# Chapter Outline – v1 (Brooks and Fafone)

## Thermal Adaptive Optics[[1]](#footnote-1)

### Introduction

1. Sources of possible optical aberrations
   1. “cold” defects
      1. Surface figure errors
         1. Curvature errors
         2. Other fabrication errors (spirograph type pattern)
      2. Substrate refractive index inhomogeneities
   2. “hot” defects
      1. review why we go to high power
      2. Physical consequences of thermal absorption
         1. Thermal surface figure errors (thermo-elastic deformation)
         2. Thermal substrate refractive index errors (thermo-refractive lensing)
      3. List of all optics this will affect (to illustrate the scope of the problem)
2. A good sized explanation of why this has a negative effect on IFO performance. This is an important section. It basically answers the question “so you’ve got thermal lensing – what difference does that make?”
3. This leads to the motivation for compensating for this: hence build an adaptive optics system that flattens out optical aberrations.

### Thermal sensors and actuators

1. Sensors –
   1. Hartmann sensor (decouples individual optics)
   2. Phase camera (assesses the performance of the interferometer)
   3. Other signals derived from the interferometer
      1. Bullseye sensors
      2. TBD
   4. Expected performances vs requirements for these sensors
2. Actuators
   1. Ring heaters
   2. CO2 lasers
      1. Static
      2. Dynamic (raster)
   3. Other techniques
      1. CHRoCC
      2. CHRAC
   4. Actuators noise coupling
   5. Expected performances vs requirements

### Design of thermal control – putting it all together

1. Putting it all together
   1. Discussion of modeling – or at least a link to any modeling chapters
   2. Best way to combine all the signals? A treatment of TCS/Adpative optics from a controls perspective would bring it into line with what is in the preceding chapters on LSC and ASC.
      1. Classical control in the frequency domain
      2. State space control of TCS
         1. Kalman filters for state estimation

### Conclusion and the future

1. Existing results from iLIGO/Virgo/aLIGO
2. Future research
   1. What are the prospects and challenges for 3rd generation adaptive optics?

1. TCS is a LIGO/Virgo acronym – thermal adaptive optics is proposed as a more accessible title. [↑](#footnote-ref-1)