Imperial College London

Lecture 1

Introduction to Design of Visual Systems

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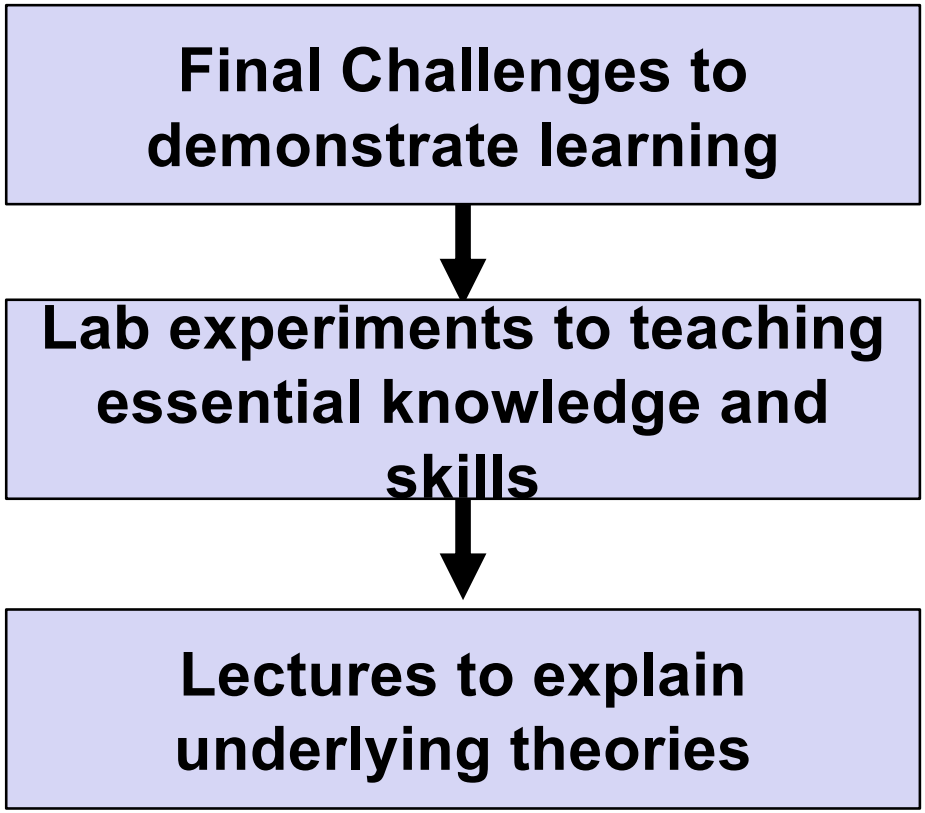
Why this module?

- Many devices and systems nowadays involve visual information, e.g self-drive, CCTV, face recognition etc.
- Visual systems is not covered by any other modules (except maybe slightly in robotics?)
- Visual systems are really interesting – instant feedback and gratification.
- Extension of signal processing in DE2 Electronics 2.

What will be covered?

- Physiology and anatomy of human visual system
- Physics of human visual system
- Technology of visual systems
- Algorithms in visual system design
- Understanding and machine interpretation of visual information

Course Design - Back-to-front



Assessment & Textbook

- DRAW week mini-project (15%)
- Final Project (25%)
- Examination on week 1 of Summer Term (60%)

- Textbook:

"Digital Image Processing", Gonzalez & Woods (4th edition)

Electronics copy of this book is available on:

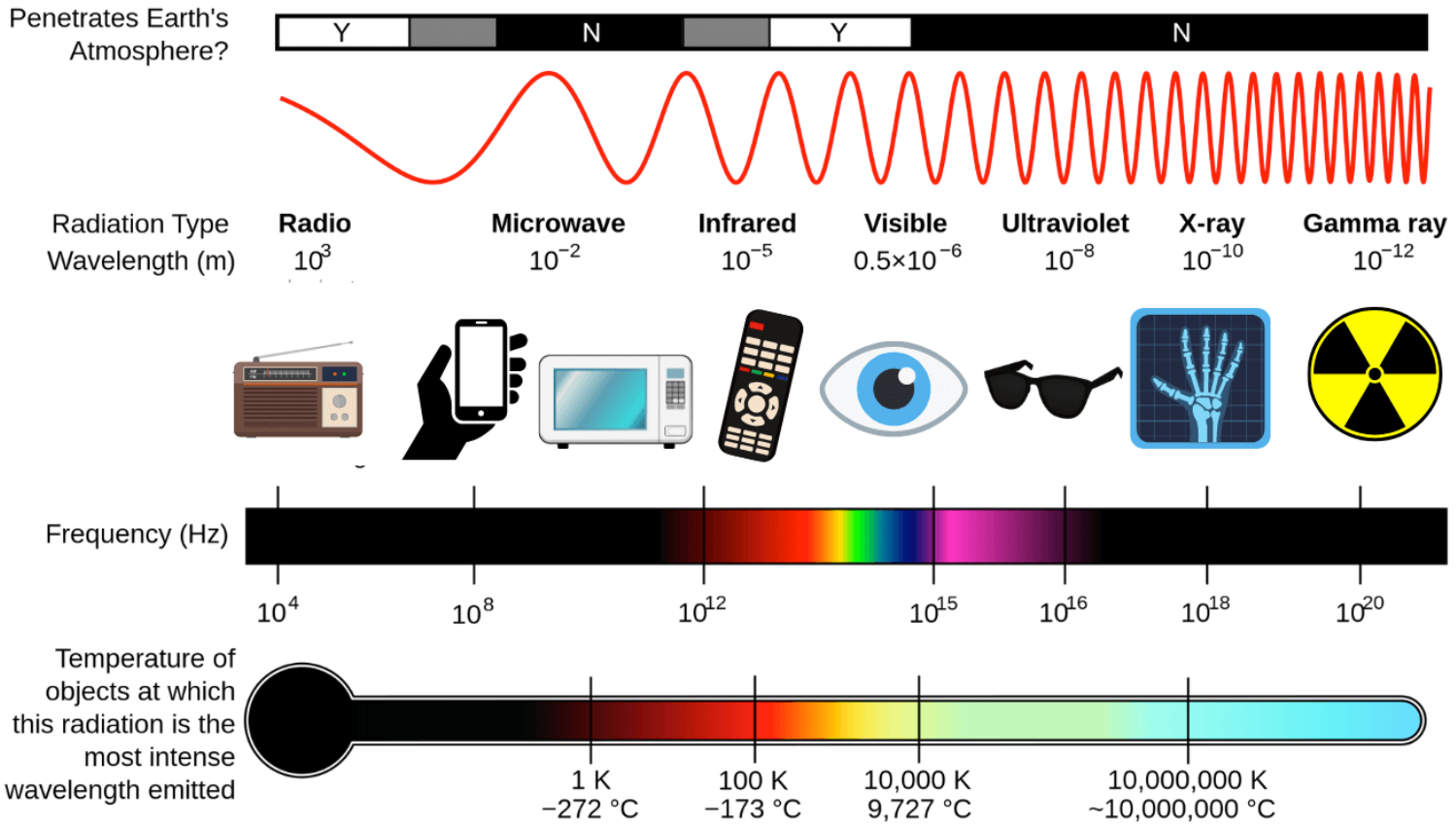
https://imperial.alma.exlibrisgroup.com/leganto/public/44IMP_INST/lists/4461809029000 1591?auth=SAML

Course schedule (2025)

This schedule is subject to change

Week starting	Lectures (Tuesday 14.00 – 16.00)	Lab (Thursday 13.00 – 16.00)
wk1 – 13 Jan	The Anatomy & Physiology of Human Visual System	Lab 1: Intro to MATLAB
wk2 – 20 Jan	How we see colours?	Lab 2: Vision test & Colours
wk3 – 27 Jan	Intensity transformations and spatial filtering	Lab 3: image enhancement & filtering
wk4 – 3 Feb	Morphological processing	Lab 4: Morphological Operations
wk5 – 10 Feb	DRAW WEEK (no lectures)	Mini-Challenges & Logbook – 15% of module
wk6 – 17 Feb	Image Segmentations and Feature Extraction	Lab 5: Segmentation and Extraction
wk7 – 24 Feb	Image Classification	Peter is away – no lab
wk8 – 3 Mar	Physics of visual systems (by Freddie Page)	Final Challenges explained + Lab 6: Image Classification
wk9 – 10 Mar	Technologies for visual systems	Final Project
wk10 – 17 Mar	FINAL WEEK (no lectures)	Final Challenges submission via GitHub on Friday 21 March (25%)

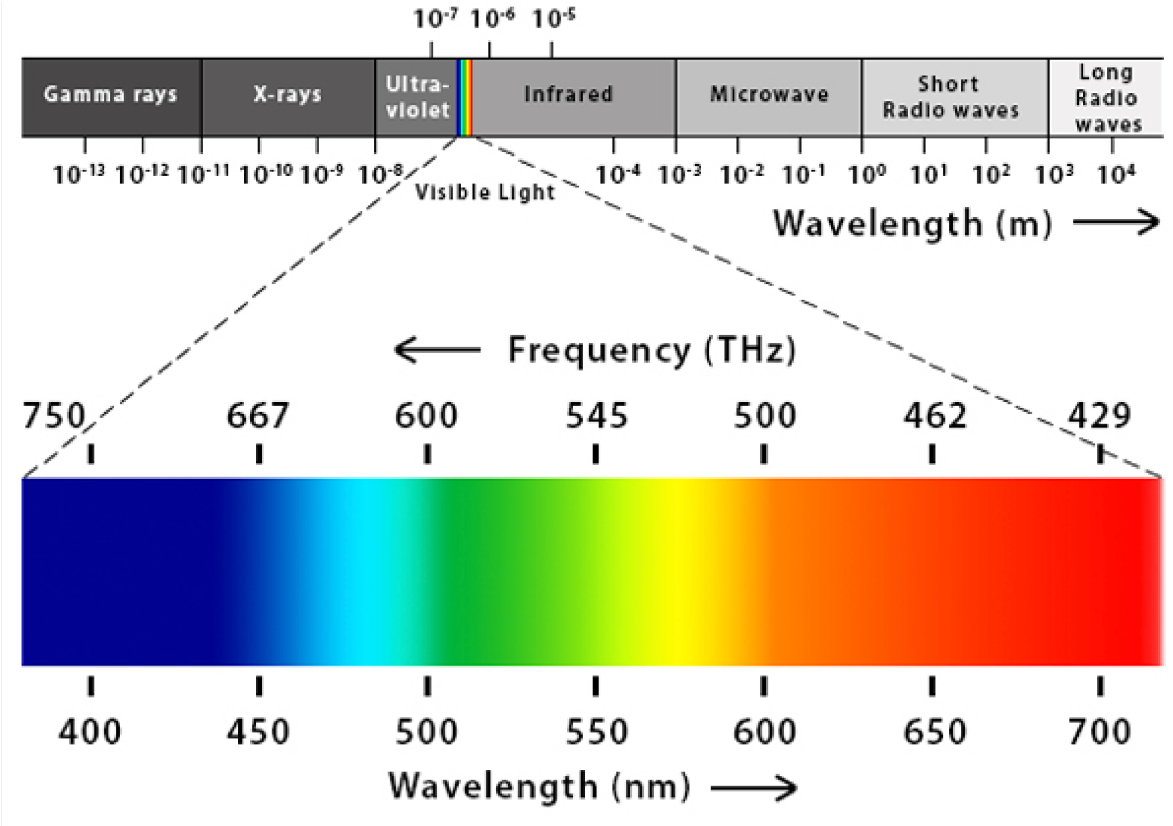
Electromagnetic (EM) Spectrum



- Visible light is only a small fraction of the entire electromagnetic spectrum
- It lies between infrared and ultraviolet frequencies
- Emitted light from an object helps to identify the temperature of that object

Source: sciencenote.org

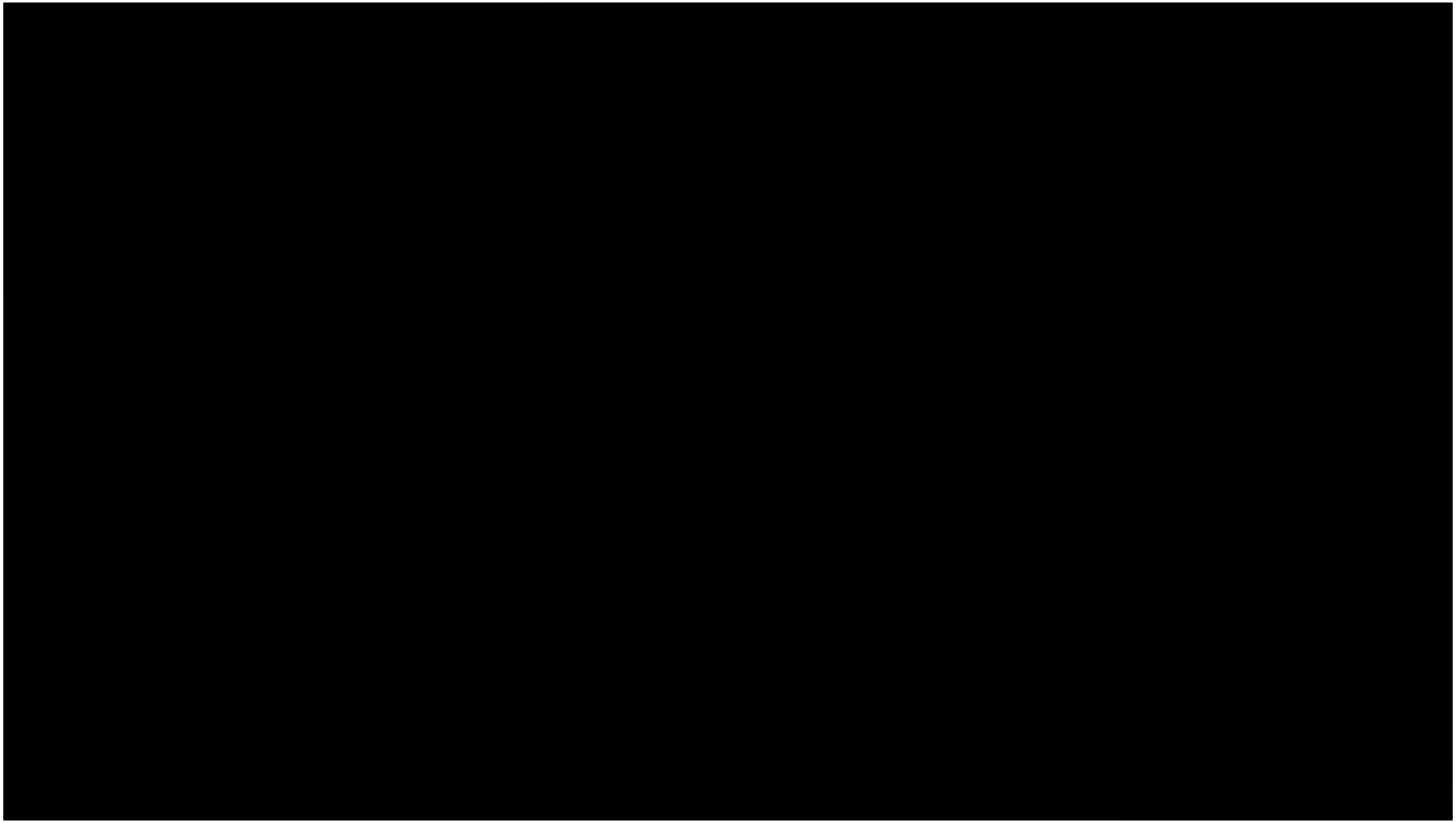
The Visible Light Spectrum



- Visible light has a wavelength between 380nm (blue) and 740nm (red)
- The frequency range is between 4 x10^{14} Hz (red) and 8 x 10^{14} Hz (violet)
- Visible light is the energy source of human vision
- Non-visible light such as infrared, X-rays and Gamma rays can also be used

Source: sciencefact.net

Visible Light Wave – a NASA video



Source: NASA series on EMS

A typical visual system