

OPTICAL ENGINEERING

Oral Examination

Year: 2016

Time: 40 minutes

- 1. What is Optical Engineering?**
- 2. Any system you would like to present?.**

The Eye. So I sketched the Gullstrand model of the human eye.

- 3. What is the total diffracting power of the human eye?**
- 4. What aberrations can be present in the human eye?.**

Stigmatism, for example, is one of the most common and then explained it.

- 5. How is the shape of the cornea in that case?.**

After thinking, it is just math: $r^2 = x^2 + z^2$ in one plane and in the other one $r^2 = y^2 + z^2$.

- 6. What does the eye see when it is looking at a star?.**

Airy function, so I wrote the equation of the airy function radius: $X = 1,22 \cdot \lambda \cdot f / D$.

- 7. What's the f-number of the eye?.**

Well...the retina diameter is around 3mm, f is around 17mm, so...f/d.

- 8. If $\lambda = 0,6\mu\text{m}$, how big is the airy disc?.**

After thinking, using $X = 1,22 \cdot \lambda \cdot f / D$, it was around $6\mu\text{m}$.

- 9. What's the shape of an airy function?.**

I draw a diffraction pattern with two side minima.

- 10. Have you ever seen that pattern?.**

Yes, when a laser diffracted in a grating, for example.

- 11. But, have you ever seen at a star?, did you see the side maxima of the airy function?.**

No...(and here it comes...)

- 12. Why?**

...because the eye doesn't have the resolution to see that size. There is $4\mu\text{m}$ between cones in the retina... (so, I should see it!, because I said that the airy was around $6\mu\text{m}$)

- 13. What is the difference in height of the main peak and the side maxima?.**

(silence + thinking)

14. How many scales of gray can the human eye see?.

...(?)...I just said 256...

15. Yes!, it is something like that. Why do we say 256?

(Awkward silence + thinking)

16. Why do we use a byte system?.

Well...1 byte is 8 bits. $2^8 = 256$ bits....(?)...

17. But why do we use it?, in the past, with the first computers?.

After a lot: Binary is use because we had two level of voltage in original computers, so we could use a binary base system . Then we have all the charcters of the computer, around 30 leters, plus capitals letters, numbers, plus other thing, let say 256 characters to save room fort he future and also, because $2^8 = 256$ (round number). So, in the decade of ´70, colors have to be some how coded and there was already the binary system, so it was use for colors as well. So...now we described the gray scale in a 8 bit system, as with $2^8 = 256$...

18. So, the gray scale, how can be control in a modern Camera?.

(Finally!...) Limiting the amount of illumination in the CCD sensor.

19. Yes. That will lead to a very low amount of illumination, and so?

And the exposition time will have to be much larger. (He wanted to hear that)

20. Another way to reduce illumination in modern cameras?.

The output signal of the CCD, prior to go through the Analog-Digital conversor, is amplified by a circuit. So in a digital camera, the amplification output level can be set (ISO) in order to reduce the gray scale (intensity) of the picture.

21. So, how ist he human eye control the ilumination?.

With the iris.

Then he explained that the human eye can distinguish somthing like 1 Million of gray scale, which are several bytes. (Look for it in Wikipedia)

Then, he explained that the difference in amplitud oft he maximun and the first minimum oft he airy function is about 2%, and that is why the eye can not see the first side minima oft he airy function. (Which of course, I belive him)

End of examination, but I was not prepared fot that at all mainly because we did not see that in class (WS 2015/2016). He said that was trying to see if he explain the topic about color codification in the future. In the end was OK.

Good look!