Visible-light optical coherence tomography

Background – Optical Coherence Tomography (OCT) acquires micrometer scale 3D images of tissue. The OCT image, and parameters derived from the data, are used to distinguish different tissue types or disease states. The resolution of OCT depends on the central wavelength and bandwidth of the light source used $\sim \lambda_C^2/\Delta\lambda$. Conventional systems use center wavelengths of 1300 nm, 1000 nm and 800 nm with typical bandwidths of 100 nm yielding resolution in the order of 10 micrometer. Resolution improvement by factor 10 can be obtained by shifting the center wavelength to visible wavelengths, e.g. 600 nm (at the expense of other trade-offs).

Goal – A laboratory OCT setup is available based on a free-space optics and a supercontinuum light source which can serve as basis to build a visible-light OCT setup. The main improvement nessecary is increase in acquisition speed which foremost requires the design and construction of a fast spectrometer for detection.

Requirements – This assignment has a strong experimental component. Some experience with Matlab or LabVIEW for instrumentation and data analysis is beneficial.

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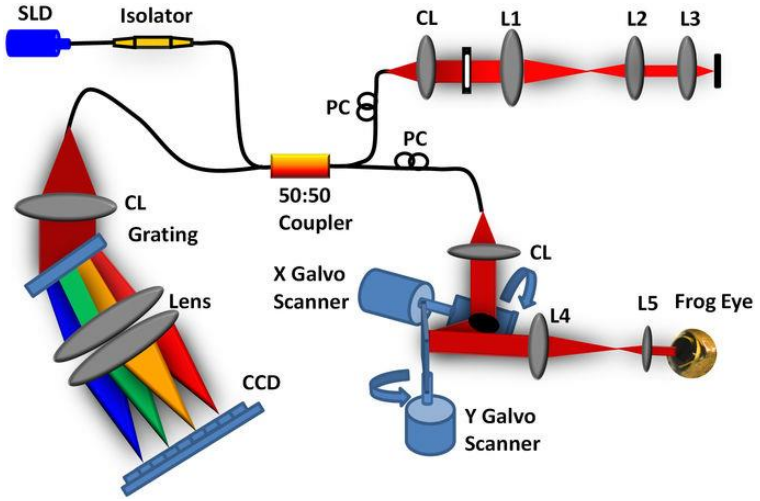

Illustration of a Visible-light illuminated OCT setup (in this case for imaging a frog's eye). The drawing highlights the basic components of the spectrometer that needs to be built in this project.