Mirror Reflections

Skylar Li, 2019

Introduction

- Mirrors are an interest to me because a perfect mirror was only created by MIT a few years ago.
    - A simple mirror may reflect 99% of light, but with every reflection, a certain amount of photons is absorbed by the mirror, making the reflection weaker than the last.

- The word laser originated from the acronym LASER, which stood for light amplification by stimulated emission of radiation. The energy that a laser emits, in the form of coherent light (a beam of photons that have the same frequency) travels at the speed of light; which is about 300,000 km per second.

Problem Statement

- How many reflections can a laser have in a room of mirrors?
- How long it would take for the laser to decrease until it is invisible to the human eye?

Results

- How many reflections can a laser have in a room of mirrors?
  - First, we assume that the laser is pointed in a rectangular room, with mirrors on every side that reflect 99.99% of light.
    - With each reflection, 0.01% of light is absorbed by the mirror
    - Also assume that light can’t be seen by the naked eye if less than 1% is present
    - Using conversion,99.99%=0.9999 and 1%=0.01.

- I let “N” be the total number of reflections made by the laser.
  - 0.9999N=0.01
- I applied natural log to both sides of the equation in order to isolate ¨N¨.
  - Nln(0.9999)=ln(0.01)
- Using simple algebra, N=46049.39. Since the laser cannot reflect 39 hundredths of itself, I rounded up to the nearest whole number.
- It would take 46050 reflections for a laser to become invisible to humans.

- The second question I asked myself was how long would it take for the laser to disappear?
  - The variable “s” is the number of seconds it takes for the laser to disappear. I let the variable “r” be the distance between the parallel mirrors (in meters).
  - Since we know that light travels at 300,000 km per second, we know that the laser travels at 300,000,000 meters per second.
  - r/300000000=1 second
- The formula to find the number of seconds for the laser to disappear is :
  - s=46050(r/300000000)
- If the distance between the mirrors is 10 meters, then the time it takes for the laser to disappear is d
  - s=46050(10/300000000)
  - s=0.000135

Conclusion

- From this project I was able to find that it takes 46050 reflections for a laser to disappear. In a square room with a length of 10 meters, the laser would disappear in 0.000135 seconds.
- The problem I posed for myself was very straightforward. Next time, I would come up with a more challenging problem, such as ones involving probability,

Future Research

- If I were to continue with this topic, I would probably look for patterns in which the laser goes when it is pointed at a specific angle and perhaps focus on more realistic mirrors and lasers.
- I think it would be interesting to explore patterns that a laser would make in different shapes as well.

Questions are welcome!