

**Disclaimer**

This summary is part of the lecture “ETH Image Analysis & Computer Vision” by Prof. Van Gool, Prof. Konukoglu and Prof. Goksel (HS19). It is based on the lecture.

Please report errors to doberm@student.ethz.ch such that others can benefit as well.

The upstream repository can be found at <https://github.com/mrrebot/Summaries>

# Image Analysis & Computer Vision

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## 1 Introduction

Vision is important:

- Half our brain is devoted to it
- Developed many times during evolution
- It is non-contact
- It can be implemented with high-resolution
- Works with ambient EM-waves
- yields color, texture, depth, motion, shape

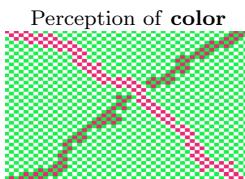
Take home message:

**For people vision is their most crucial sense, for good reason**

### 1.1 Perception of vision

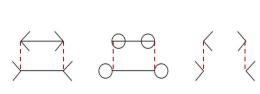


The gray fields have the same intensity (same gray tone).



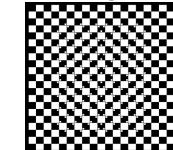
The red squares have equal color (gray tone).

#### Perception of length



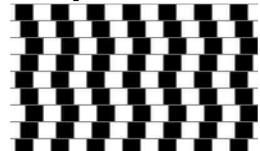
the horizontal lines are equally long.

#### Lines being straight



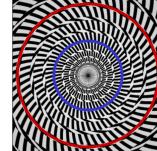
The lines do not have any curvature.

#### Perception of parallelism



All lines are parallel.

#### Perception of curvatures



There is no spiral.

## Perception of motion



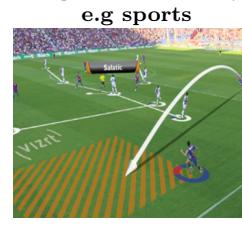
The pole rotates about the vertical, it does not translate vertically.

## The role of context



All encircled patterns are identical!

## Augmented Reality, e.g. sports



Take home message:  
**It is feasible now to let most things see and interpret their environment.**

## Computer-assisted surgery



The visible range differs from humans to animals and also cameras may have different spectral sensitivities. There are also cameras for non-visible light such as infrared. The following picture shows the three color cones humans have and their sensitivity range: nm 350 400 450 500 550 600 650



### 1.3.2 Interactions with matter

We look at the following types of interaction with matter:

1. **Absorption**  
→ blue water
2. **Scattering**  
→ blue sky  
→ red sunset
3. **Reflection**  
→ colored ink
4. **Refraction**  
→ dispersion by a prism
5. **Diffraction**

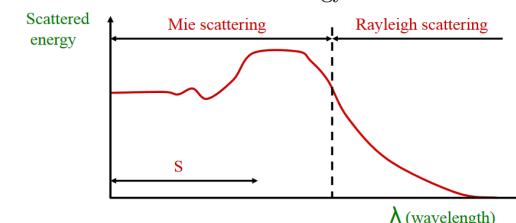
We look at few of those in more detail:

### 2. Scattering

There are three types of scattering depending on the relative sizes of particles and wavelengths:

- (a) Small particles: **Rayleigh** (strong wavelength dependent)
- (b) Comparable size: **Mie** (weakly wavelength dependent)
- (c) Large particles: **Non-selective** (wavelength independent)

If we look at the scattered energy it looks as follows:



### Wavelength [nm]

Wavelength [nm]	Color
380 - 450	→ violet
450 - 490	→ blue
490 - 560	→ green
560 - 590	→ yellow
590 - 630	→ orange
630 - 760	→ red

Let's see some examples of these different scatter-types in our atmosphere:



**Rayleigh:** Tyndall effect (blue sky, red setting sun)

**Non-selective:** Grey clouds

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