

Network Analysis and Simulation - Homework 4

Michele Polese, 1100877

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Exercise 2 - Read logs and analyze data

In this second exercise the goal was to extract a look-up table from a log file of a simulator and use it to compute some measurements on useful quantities in underwater optical communications. In particular, the log files are obtained from the simulations of the ambient light irradiance E_0 with the simulator HYDROLIGHT. From the 3 different dump files (each for a different value of $c \in [0.15, 0.4, 2.19]$ with c the attenuation coefficient) I recovered the values of E_0 and the corresponding depth z in meters using a `perl` script. It uses a regular expression to identify the right rows of the log and selects the columns with the desired values. In Figure 1 E_0 is plotted as a function of the depth z .

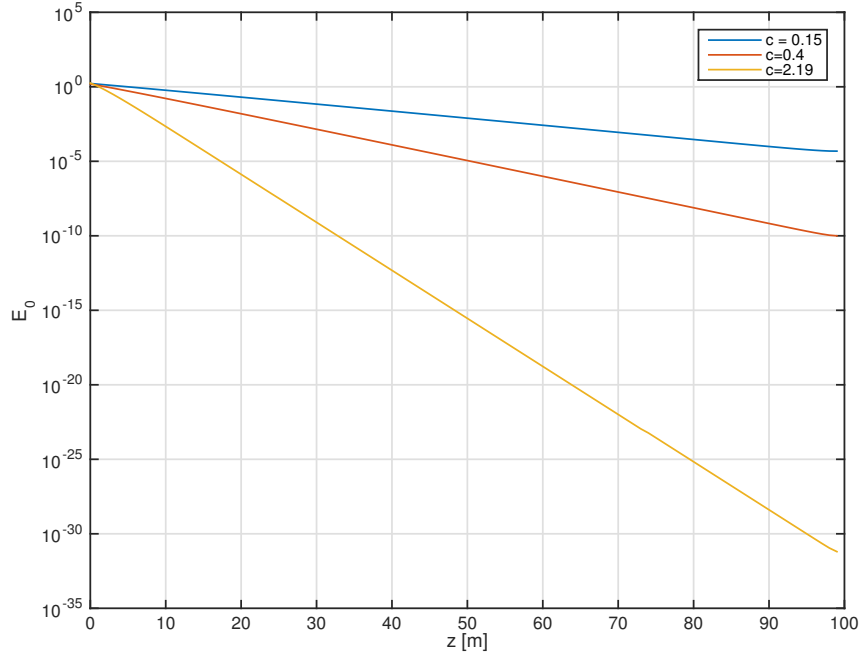


Figure 1: Irradiance E_0 vs. z

Some evaluation on the propagation are then carried out with a MATLAB script that uses the provided parameters for receiver and transmitter. The propagation model used the one proposed in [2] and assumes that there is a successful transmission if the SNR is over a certain threshold. In particular from the irradiance and the parameters S (sensitivity) and A_r (area of the receiver) of the considered modem it is possible to compute the power of ambient light noise, which is $N_A = (SE_0A_r)^2$. Let the received power P be

$$P = \frac{2P_{tx}A_r \cos(\beta)}{\pi d^2(1 - \cos(\theta)) + 2A_t} e^{-cd} \quad (1)$$

then the SNR is

$$\Gamma = \frac{(SP)^2}{2q(I_D + I_L)BW + \frac{4KTBW}{R} + N_A} \quad (2)$$

In the following, if the SNR is above the threshold of 20 dB then there is a successful transmission. In particular, by setting the threshold and a distance $d = 10$ m, by inverting (2) in order to get P and (1) in order to compute P_{tx} it is possible to know which is the minimum transmission power that can be used to reach a distance d . In Figure 2[a] there is the plot of the minimum P_{tx} against the irradiance E_0 , while in Figure 2[b] the x axis is the depth Z considered.

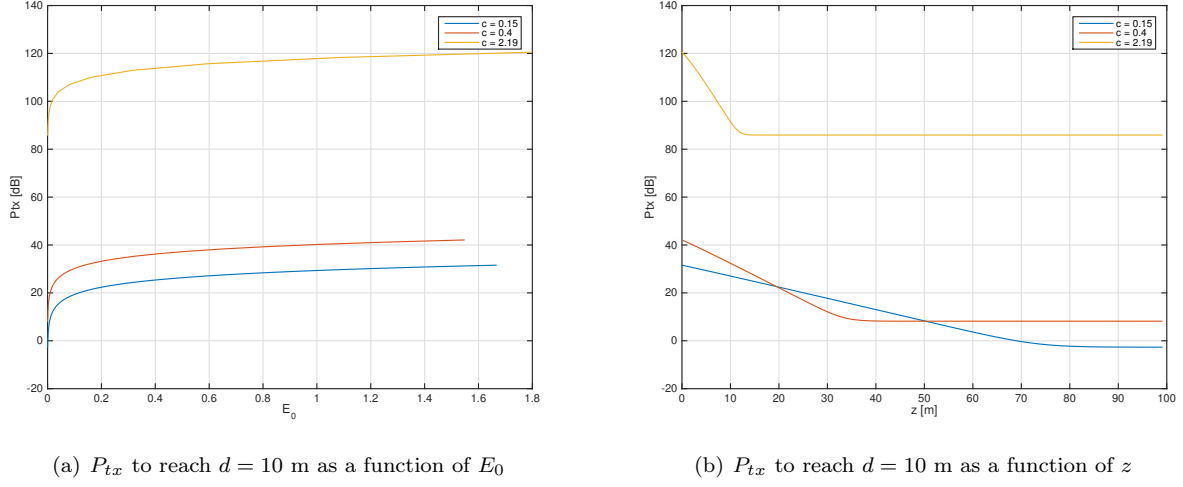


Figure 2: Transmitted power P_{tx} required to transmit at a distance of $d = 10$ meters

References

- [1] Y. Le Boudec, Performance Evaluation of Computer and Communications Systems, EPFL, 2015
- [2] D. Anguita et al., "Optical wireless underwater communication for AUV: Preliminary simulation and experimental results," in Proc. IEEE/OES Oceans, Santander, Spain, Jun. 2011