Developing an Optical System with a Confocal Chromatic Sensor for Microscopic Robot Characterization

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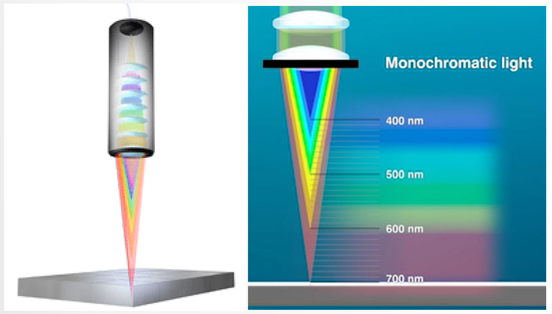
Abstract

Robots on the microscopic scale are smaller than what the naked eye can see, leaving certain aspects of the microbots, like their topography, difficult to characterize. To measure this, we can use a confocal chromatic sensor, but the sensor only has a short focal length and needs to be integrated with a microscope to characterize the microbots. Additional we have a Galvo Steering system, and in our experiment, we explored the possibility of using the system to more precisely control the confocal Chromatic sensor. We determined that we needed to collimate the beam for microscope utilization and an optical system with achromat lenses was studied and tested. From experiments with these system, we were able to collimate the beam with the sensor into a point. However, we were still out of range with the device sensing system despite refocusing the beam, so there more work to be done on the system, with a focus on integrating the sensor into a microscope.

Background

Confocal Chromatic Sensor

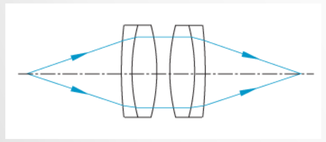


Measuring Principle

Light is split into different spectra by lenses and focused on an object through a multi-lens optical system.

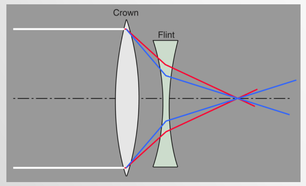
Then, light is broken down by controlled chromatic aberration into monochromatic wavelengths dependent on the displacement

Lens and Beam Collimation

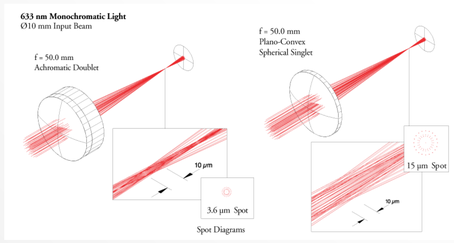


Collimation occurs when all the rays in the beam are parallel.
Collimated light sources can be used in the microscope

Achromatic lenses (Archomats)



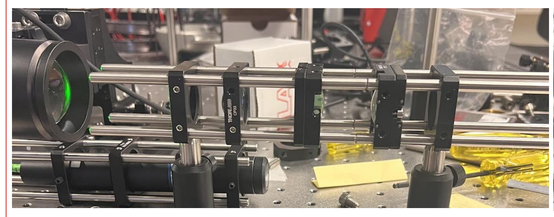
Lens with two optical components cemented together:
A positive low-index component, *the crown* and a negative high-index component, *the flint*

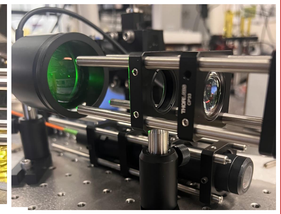


Advantage of the lens: ability to reduce chromatic aberration

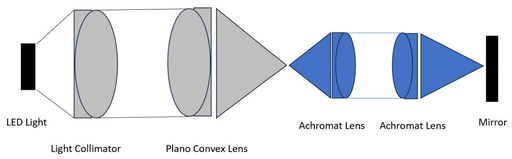
Optical Setup

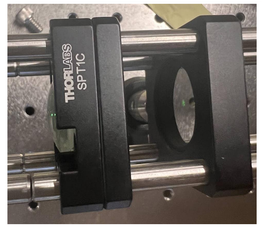
LED Light Optical System



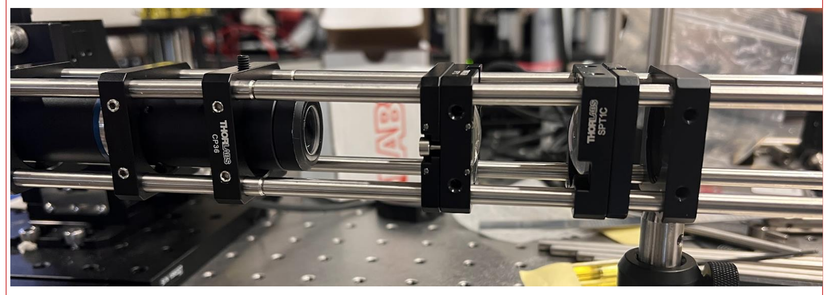


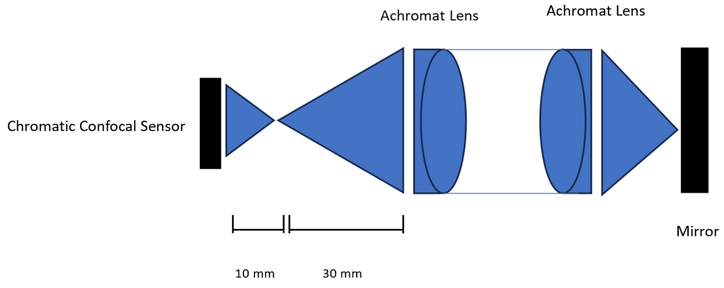
Light Path

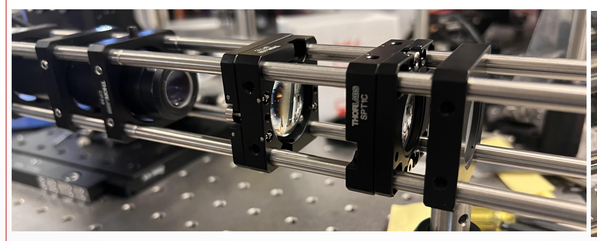




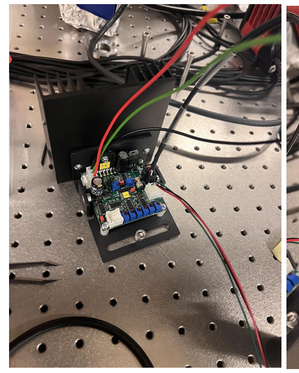
Confocal Chromatic Sensor Optical System

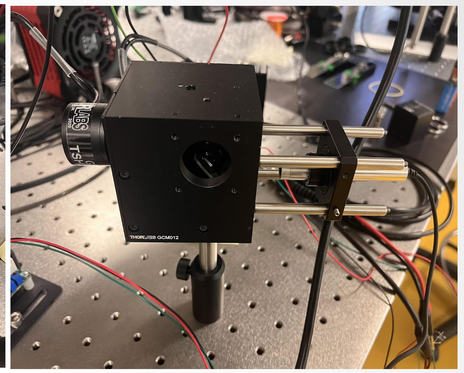


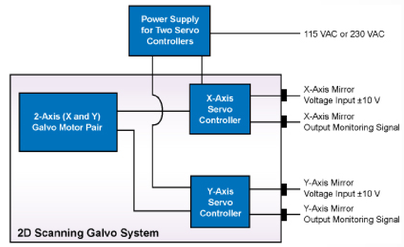




Galvo Steering System

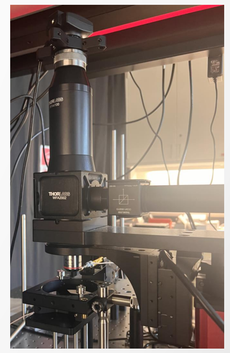






Future Direction

- Utilization with microscope
- In range of sensor
- Robot characterization



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