WaMI: The Waves Michelson Interferometer

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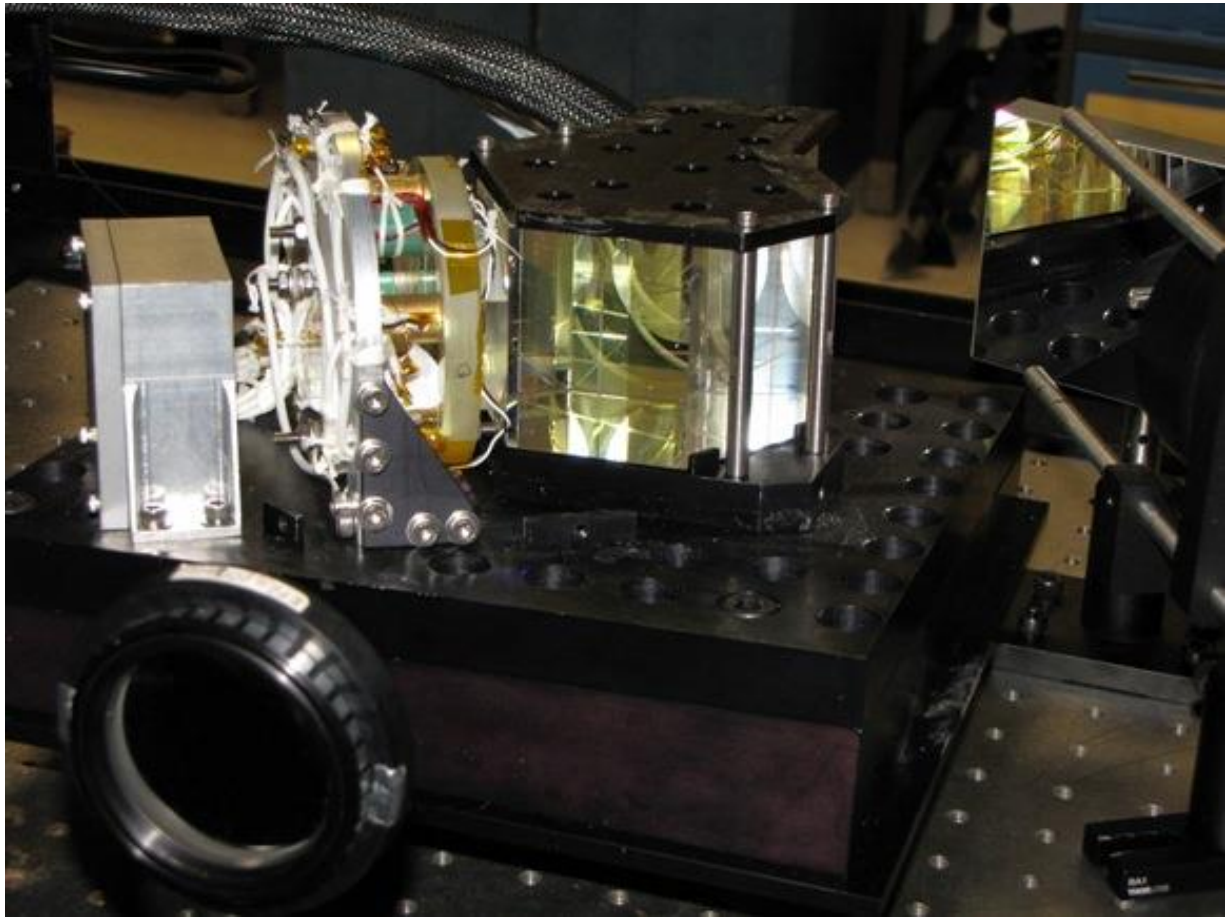
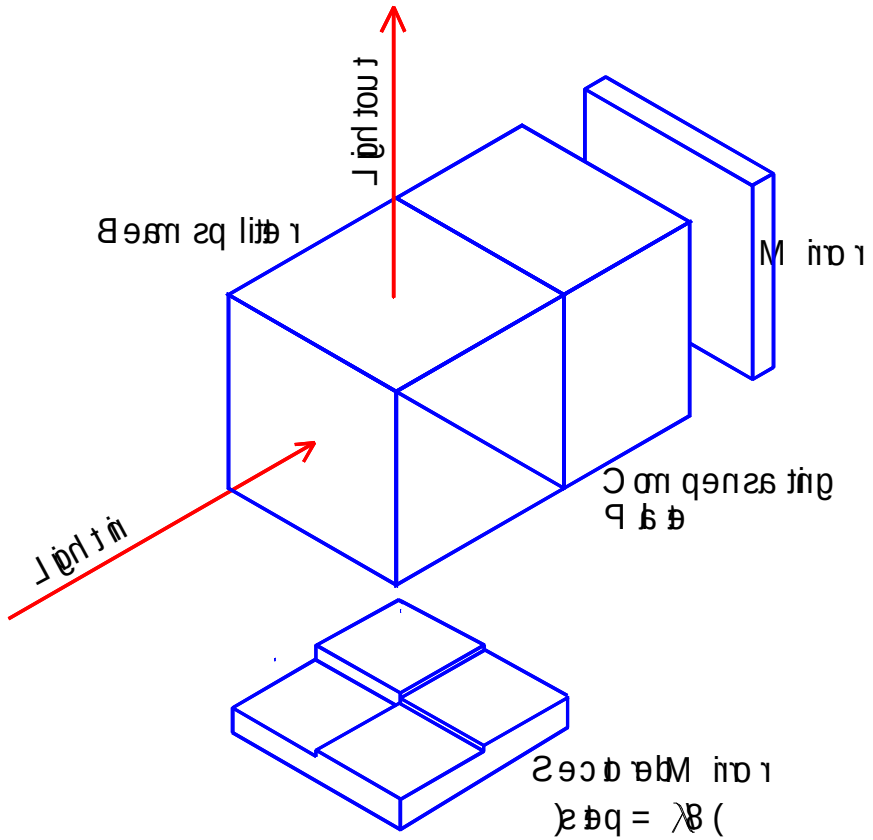
WaMI

- Field-Widened Interferometer
- Has a sectored mirror which generates four path differences without scanning
- Measures 557 nm (green line) and 1260-1280 nm (O_2) and 1316 nm (OH) emissions
- Designed to measure winds via Doppler shift in the airglow emissions



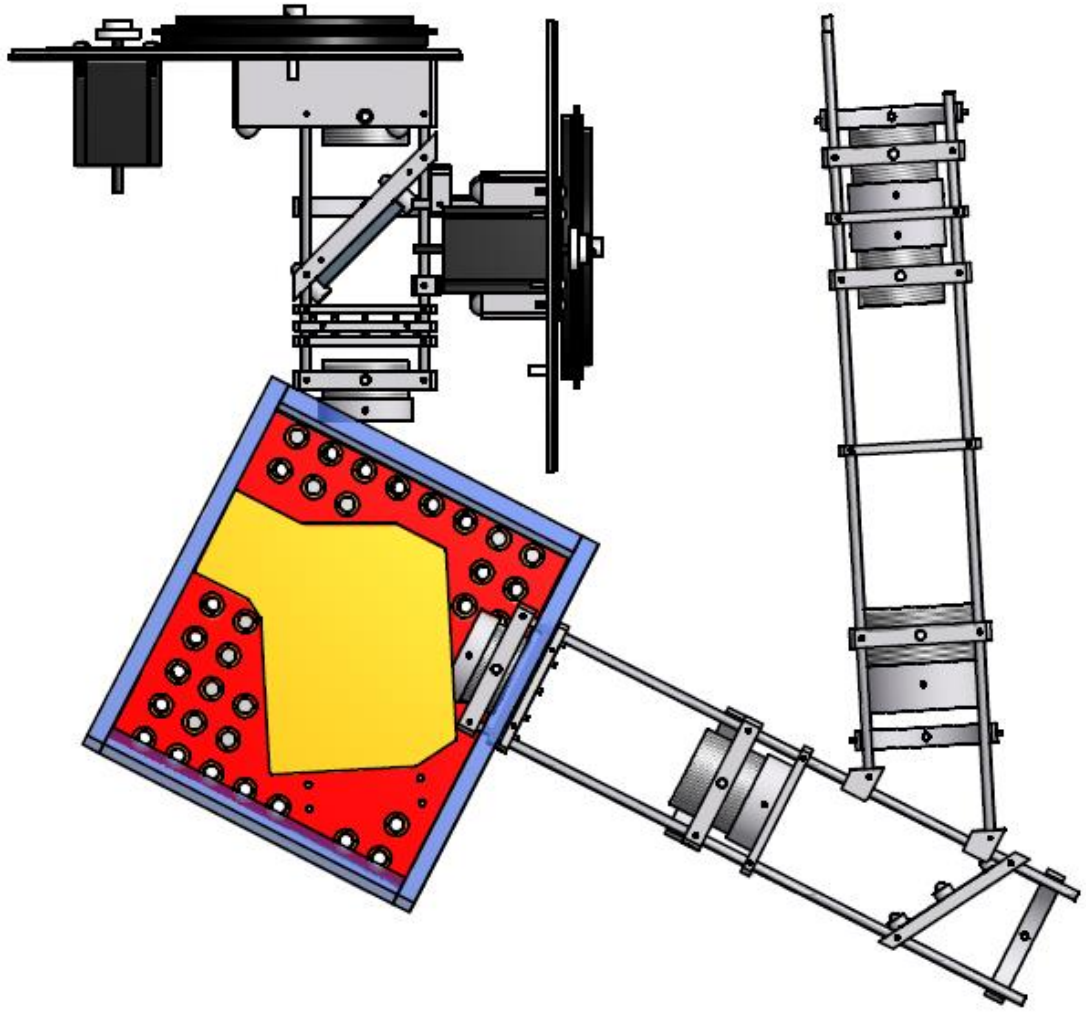
WaMI Concept

- Phase steps are deposited on the mirror – all exposures are made simultaneously.
- Eliminates issues with intensity variation.
- Achromatically field-widened for 557-1300 nm.



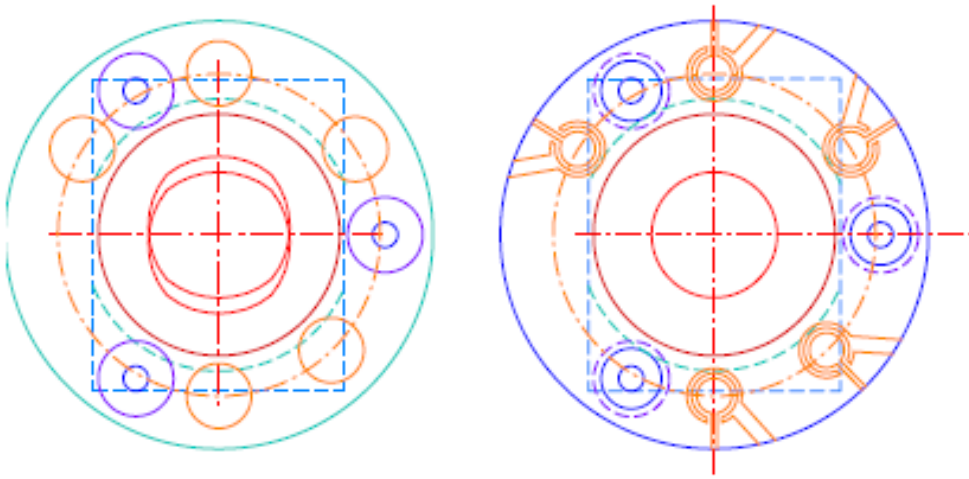
Basic optical design

- A dichroic beamsplitter allows for simultaneous observation of the IR and visible wavelengths.
- A prism, located at the aperture stop after each filter wheel, is used to separate the four sections of the sectored mirror in space.



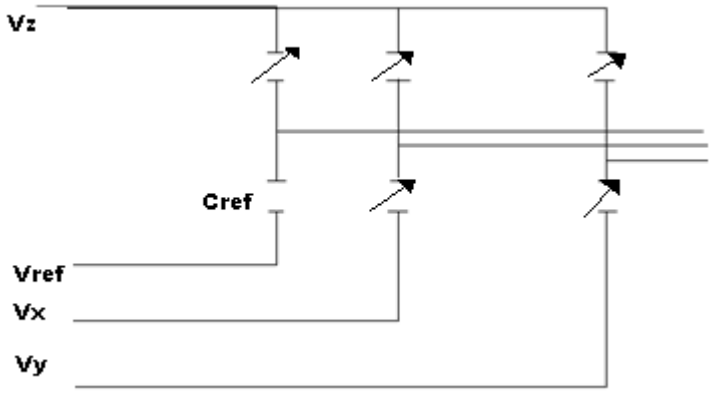
Capacitive feedback mirror control

- Designed by Com Dev.
- Provides mirror control on the order of less than an angstrom.
- Capacitive bridge and 3 piezo-electric crystals provide 3-dimensional control of the mirror.
- Mirror parallelization and stepping characterization were performed at UNB.



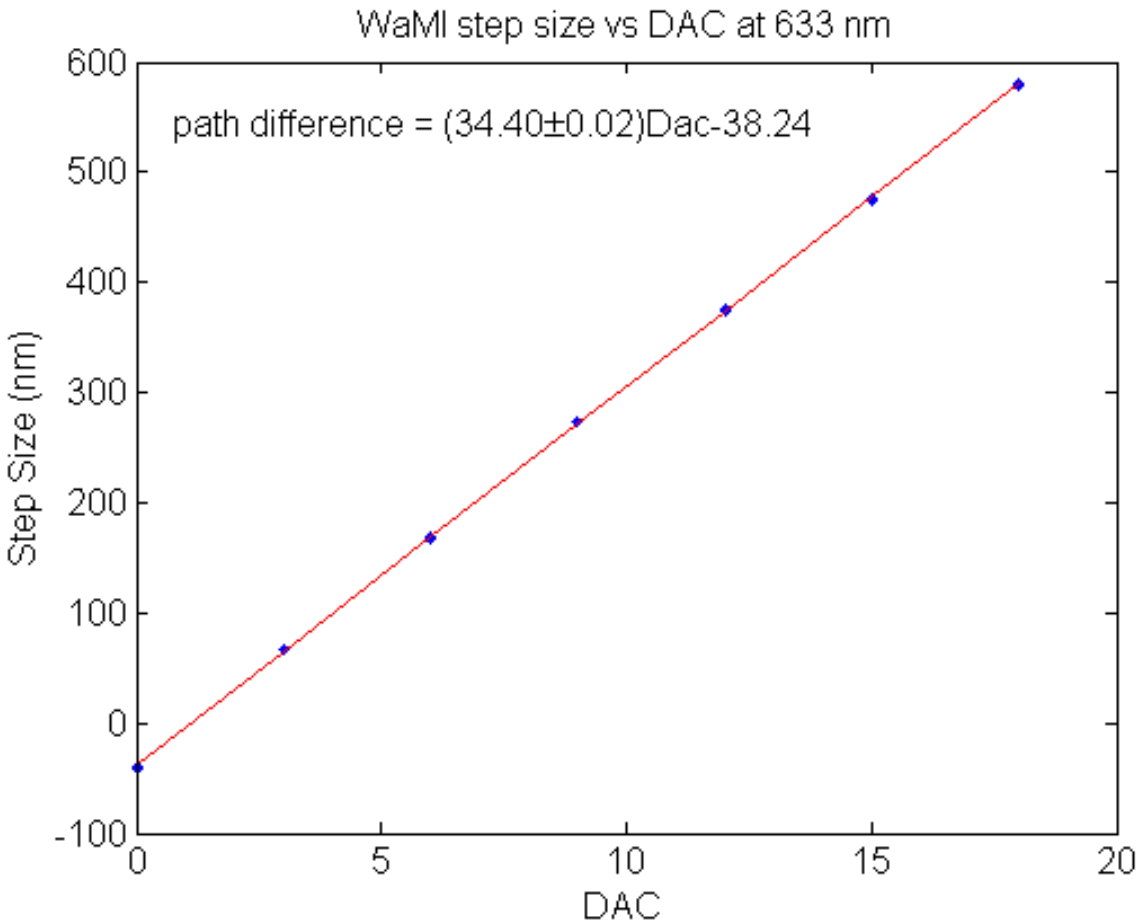
Beam splitter side of air gap

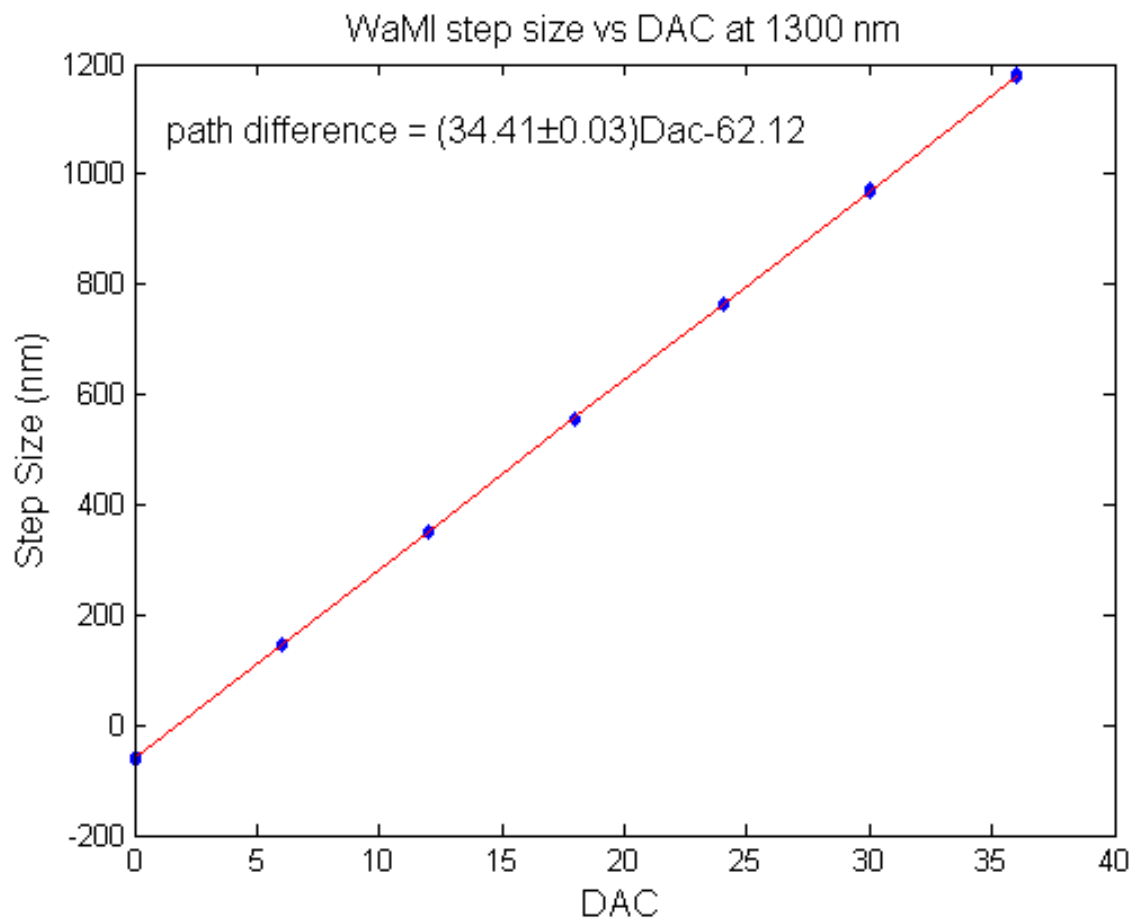
Mirror side of air gap



Control electronics will locate the gap corresponding to these values

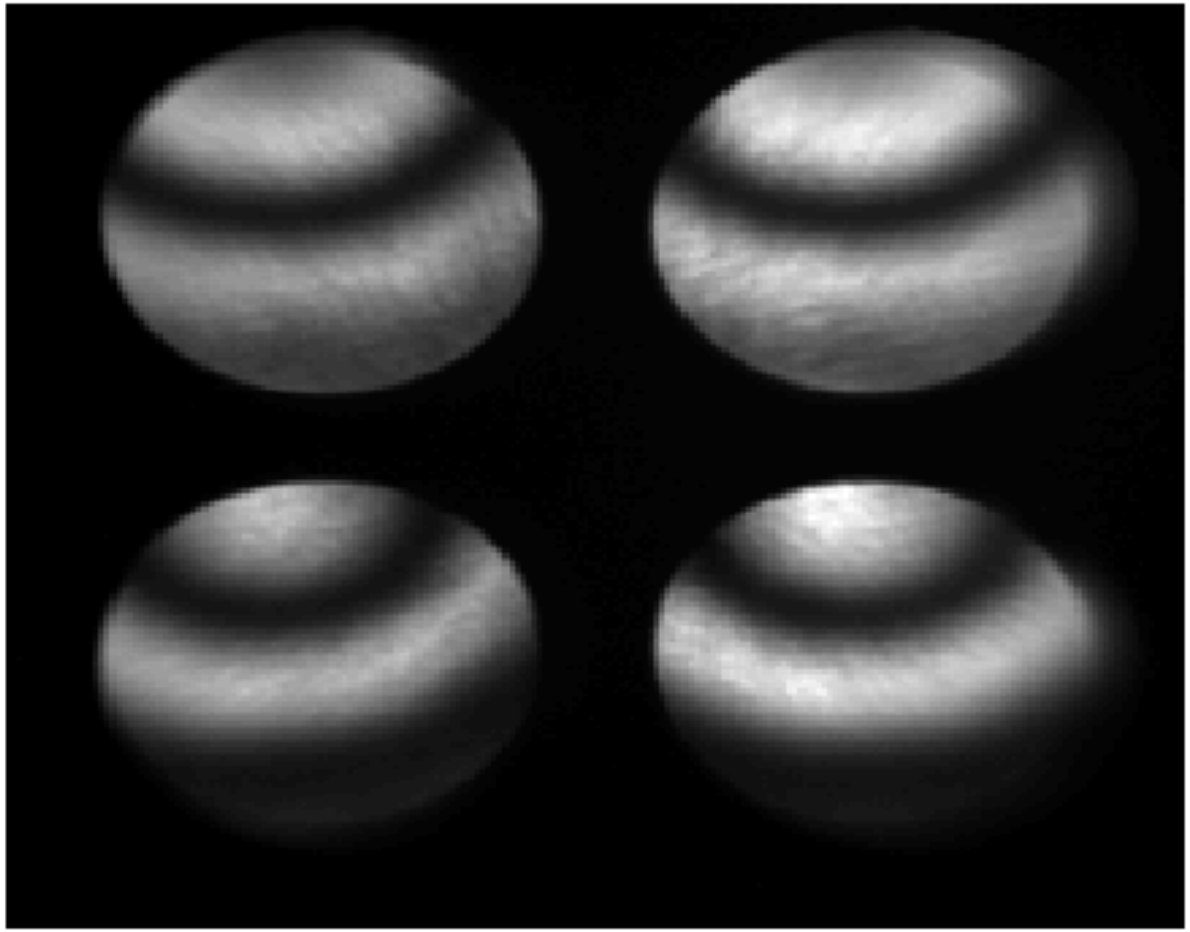
Step Size Determination





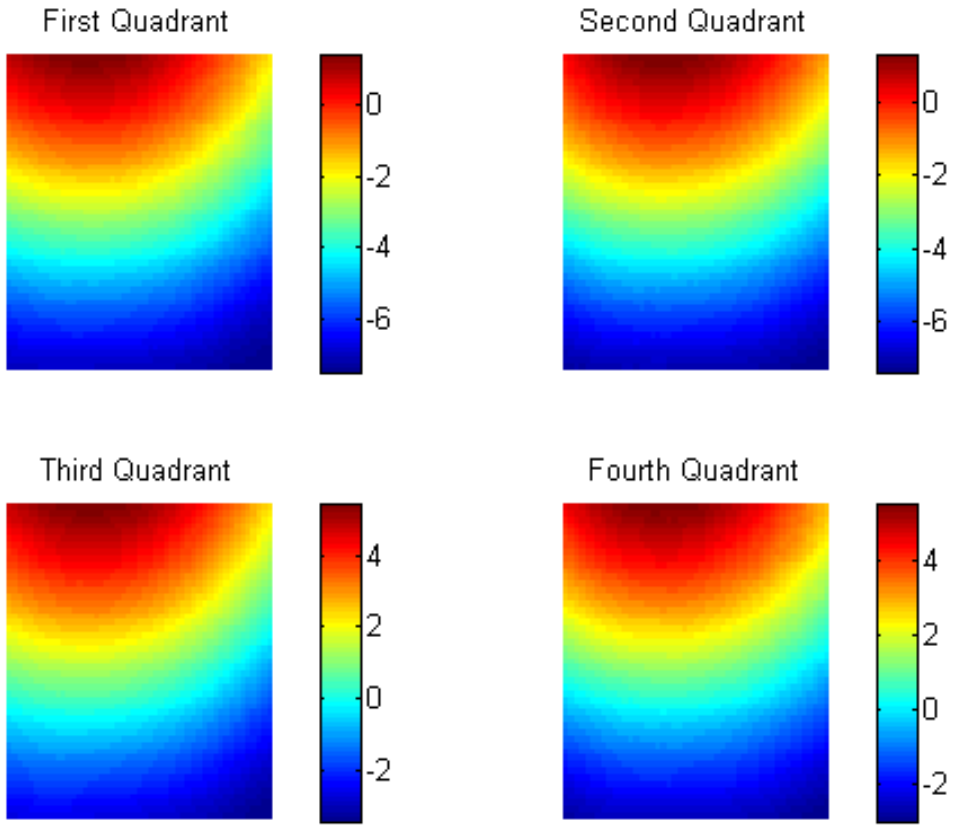
Sectored Mirror

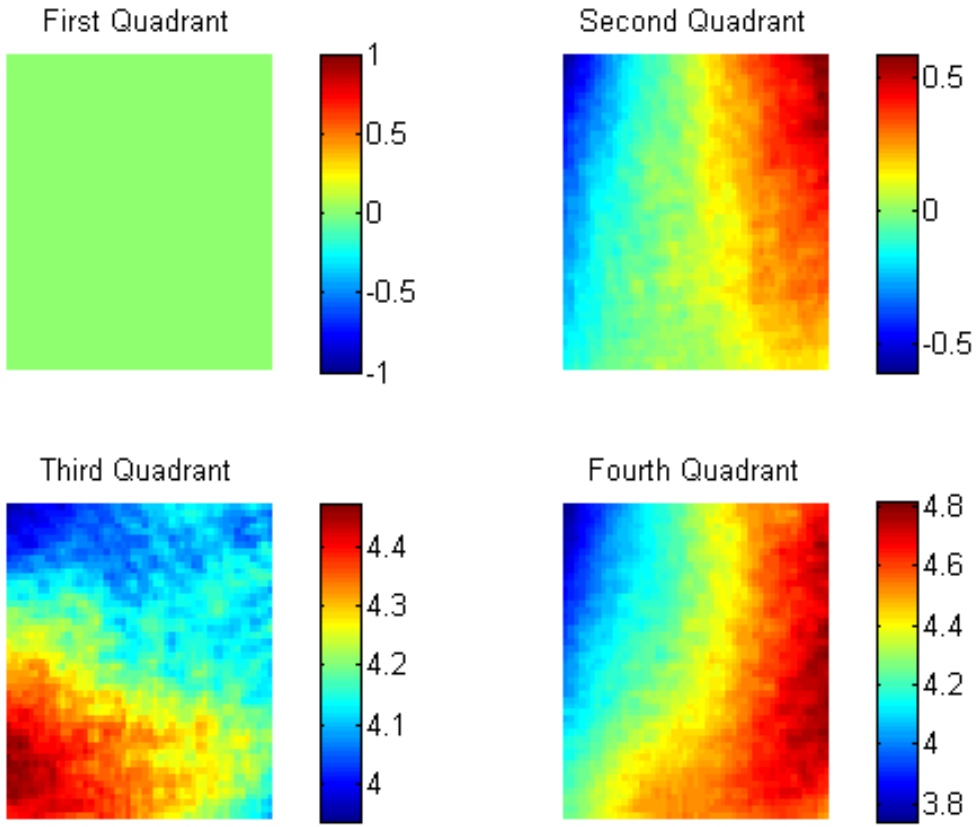
He-Ne (633 nm) Haidinger Fringes



Sectored mirror step sizes (in rad)

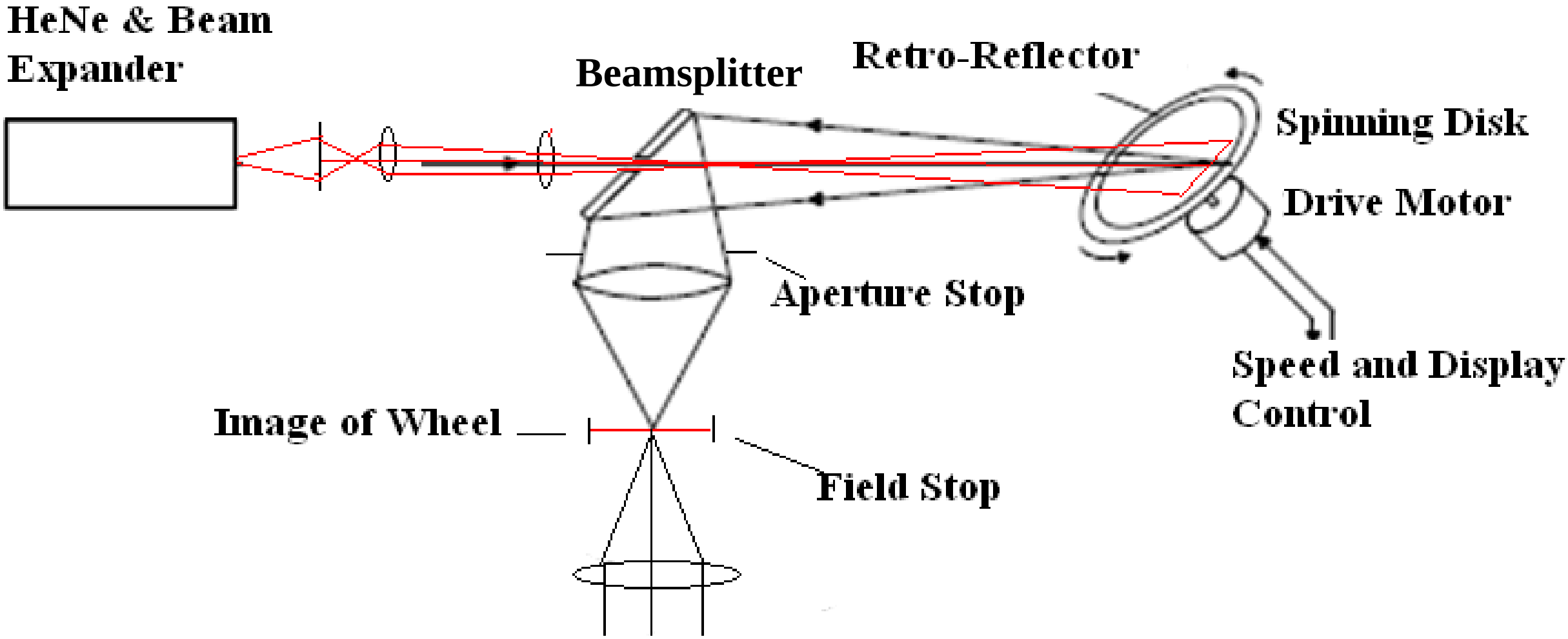
Step Size (nm)	
$\lambda = 633nm$	$\lambda = 1310nm$
209.5 ± 1	230 ± 20
651 ± 1	660 ± 10
849 ± 1	860 ± 10



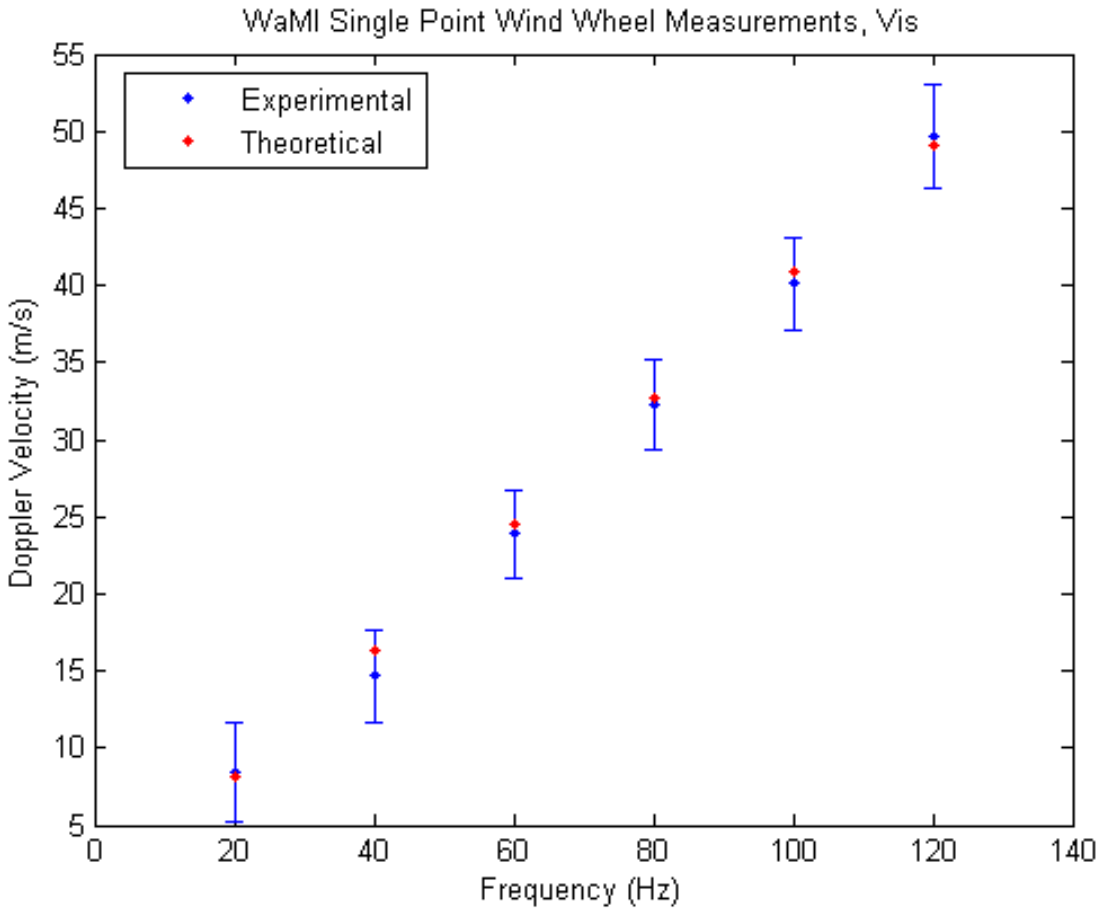


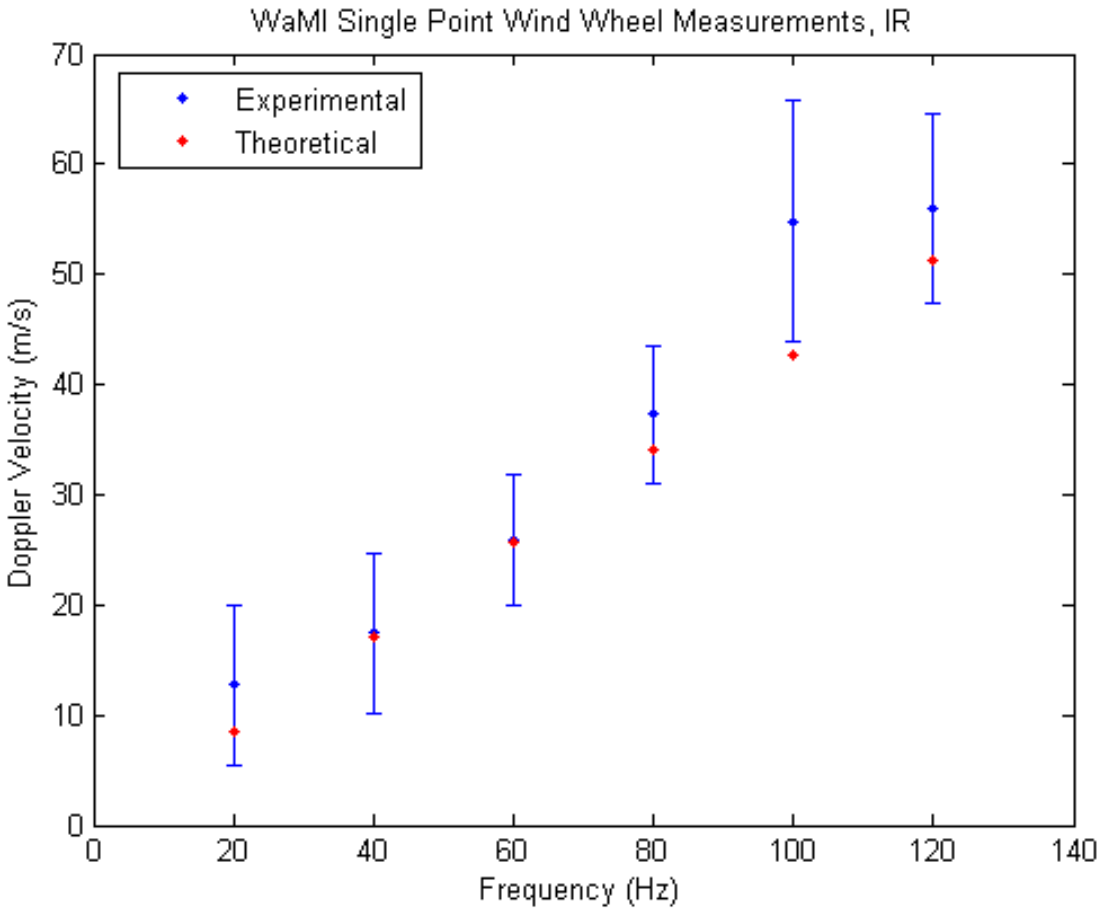
Wind Wheel

$$v_{LOS} = 4\pi r \cos(\theta) f$$

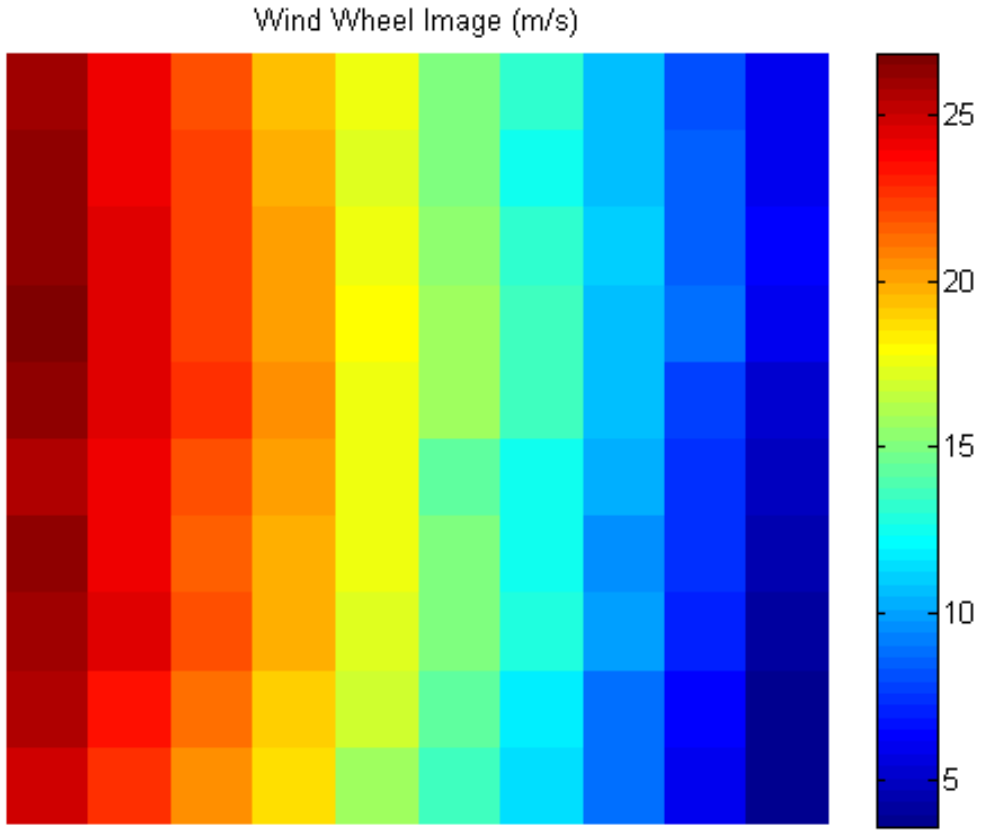


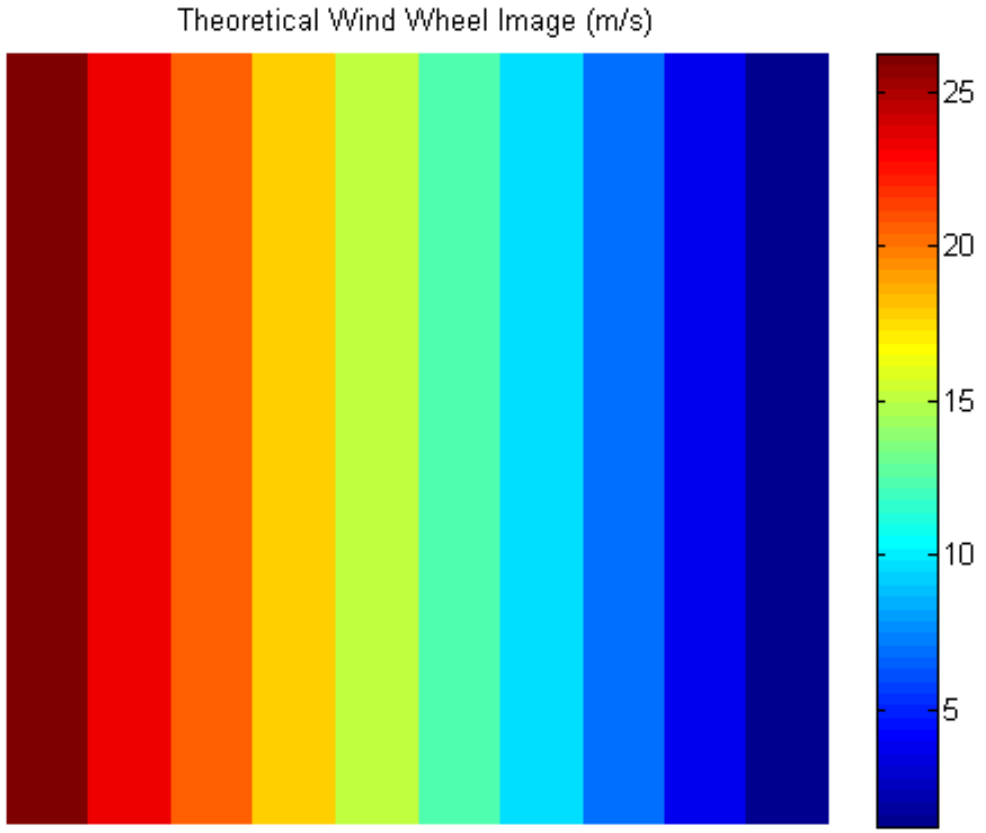
Single point wind wheel ‘winds’



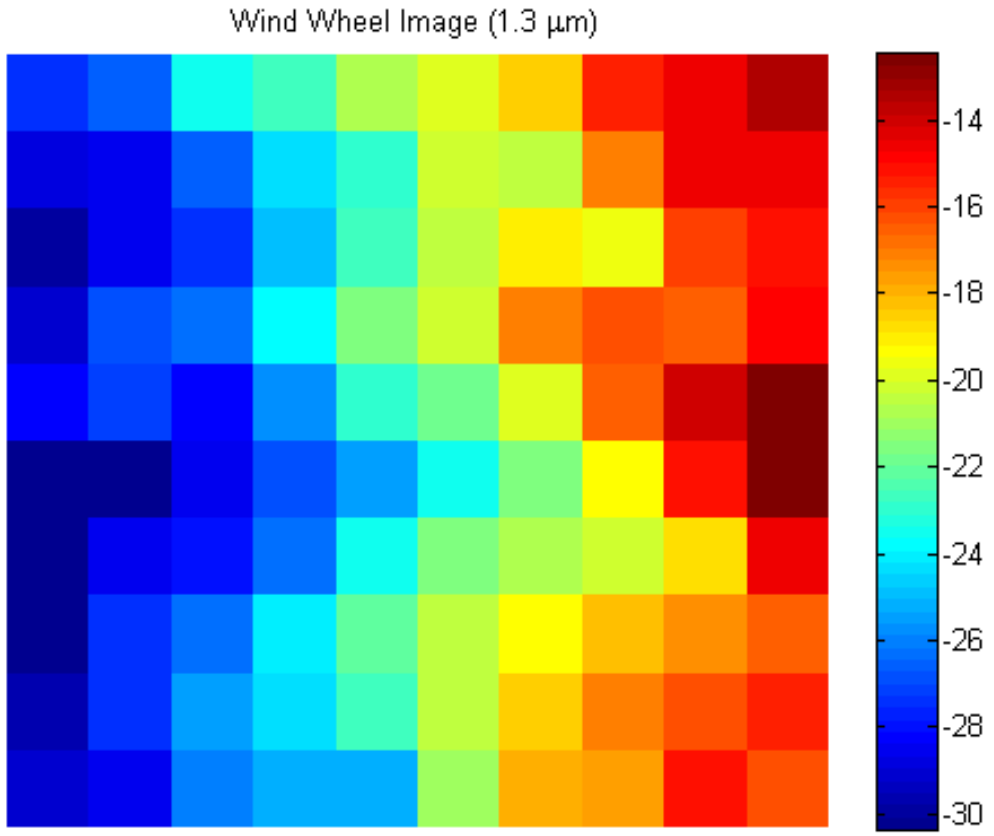


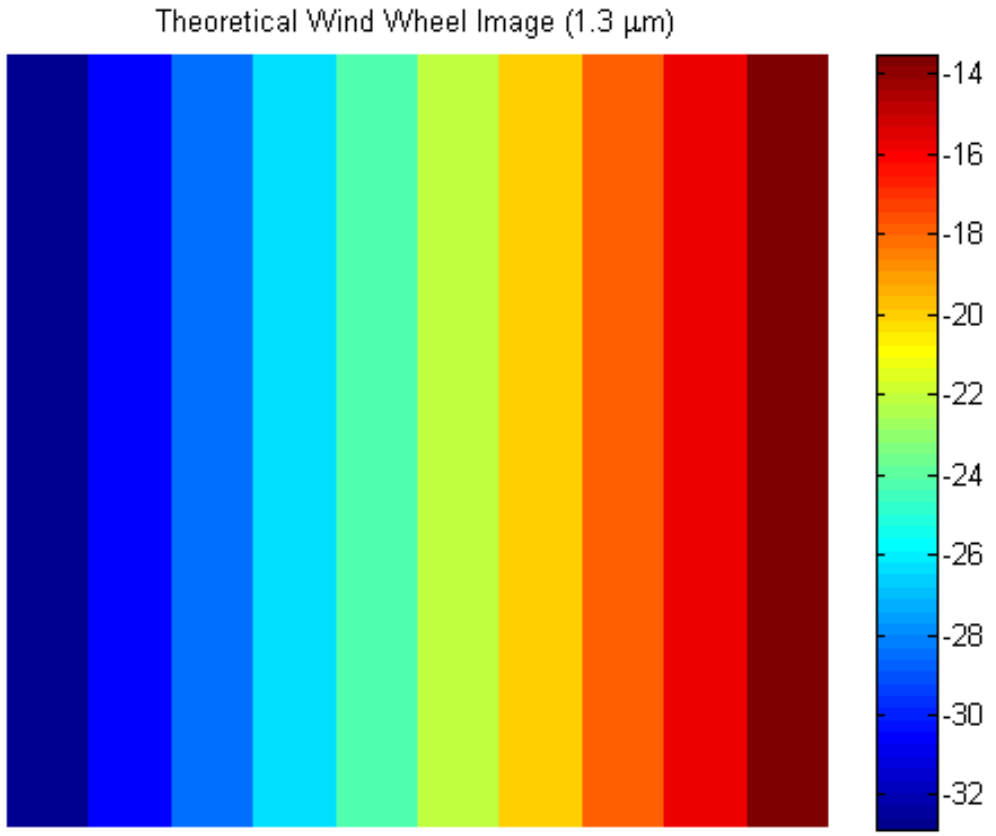
Wind Wheel Imaging (633 nm)





Wind Wheel Imaging (1.3 µm)





Conclusions

- The capacitive feedback system for mirror control is precise to on the order of 0.1 Å.
- The sectored mirror can be used to successfully create scans, eliminating the need to physically move the mirror, and reducing the time for each scan.
- Use of a retro-reflective ‘wind’ wheel has verified the capability to image winds with precisions of a few m/s.

Acknowledgements

- Funding support from CFI, CSA, NSERC, and UNB is gratefully acknowledged.
- Design and support of the capacitive feedback system for mirror control was provided by Com Dev.
- Thanks to my supervisor William Ward.