

Meeting Notes 1

2020年9月23日 20:00

Meeting Method: Zoom (online video calling), **Date:** 09/23/2020, **Time:** 11:00 GMT (19:00 Beijing Time)

Items for discussion (noted by student before supervisory meeting):

1	Details of the project
2	Time schedule for the submission

Record of discussion of supervisory meeting:

1	The project is to build an optical spectrometer based on a USB camera that can measure the light spectrum at different wavelength and showing the frequency spectrum.
2	The time schedule can be found on Moodle.

Action list (to be attempted or completed by student by the next supervisory meeting):

1	Do some brief research about the spectrometer, its principle and its basic structure.
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Time schedule:

Project Component	Weight	Deadline	Submission Method	Responsible
Project Specifications & Preliminary Report and 1st logbook		Friday, 30th Oct 2020 23:59 CST	Moodle	Student
Project Specifications & Preliminary Report (Grading) - Resources	5%	Friday, 20th Nov 2020	Moodle/Blackboard + MS Forms	Supervisor
Interim (Mid Project report) and 2nd logbook + Risk Assessments + Ethics		Monday, 04th Jan 2021	Moodle	Student
Interim (Mid Project report) (Grading)	5%	Friday, 22nd Jan 2021	Moodle/Blackboard + MS Forms	Supervisor
Final Report and 3rd logbook		Friday, 23rd April 2021 23:59 CST	Hardcopy handover and softcopy through	Student
Student Performance	10%	Friday, 23rd April 2021	Moodle/Blackboard + MS Forms	Supervisor
FYP software codes, prototyping/equipment		Friday, 23rd April 2021	Software codes, hardware and equipment submission	Student & GC-UESTC
Final Report (Grading)	50%	Friday, 14th May 2021	Moodle/Blackboard + MS Forms	Final Report Panel
PowerPoint slides for oral presentations		Friday, 07th May 2021	Moodle	Student
Oral presentations	30%	Monday, 10th-Friday, 14th May 2021	Panel presentations + MS Forms	Oral Presentation Panel

来自 <<https://moodle.gla.ac.uk/course/view.php?id=21109>>

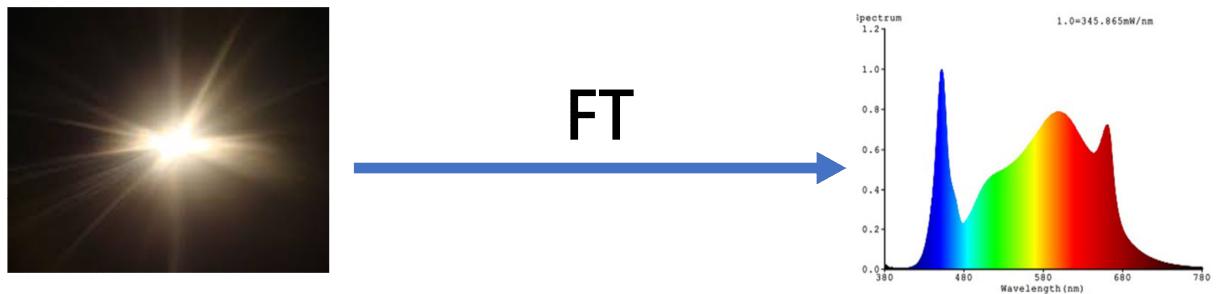
Brief Research 1

2020年10月26日 22:00

Date: 10/26/2020, **Time:** 13:00 GMT (21:00 Beijing Time)

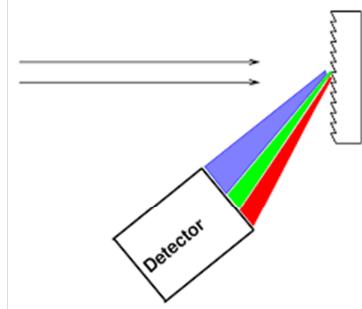
I have made some search online and got better understanding about the project.

The basic idea of the Optical spectroscopy is actually doing fourier transform on the incoming light signal, transforming it in to frequency domain.

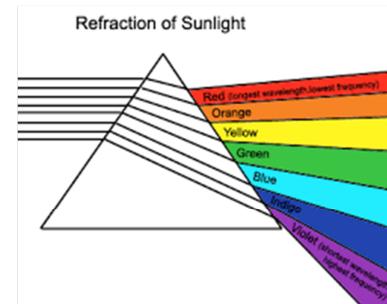


However the visual light's frequency is around several Tera Hertz and it is impossible for a typical electronic device to sample on this high frequency. So we want to use some optical instrument to separate the wide-band light signal into many narrow-band so that we can estimate the power spectrum on each frequency.

To achieve this, we usually use two instruments: diffraction grating and prism and in this project I am requested to use the diffraction grating.

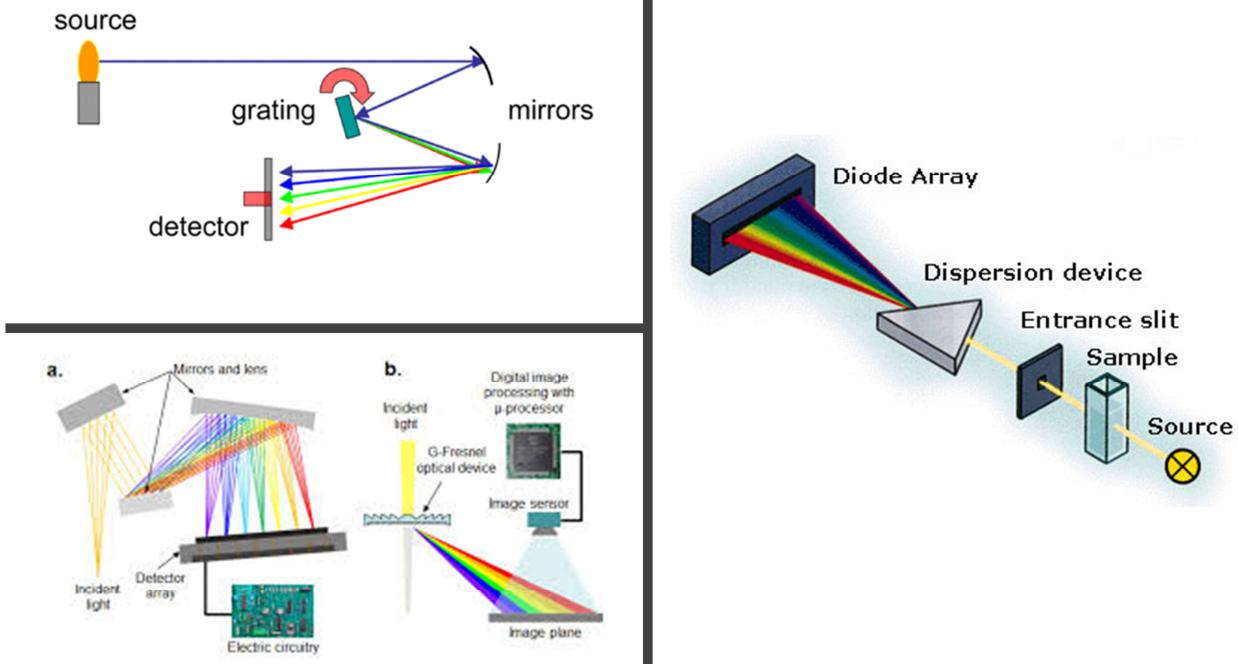


Diffraction Grating



Prism

Then I did some search online, and found some basic design structure below:



Meeting Notes 2

2020年10月28日 20:00

Meeting Method: Zoom (online video calling), **Date:** 10/27/2020, **Time:** 14:00 GMT (22:00 Beijing Time)

Items for discussion (noted by student before supervisory meeting):

1	Show my brief research about the project to the supervisor.
2	Ask about the tangible tasks, targets, outcomes and other details which will be written in the preliminary report.

Record of discussion of supervisory meeting:

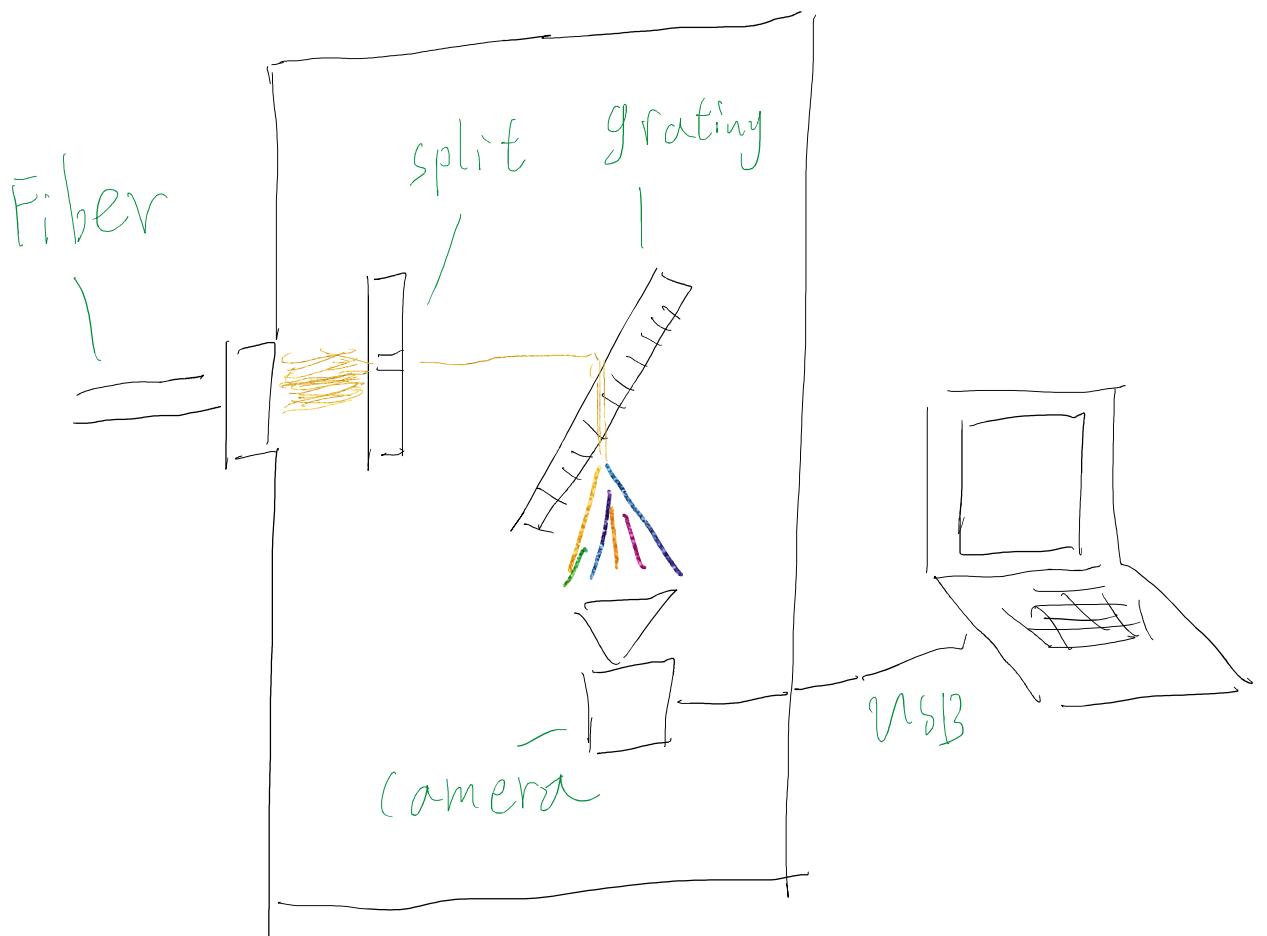
1	The supervisor confirm my brief research.
2	<p>The main tasks are:</p> <ol style="list-style-type: none">1. Design and choose the diffraction grating2. Design and choose a CCD camera3. Build the software for data processing4. Build a graphical user interface <p>The measurable outcomes are:</p> <ol style="list-style-type: none">1. A fully functional spectrometer with a USB interface.2. A software with GUI to show the light spectrum.

Action list (to be attempted or completed by student by the next supervisory meeting):

1	Finish the resources list and Risk Assessment Form
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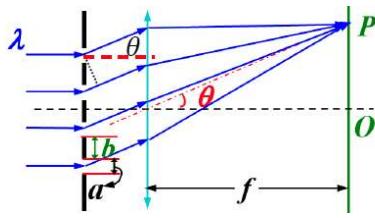
Design Draft

2020年12月23日 4:53



Calculation of two equations

2020年12月29日 2:05



$$\Delta\phi_p = \frac{2\pi}{\lambda} d \sin \theta$$

Phase different for maximum

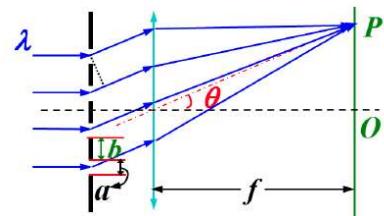
$$d \sin \theta = \pm k \lambda \quad (k = 0, 1, 2, \dots)$$

$$\Delta\phi_p = \pm 2k\pi \quad (k = 0, 1, 2, \dots)$$

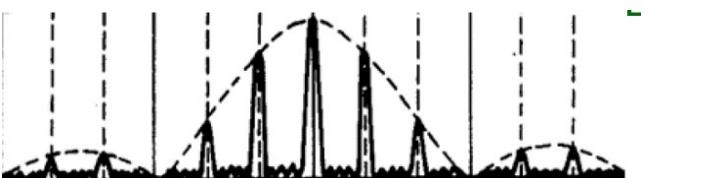
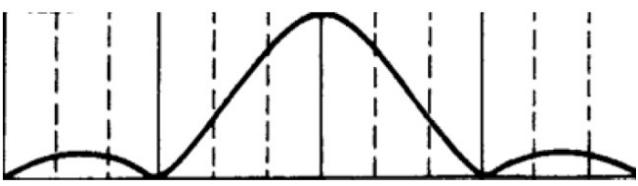
$$\Delta\phi_p = \frac{\pm 2k' \pi}{N}$$

$$: d \cdot \sin \theta = \frac{\pm k'}{N} \lambda$$

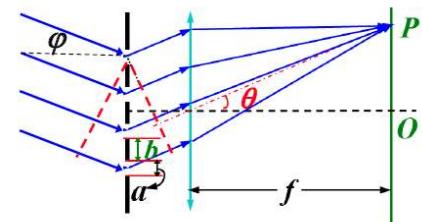
Phase different for minimum



$$\Delta\phi_p = \frac{2\pi}{\lambda} d \sin \theta$$



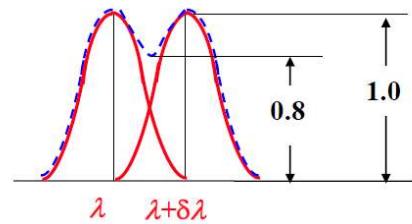
the effect of the diffraction can be explained as the result of multi-split interference modulated by single-split diffraction.



$$d(\sin \theta + \sin \varphi) = k \lambda \quad (k = 0, \pm 1, \pm 2, \dots)$$

When the incident light has angle with the grating

$$R \equiv \frac{\lambda}{\delta\lambda}$$



Resolution definition

$$d \sin \theta = \pm k\lambda$$

$$d \cdot \sin \theta = \frac{\pm k'}{N} \lambda$$

$$\sin \theta = \frac{k'}{Nd} (\lambda + \delta\lambda)$$

$$\frac{k}{d} \cdot \lambda = \frac{Nk - 1}{Nd} \cdot (\lambda + \delta\lambda)$$

$$\begin{aligned} Nk\lambda &= (Nk - 1)(\lambda + \delta\lambda) \Rightarrow 0 = Nk\delta\lambda - \lambda - \delta\lambda \\ &\Rightarrow \lambda = \delta\lambda(Nk - 1) \end{aligned}$$

$$R = \frac{\lambda}{\delta\lambda} = Nk - 1 \approx Nk, (k \neq 0) \quad (N \gg 1)$$

$$R \approx Nk$$