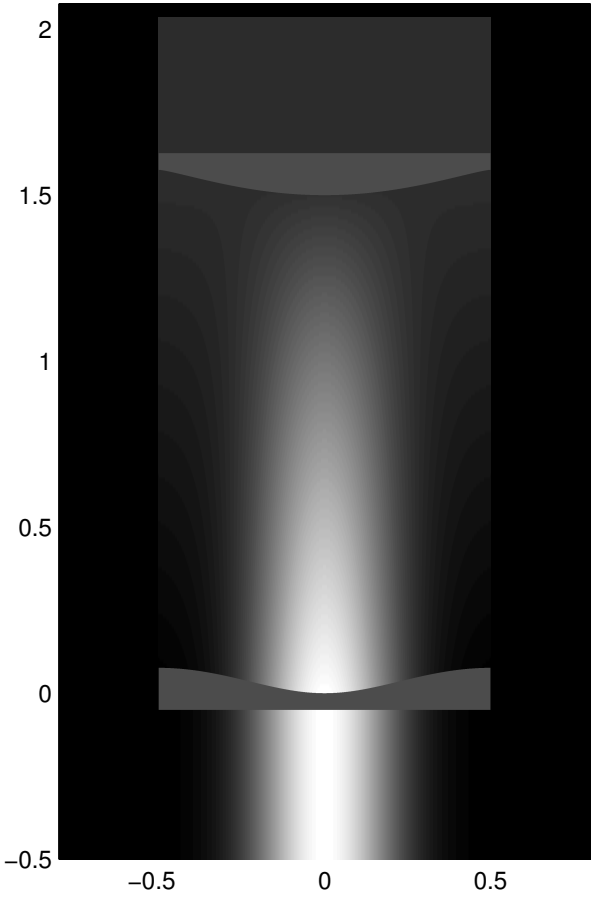
Pupil Mapping

Advantages:

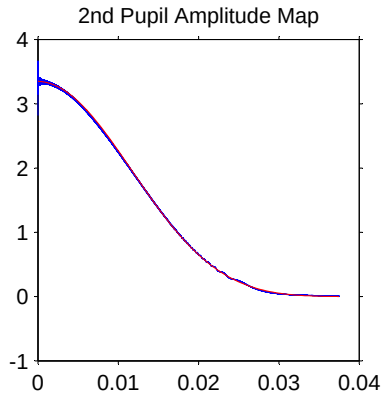
- 100% throughput
- Implicit magnification... effectively iwa $\approx 1\lambda/D$.

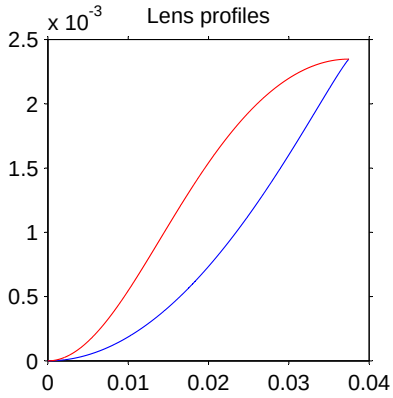
Disadvantages:

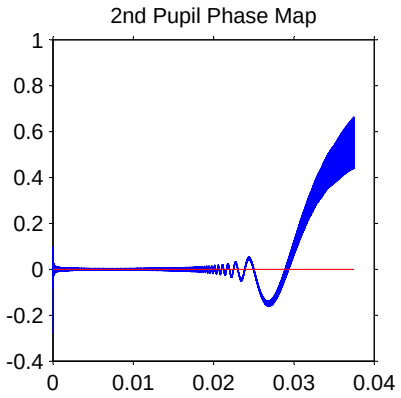
- Diffraction effects limit achievable contrast to 10^{-5} for a pure pupil-mapping system—a hybrid system is required.
- Hybrid system is inherently chromatic.
- Unmanufacturable?

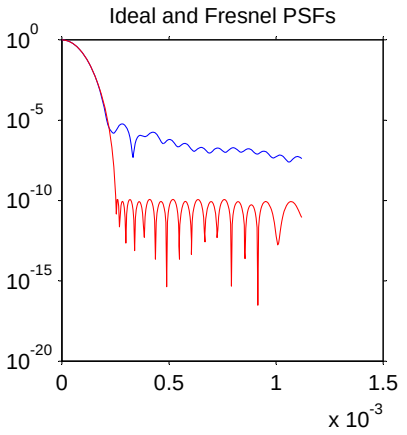


Pupil Mapping for High Contrast (PIAA)





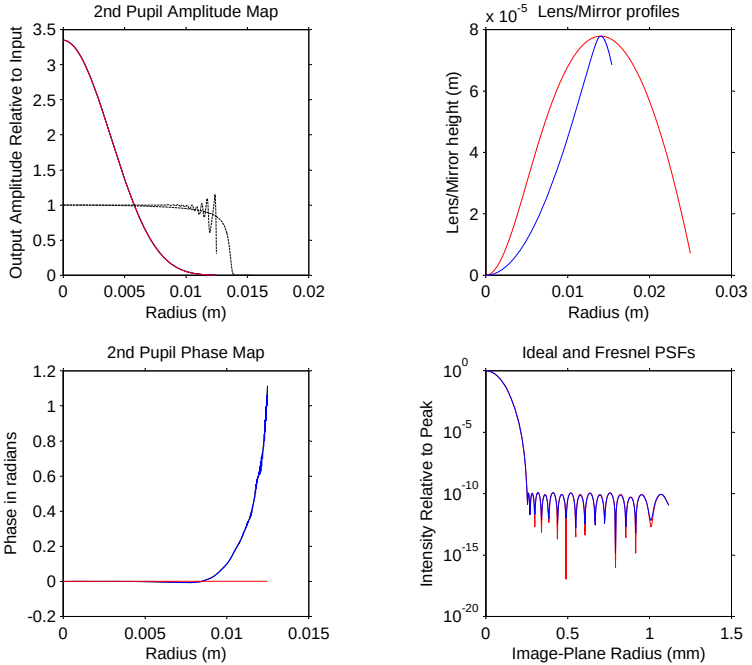




$n = 1.5$. $D = 75$mm. $z = 5D$. $\lambda = 632.8$nm.
Designed for 10^{-10}. Delivers 10^{-5}.

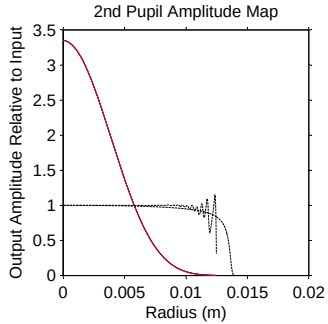
Using a pre- and post-apodizer...

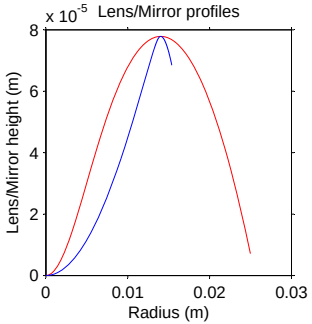
... and a post-phase-shifter

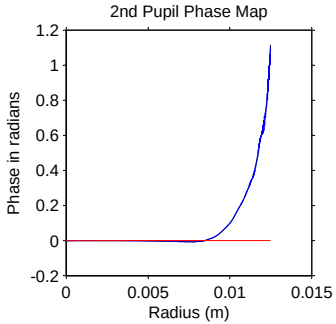


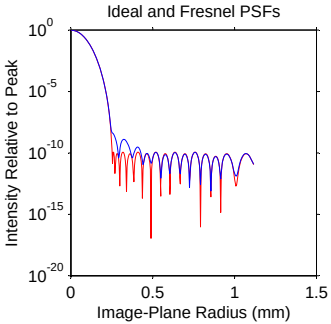
This is a mirror design.

Wavelength Dependence









Changed wavelength by 10%.

Conclusion

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Disadvantages:

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