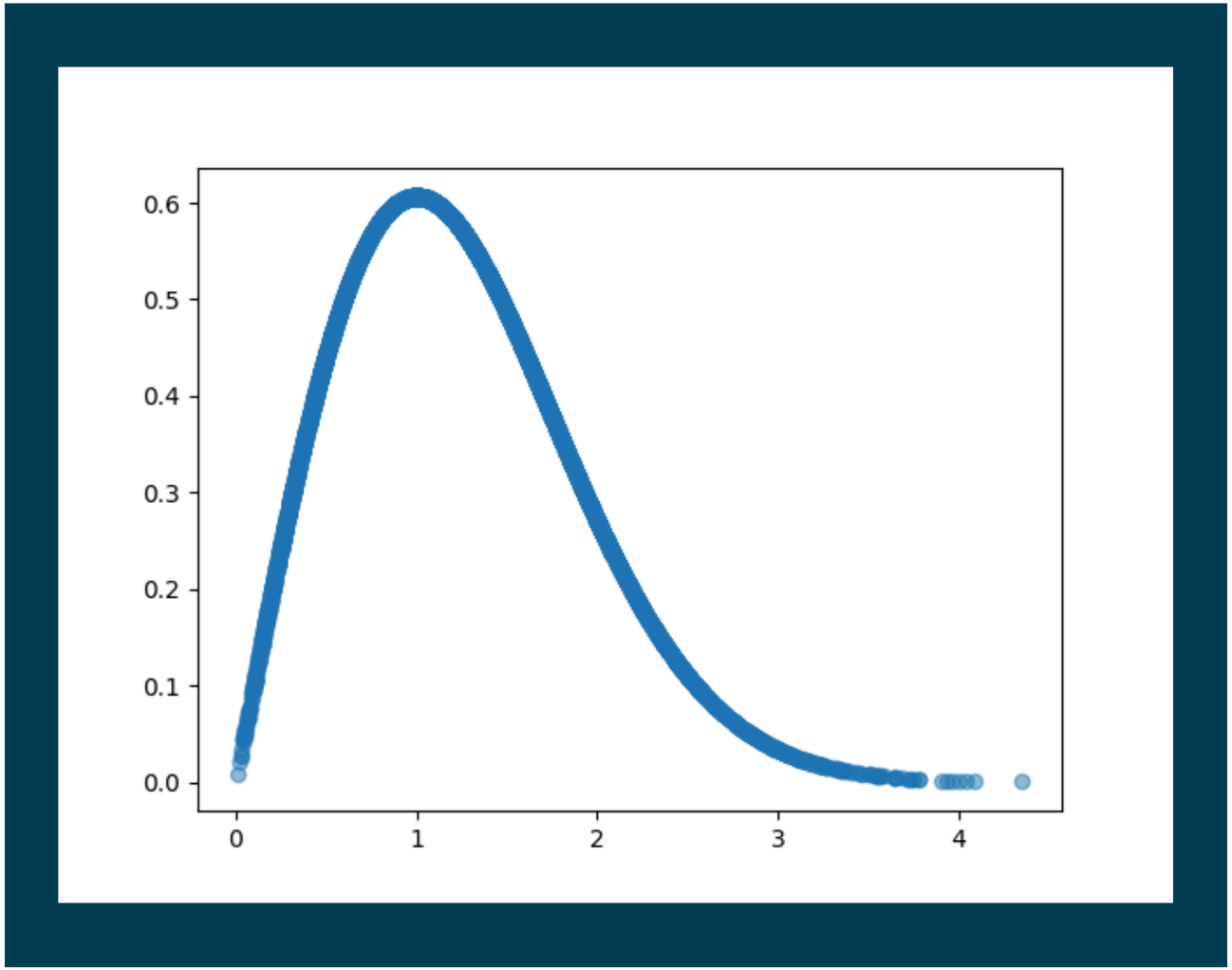
Exercício 1

In this exercise you will generate Rayleigh random numbers from normally distributed ones. Consider sigma_r = 1: For this experiment start by generating two long vectors of zero-mean unit-variance normal random numbers x1 and x2. Now generate the Rayleigh random number vector by applying element-wise transformation **r** = sqrt(**x1^**2 + **x2^**2). To confirm that your experiment is correct, calculate the mean, mean quadratic value and variance of r and compare with their theoretical values from Eqs.3 to 5. Also, plot a histogram of r and compare with the theoretical Rayleigh probability rule from Eq.2. Apply the appropriate scaling factor so that the histogram and the theoretical probability rule graph are superimposed over each other. You should get a plot similar to one in Fig.4.

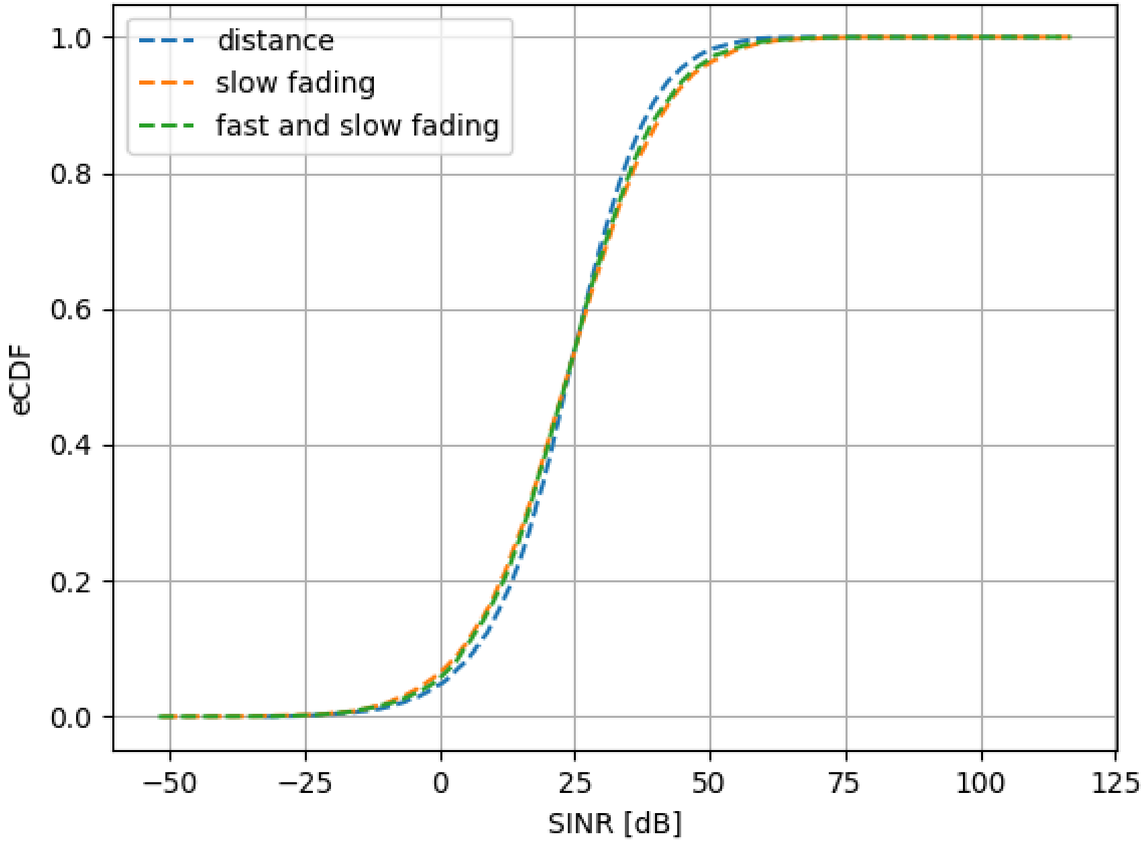
Exercício 1



Exercício 2

Revisit simulations from Parts 1 and 2, now considering the channel model which includes the fast fading effect. Consider a baseline system configuration with M = 64, K = 13 and N = 2 (do not consider any special radio resource management function such as advanced UE-AP attachment, channel allocation or power control). Simulate your system with each of three channel models from Part 1 (distance dependent path gain only), from Part 2 (the model from Part 1 plus shadowing), and the total path gain model from this Part including fast fading. Notice the variation in the per- UE channel capacity 10th and 50-th percentiles as you go from the simple to the more complete channel model. By adjusting (reducing) the demand (number of UEs, K) is it possible to restore the QoS target (spectrum efficiency of 1 bps/Hz at cell border) with fast fading? Discuss the implications with your advisor.

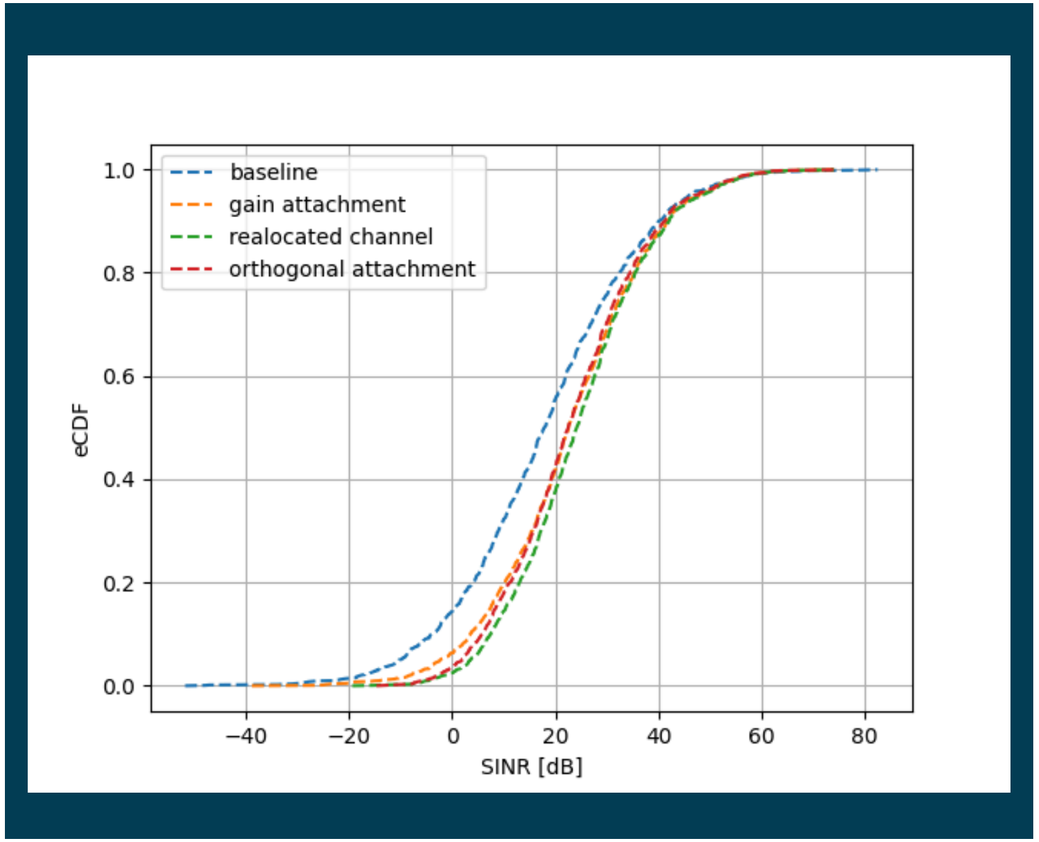
Exercício 2

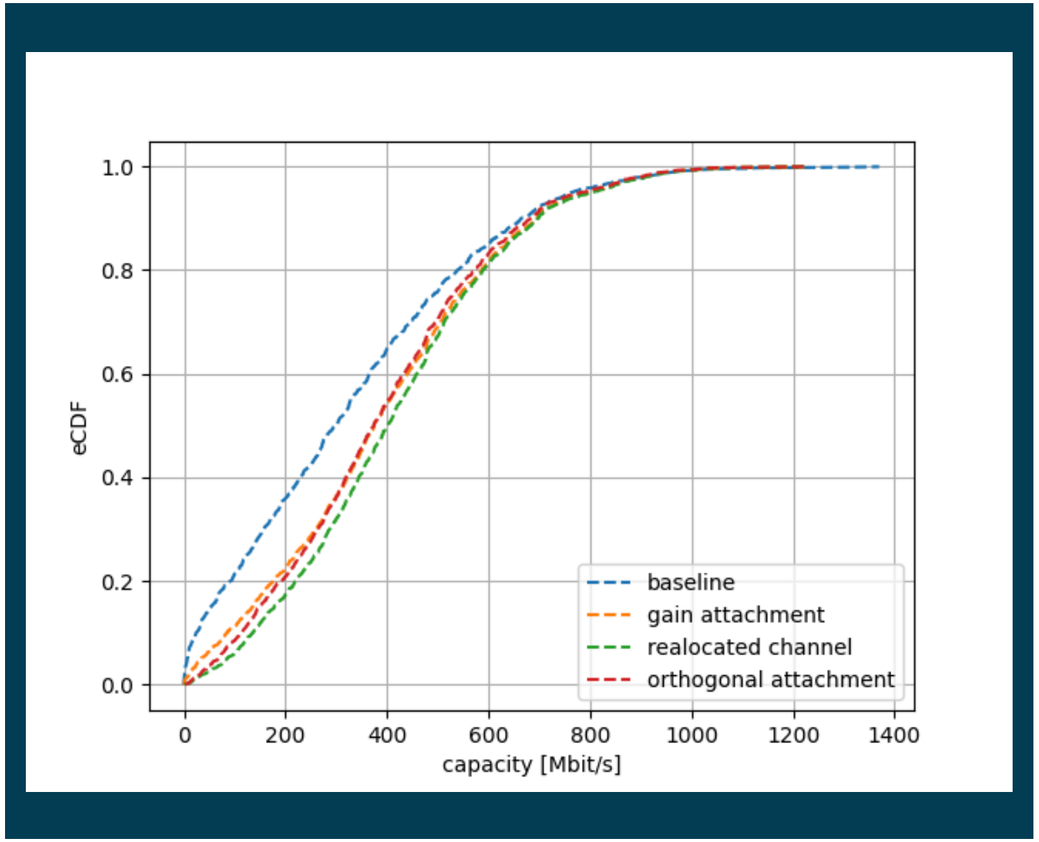

distance
slow fading
fast and slow fading
1.0
0.8
0.6
0.4
0.2
0.0
eCDF
−50
−25
0
25
50
75
100
125
SINR [dB]

Exercício 3

Consider as a baseline scenario one with M = 64, K = 13 and N = 2; distance-based UE-AP attachment and random channel allocation. Run Monte Carlo simulations to evaluate the three UE-AP attachment and channel allocation algorithms above and compare it to the baseline case. Create a table comparing the KPIs. See how much capacity you can recover in comparison with the baseline case.

Exercício 3

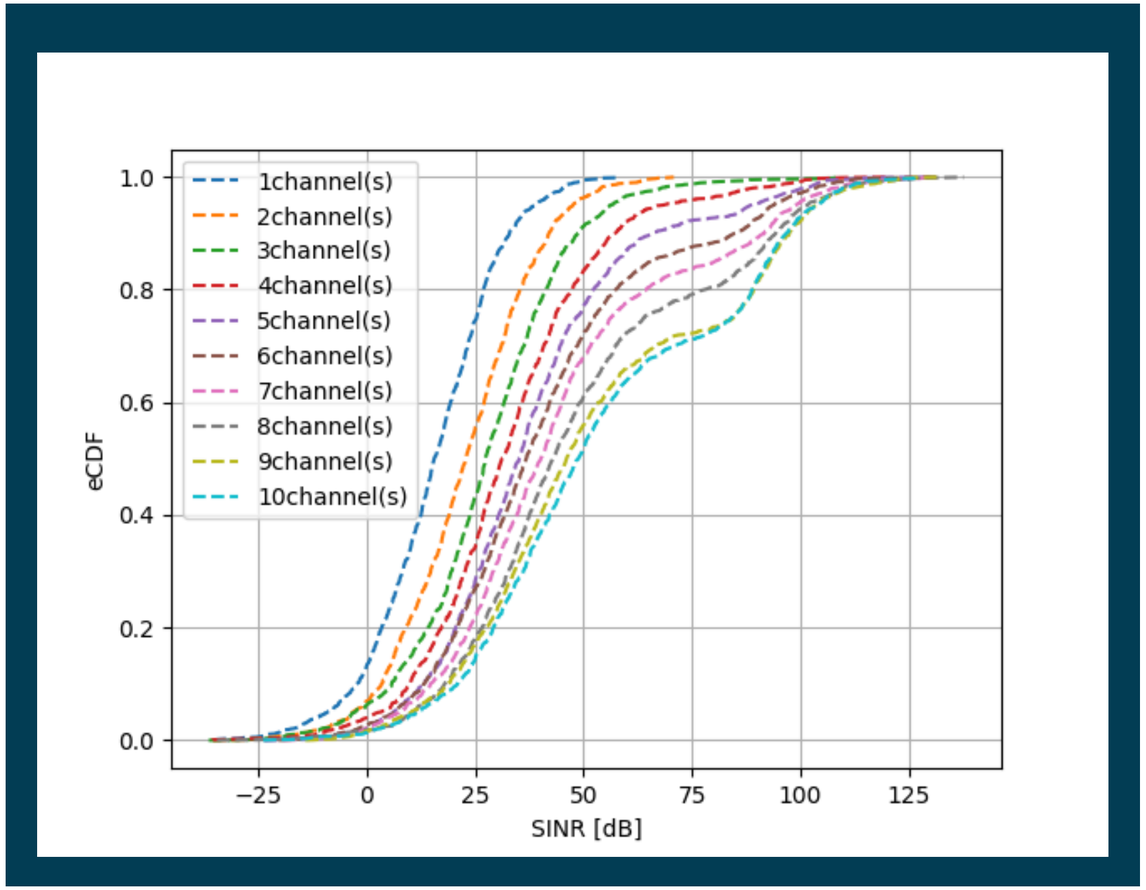

baseline
gain attachment
realocated channel
orthogonal attachment
eCDF
SINR [dB]
1.0
0.8
0.6
0.4
0.2
0.0
−40
−20
0
20
40
60
80

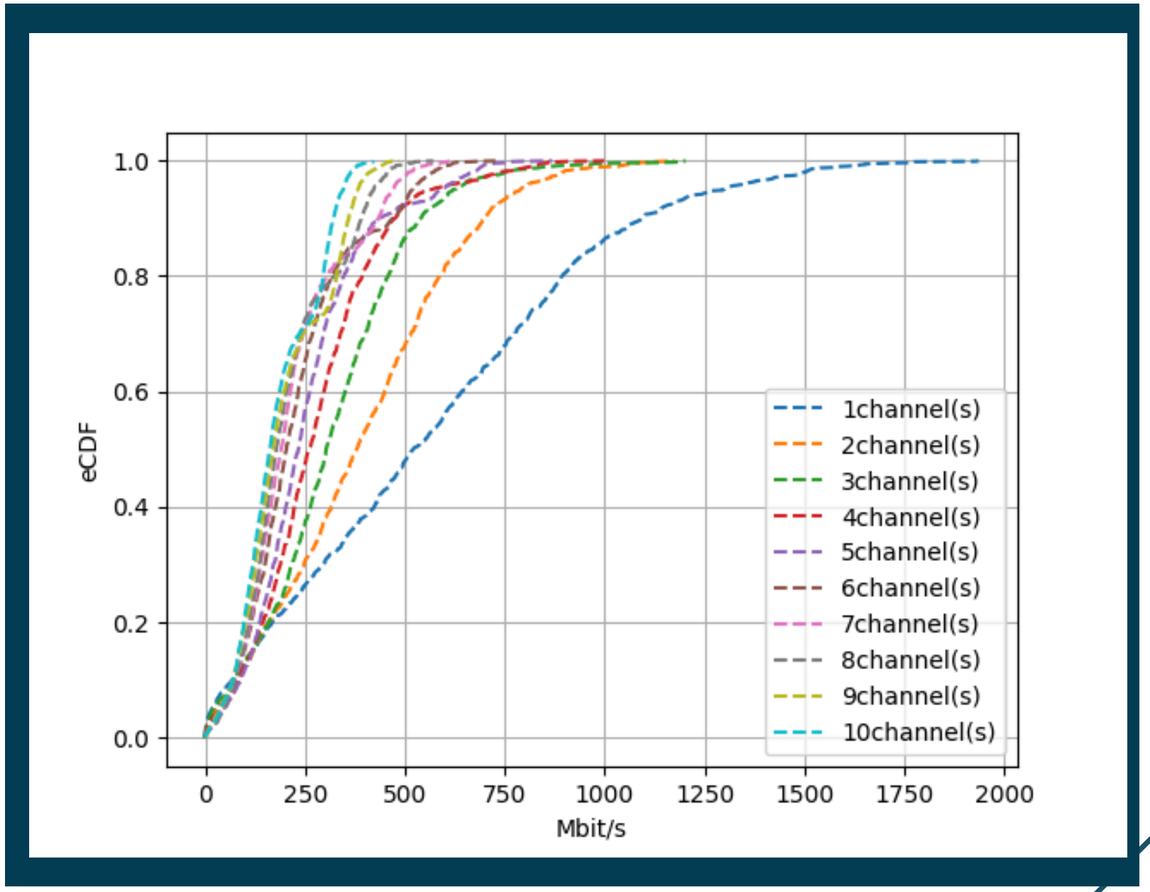

baseline
gain attachment
realocated channel
orthogonal attachment
eCDF
capacity [Mbit/s]
1.0
0.8
0.6
0.4
0.2
0.0
0
200
400
600
800
1000
1200
1400

Exercício 4

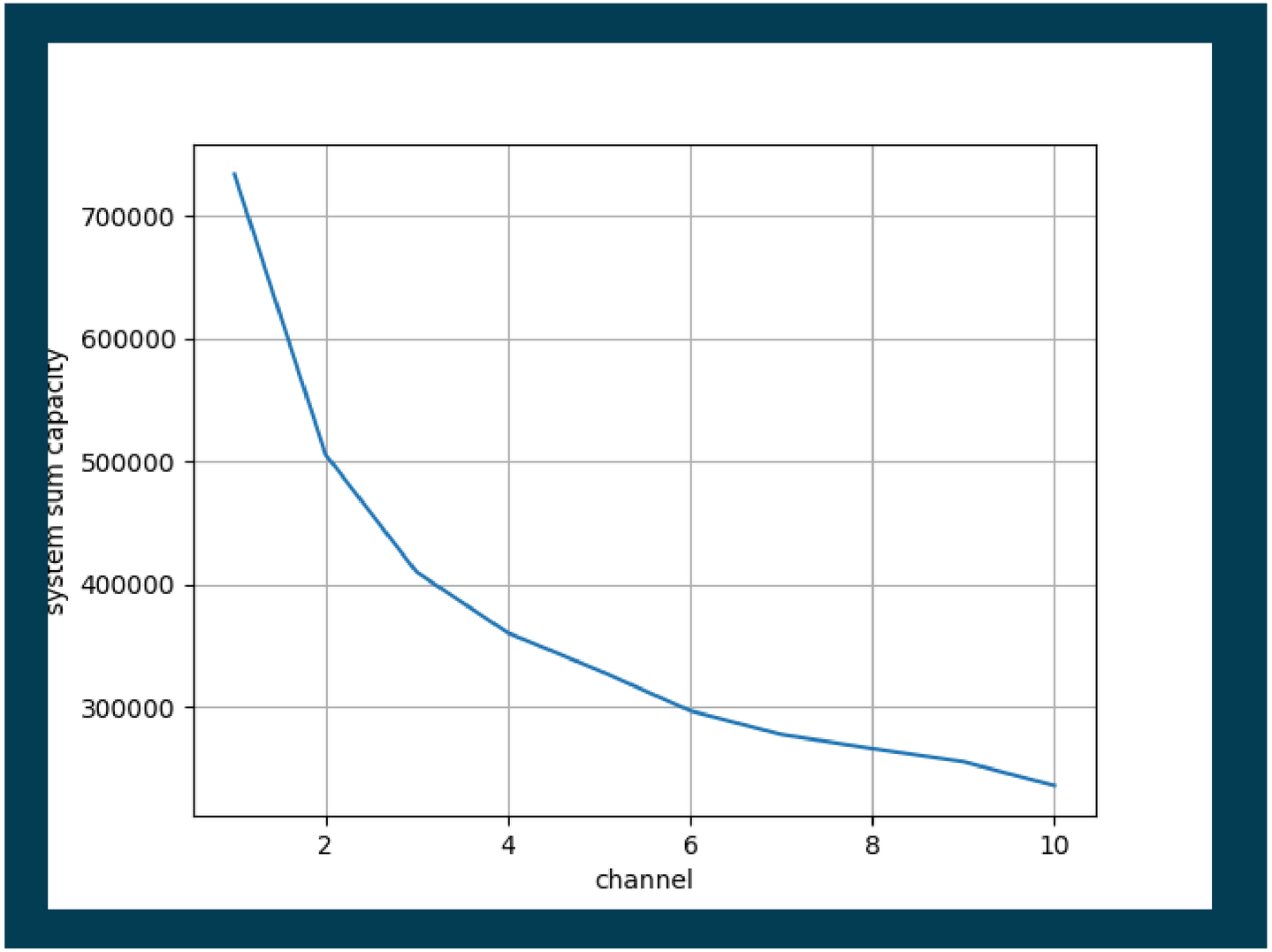
For this exercise you should go back to basics and assume simple random channel allocation. Consider a scenario with M = 64 and K = 13. As for the number of channel pay attention to the following important consideration: you will repeat simulations for values of N starting at N = 1 up to N = 10. Write down the KPIs for each value of N and organize the results in terms of graphics. In particular, plot KPIs against the variation of N.

Exercício 4


1channel(s)
2channel(s)
3channel(s)
4channel(s)
5channel(s)
6channel(s)
7channel(s)
8channel(s)
9channel(s)
10channel(s)
eCDF
SINR [dB]
1.0
0.8
0.6
0.4
0.2
0.0
−25
0
25
50
75
100
125


1channel(s)
2channel(s)
3channel(s)
4channel(s)
5channel(s)
6channel(s)
7channel(s)
8channel(s)
9channel(s)
10channel(s)
eCDF
Mbit/s
1.0
0.8
0.6
0.4
0.2
0.0
0
250
500
750
1000
1250
1500
1750
2000

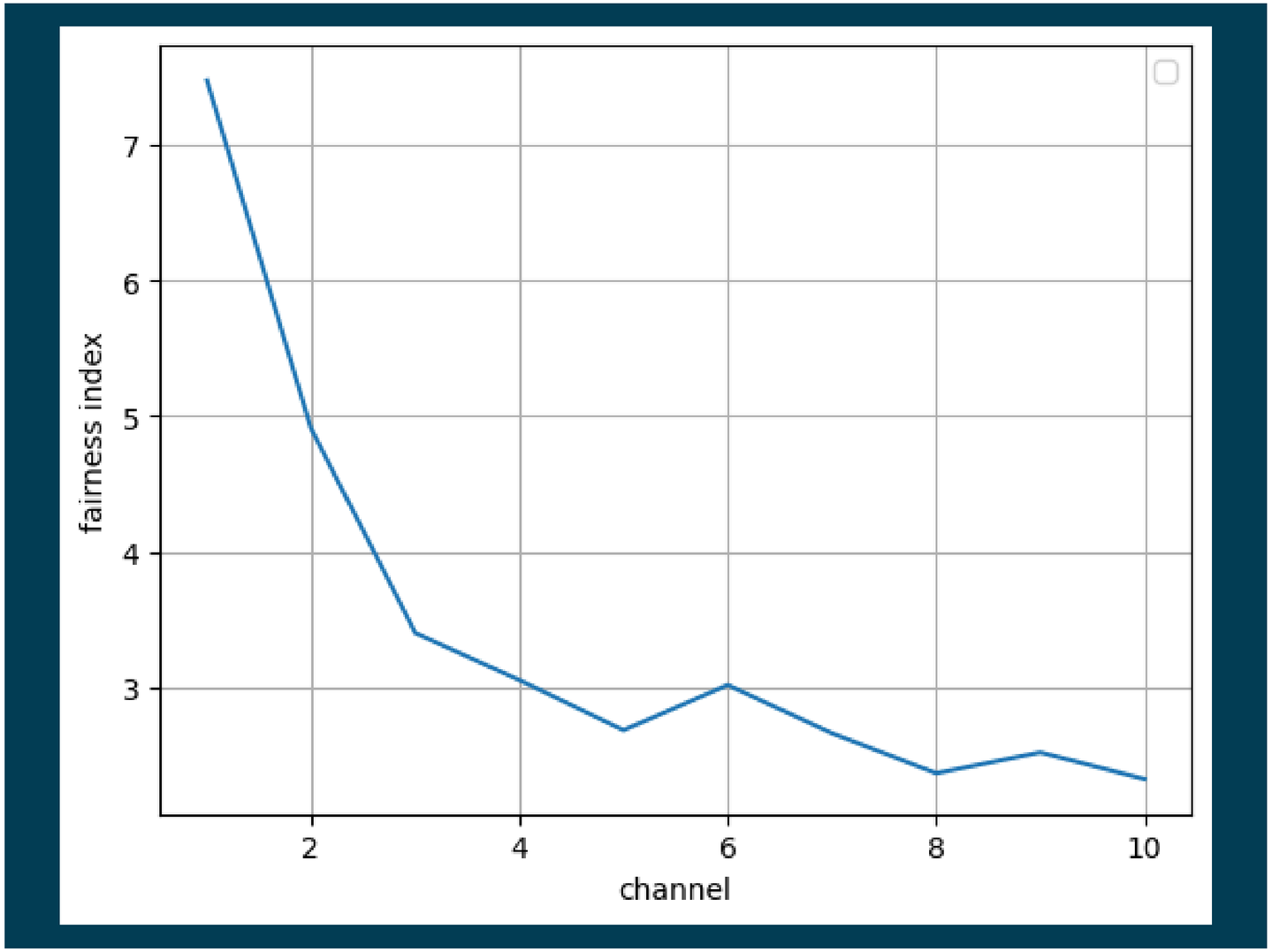
Exercício 4


700000
600000
500000
400000
300000
system sum capacity
2
4
6
8
10
channel

Exercício 5

Based on the results from the previous exercise plot a graphic that shows the ratio between the 50-th and 10-th percentiles of the per-UE channel capacity as a function of N . Let us call this ratio the fairness index. The higher the fairness index, the more unfair is the system as a whole (i.e. the performance disparity between mid-cell and cell-border is greater). In a system in which cell-center and cell-border UEs have the same channel capacity the fairness index would be equal to 1. What do you observe by plotting the fairness index?

Exercício 5



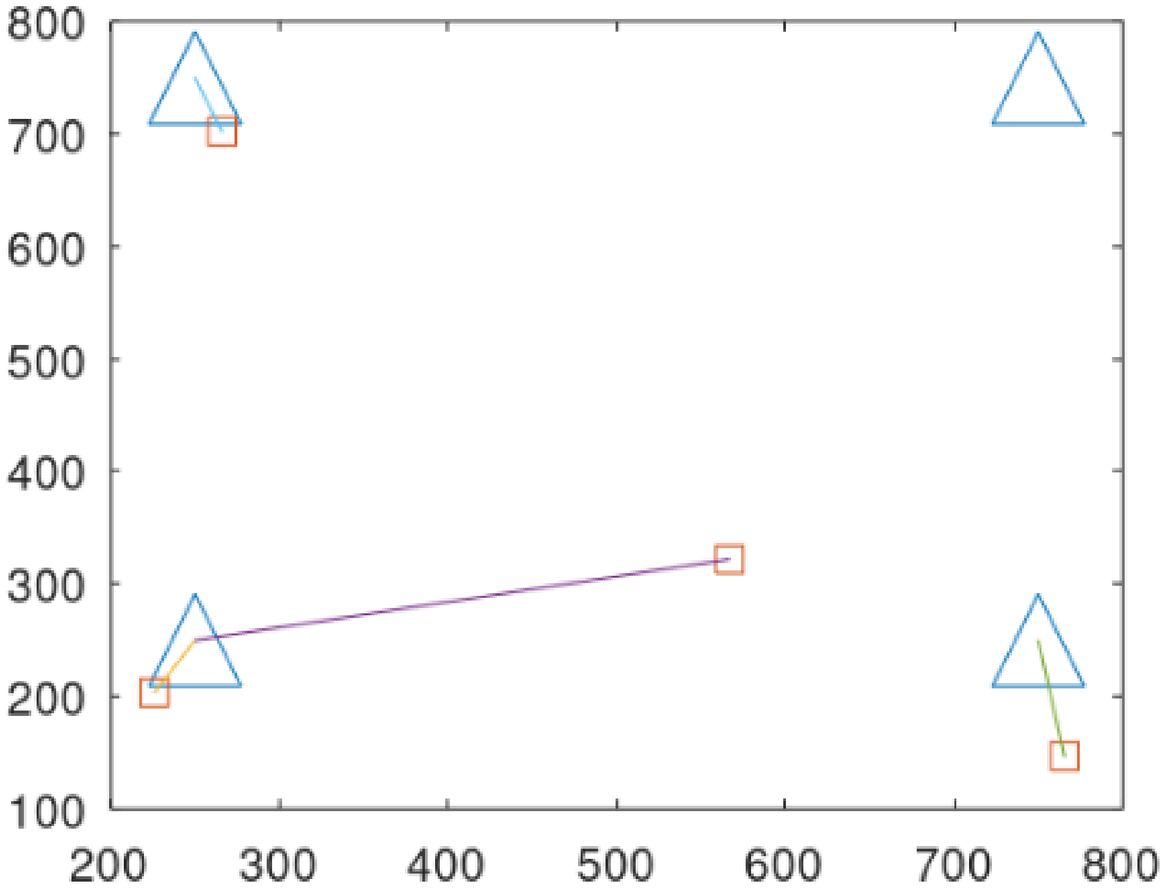
Exercício 6

Discuss with your advisor the possible impacts of a highly unfair system performance as perceived by users of different services.

Exercício 7

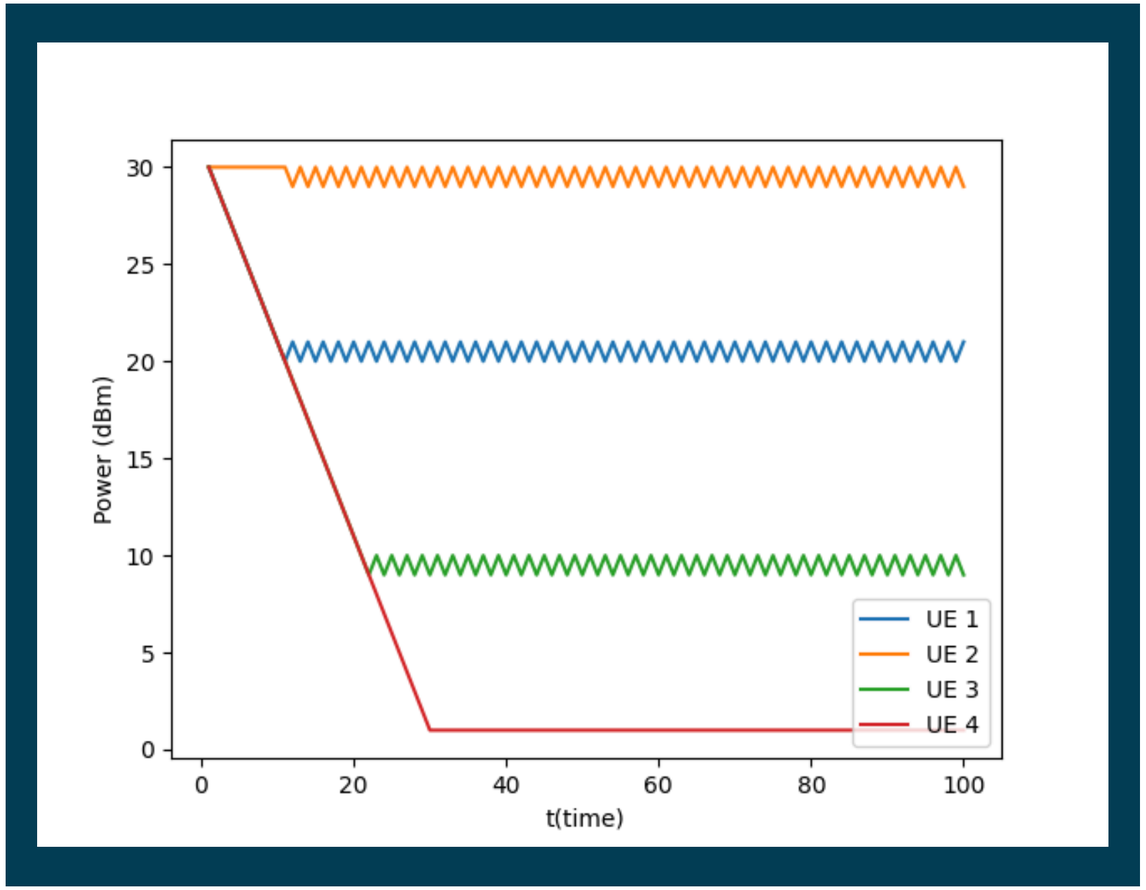
Compare no power control with UD-DPC in the noise-limited and interference-limited scenarios. Set Pmax = 30 dBm, Pmin = 0 dBm and the discrete power control update step as mu = 1 dBm. As for the target SINR required in UD-DPC, let us assume the value corresponding to the QoS target of 100 Mbps at cell border under 100 MHz which equates to sinr_t = 1. All other simulation parameters are kept in the same values used in previous exercises. What are your observations? Did fixed-target SINR-based power control (UD-DPC) help in any of the scenarios?

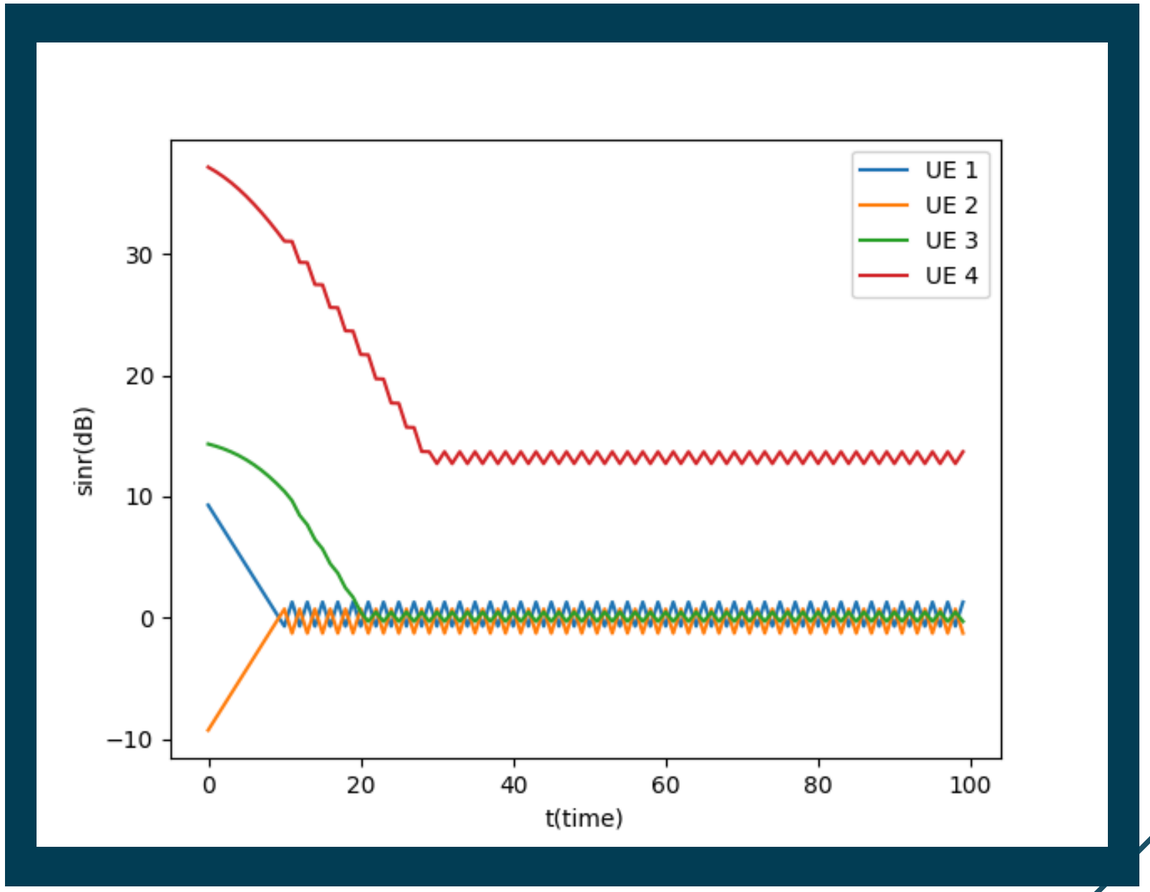
Case study



Exercício 7

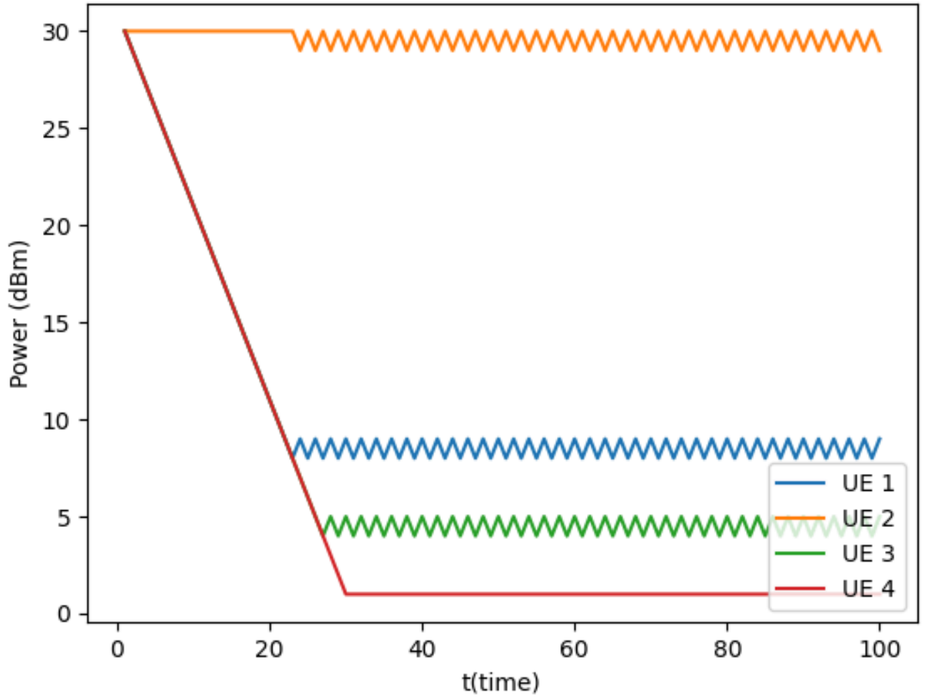
Interference-limited case

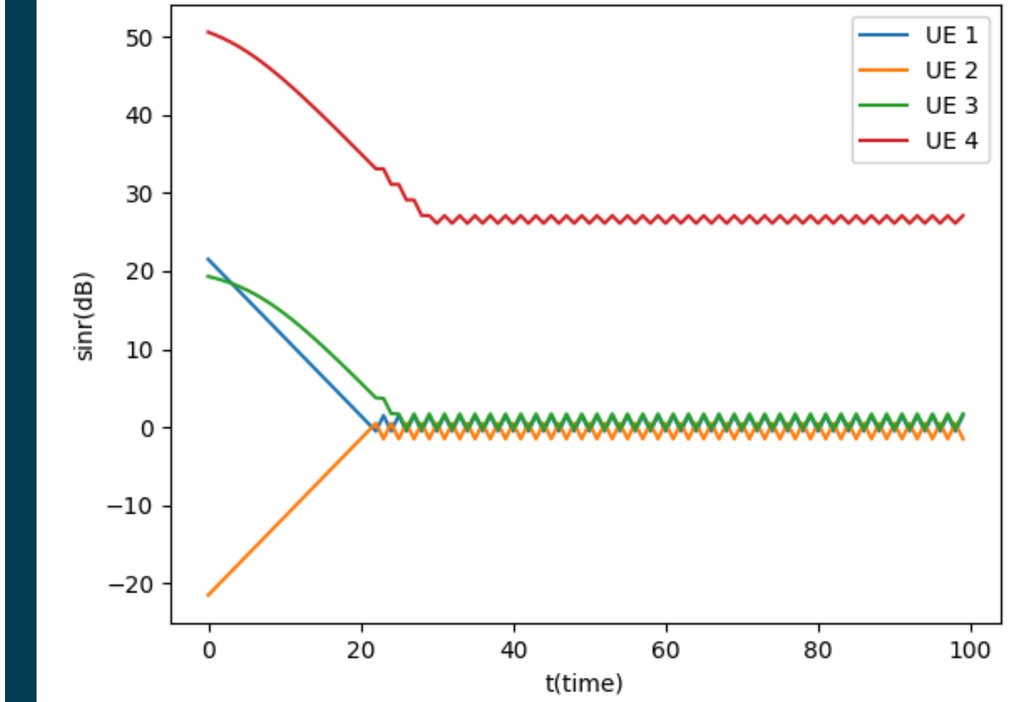




Exercício 7

Noise-limited case



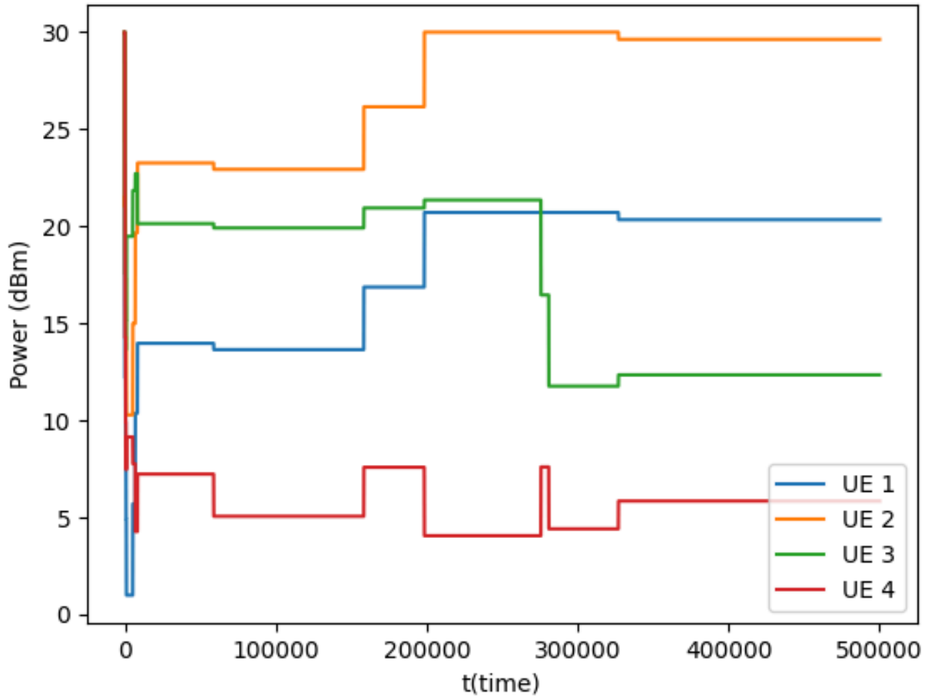


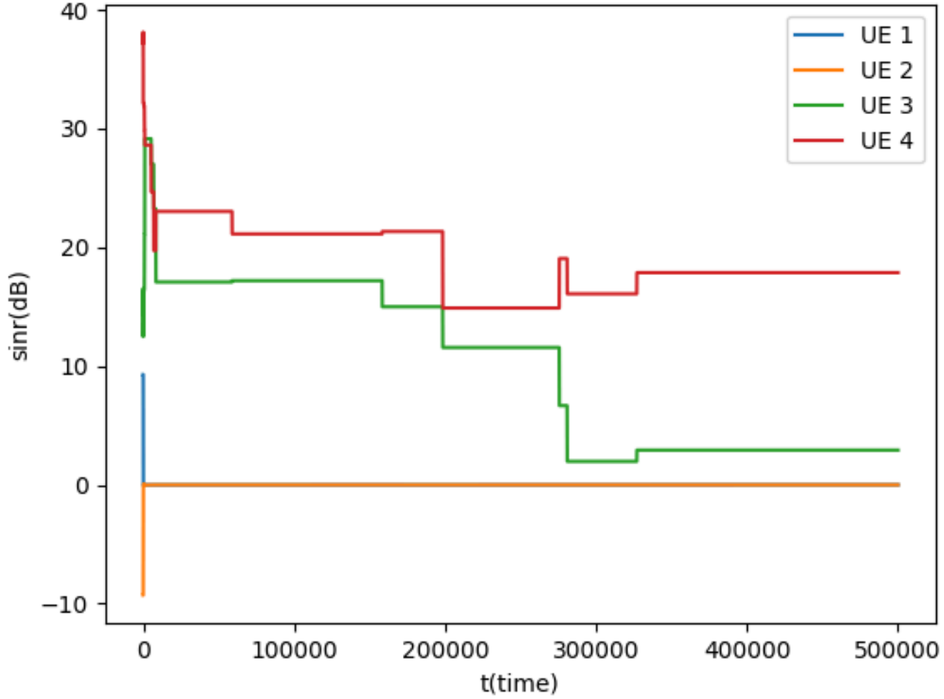
Exercício 8

You are now in condition to test the two objective functions F1 and F2 defined above that represent two different views for power control in data-centric wireless systems. Apply the ESNP algorithm above for each objective function F1 and F2. Adopt epsilon = 0.5 and delta = 10 dBm: The number of iterations can be large for convergence. As a suggestion, monitor the evolution of the changes in F and P in step 12 of the ESNP algorithm so as to identify stabilization of the convergence process. Obtain the KPIs and organize results in graphics and tables. Compare with results from no power control and UD-DPC of the previous exercise in both noise-limited and interference-limited scenarios defined in Appendix A. Discuss with your advisor if the results make sense in light of the two objective functions.

Exercício 8

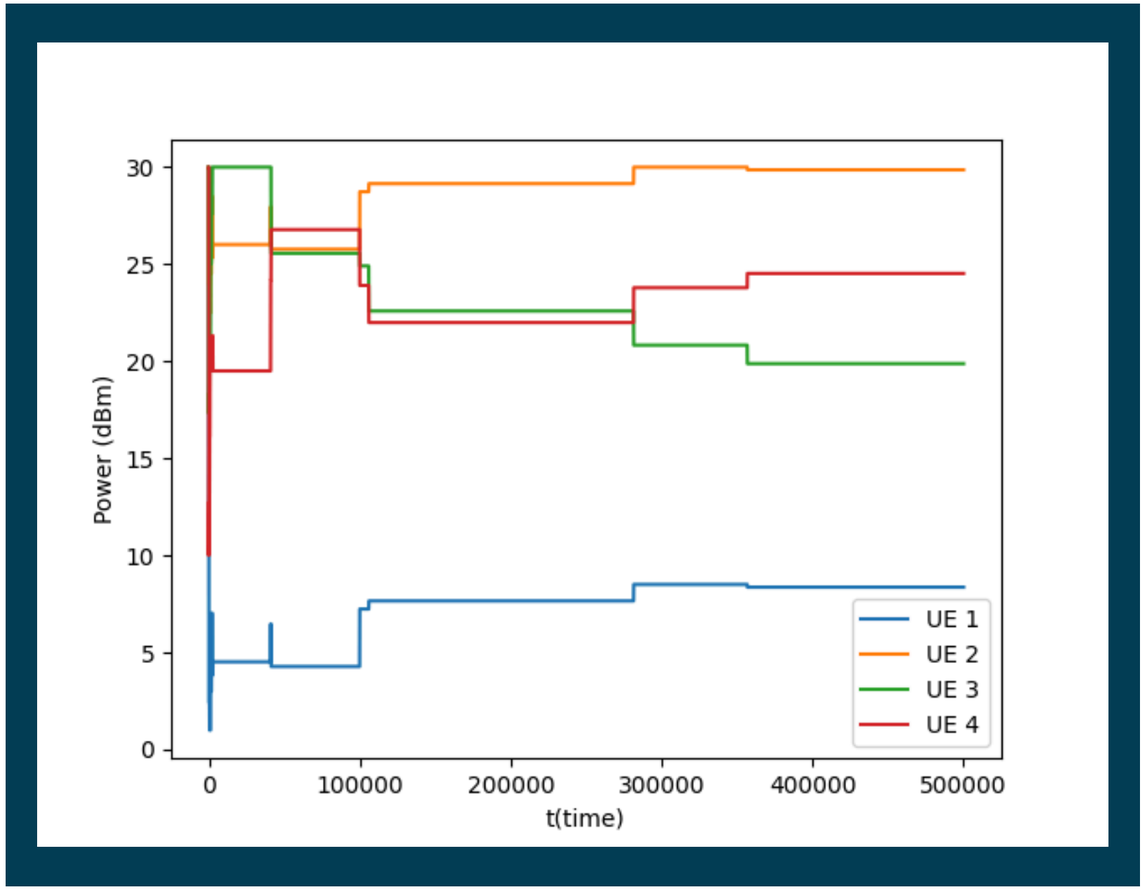
Interference-limited case objective function = min(sinr)

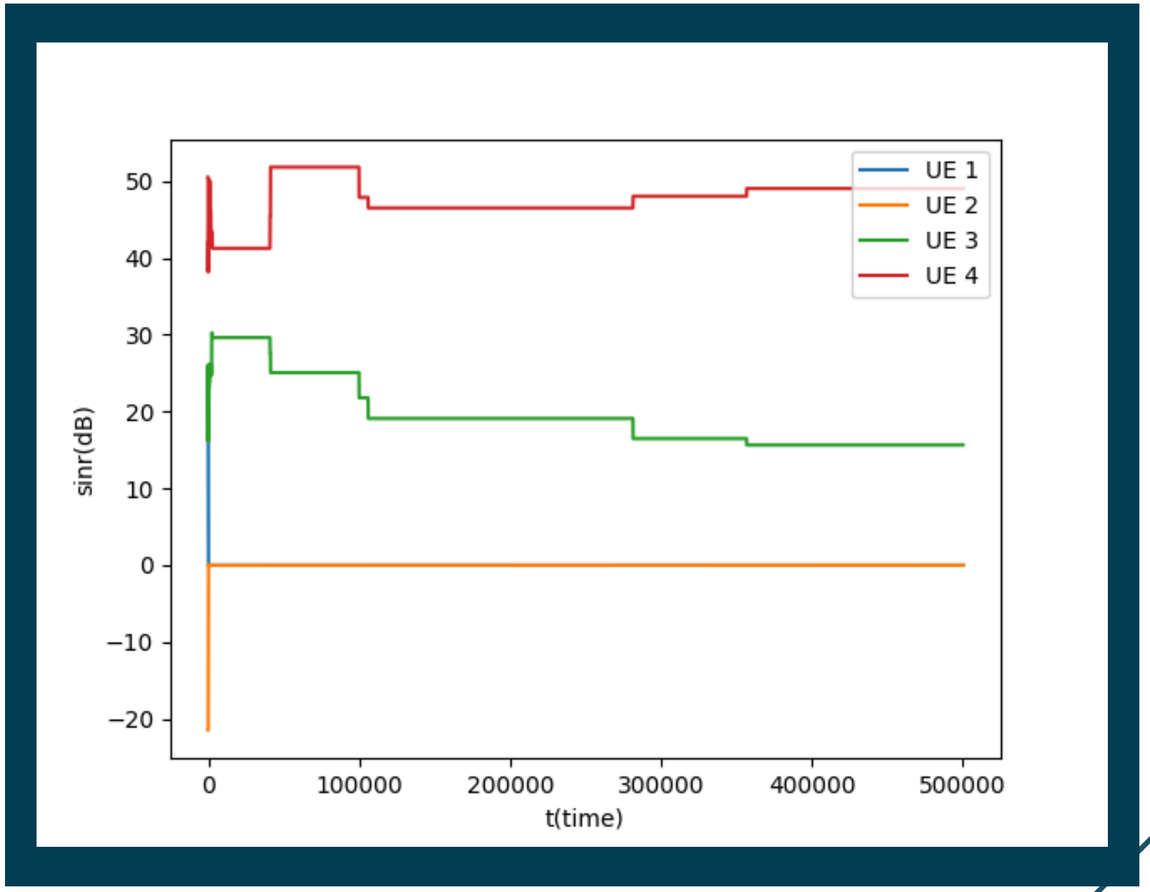




Exercício 8

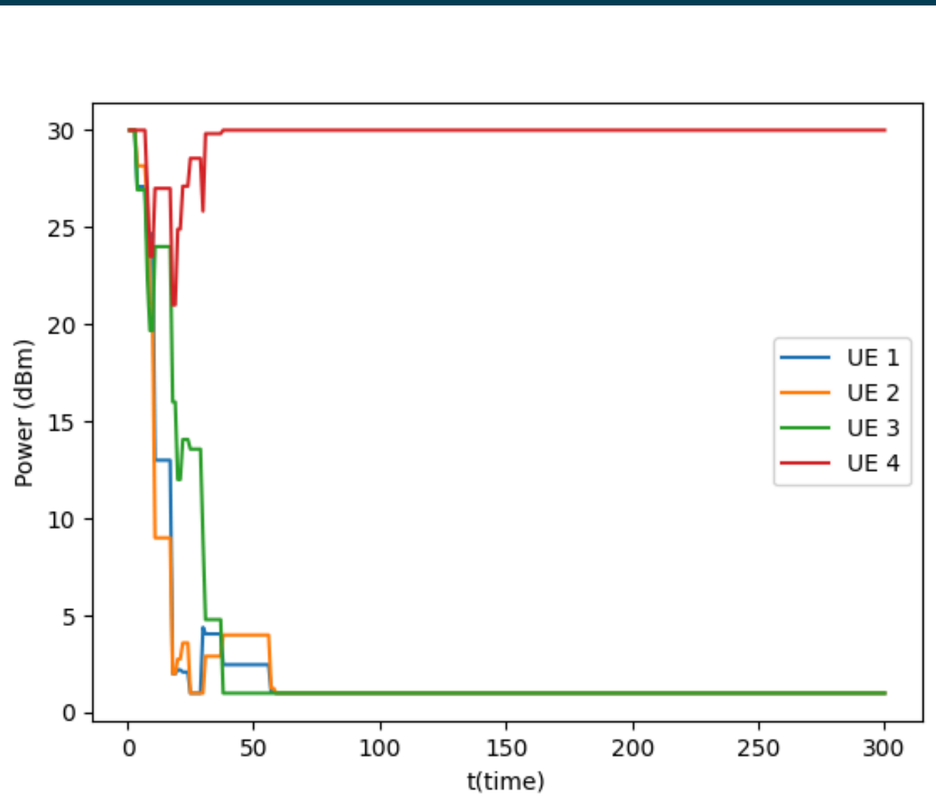
Noise-limited case objective function = min(sinr)

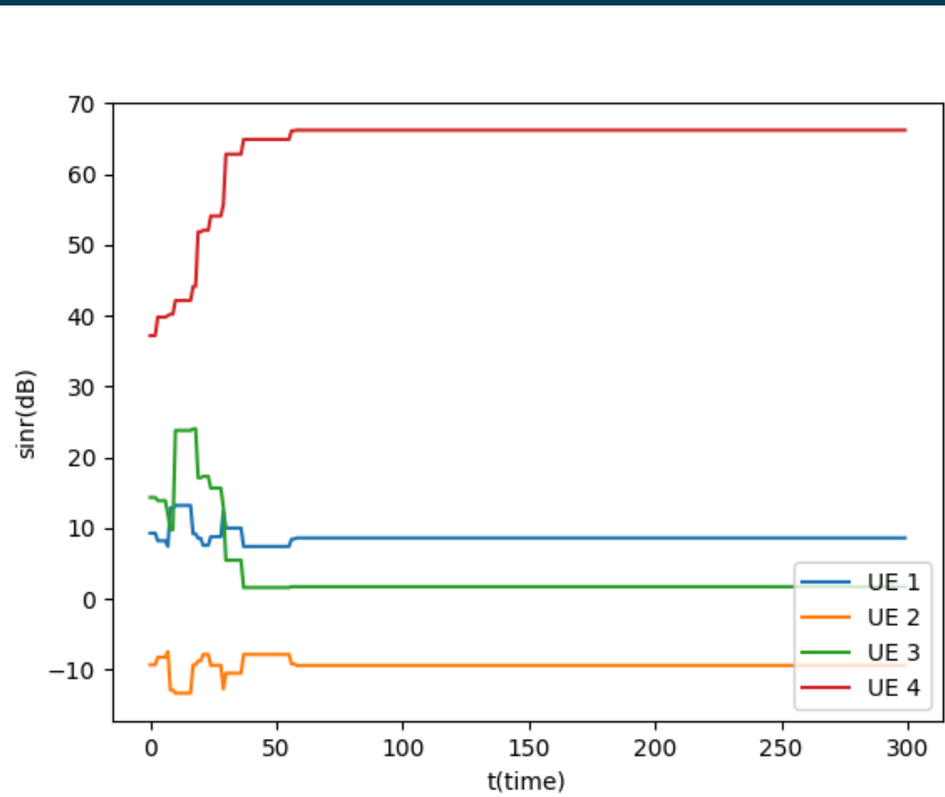




Exercício 8

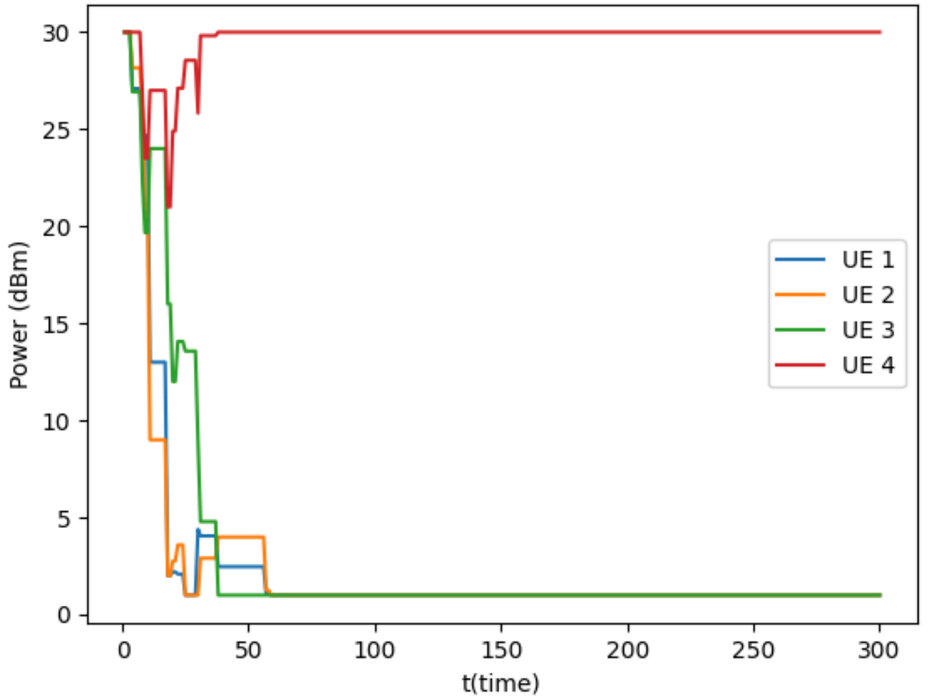
Interference-limited case objective function = sum(sinr)

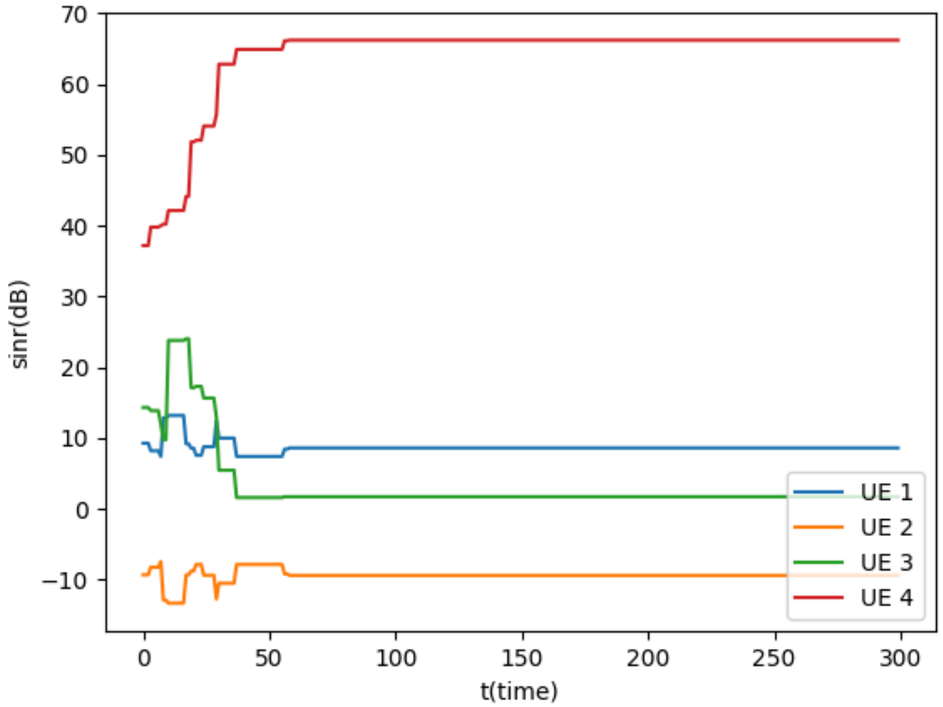




Exercício 8

noise-limited case objective function = sum(sinr)



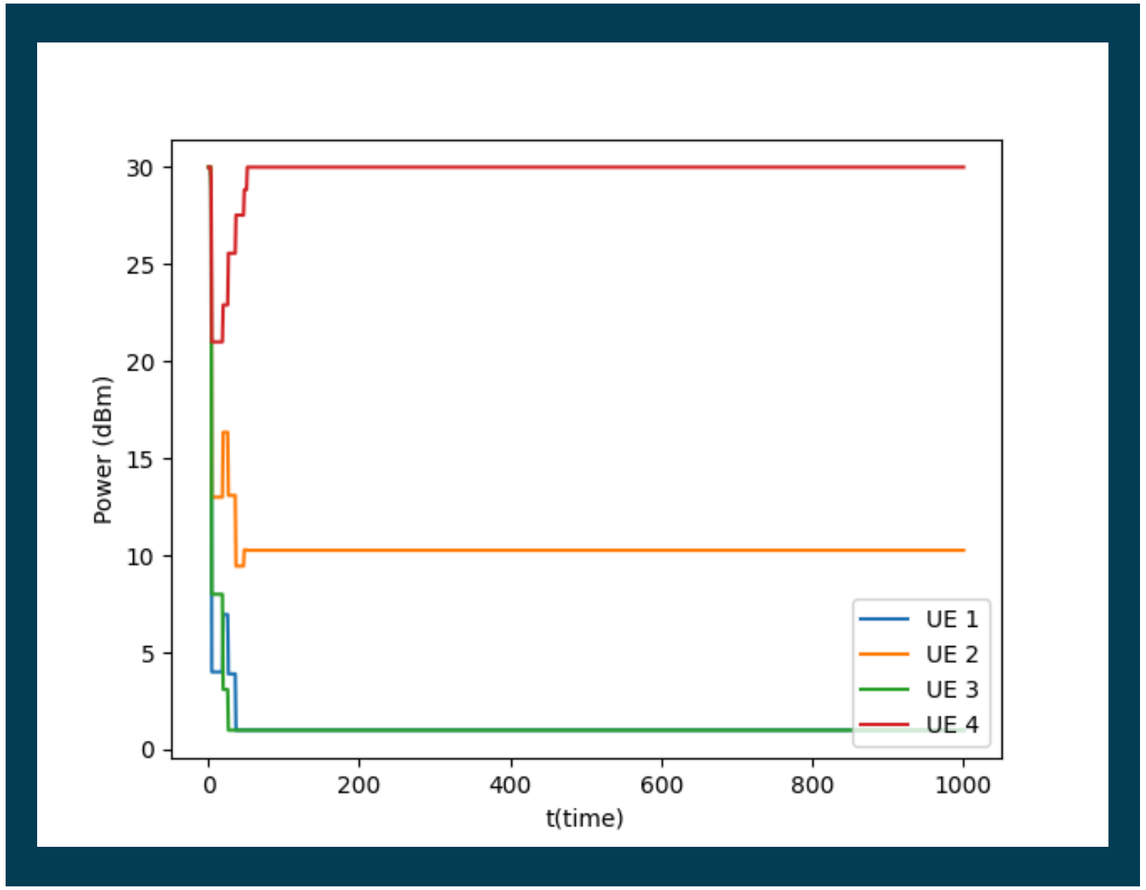


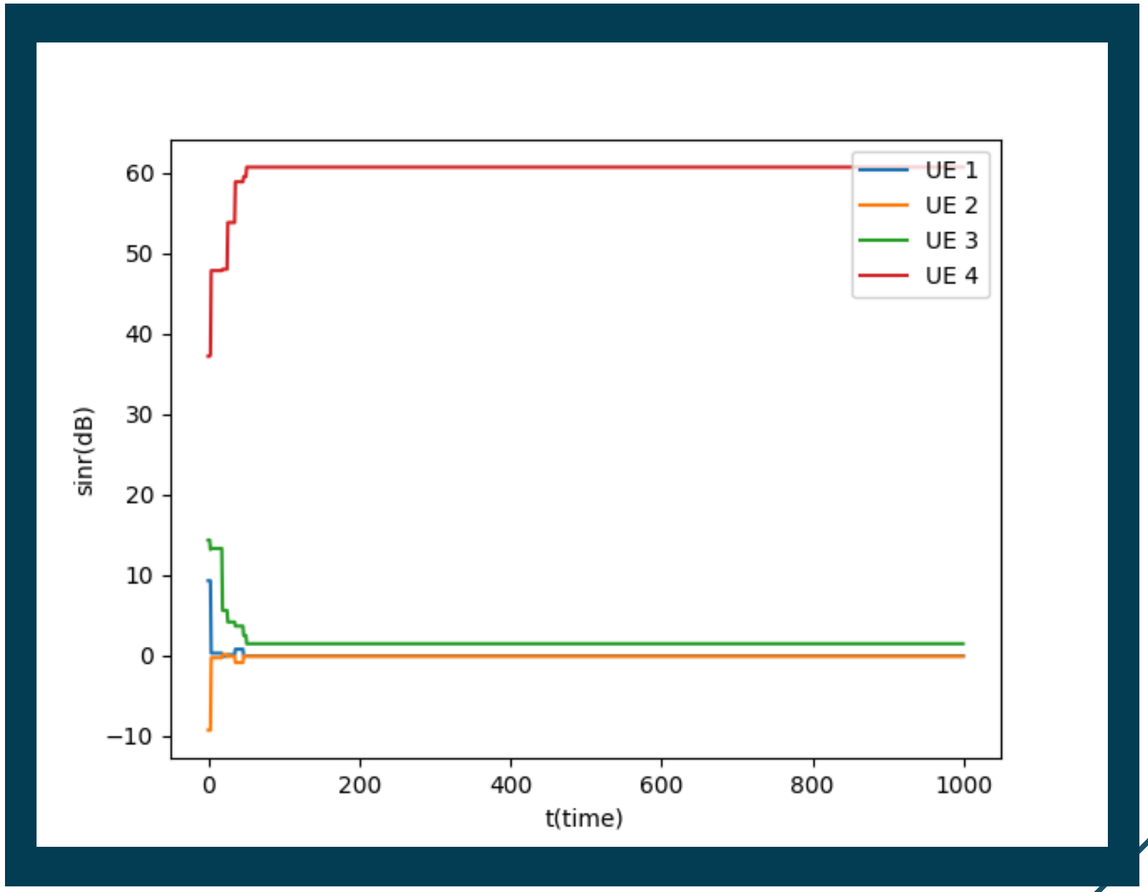
Exercício 9

Test the objective function in Eq.9 as a power control approach using the ESNP algorithm and same parameters and procedures as in the previous exercise. Obtain the KPIs and organize results in graphics and tables. Compare with results from all other PC algorithms you have tested so far, as well as against no power control. Discuss with your advisor if the results make sense and the corresponding implications. Present your advisor a final scientific report explaining in details all your research about power control (models, methods, solutions, results, comparisons). Present your final conclusions about the best approaches for power control in data centric wireless systems, as well as the limitation of the methods and algorithms you experimented with.

Exercício 9

Interference-limited case objective function = sum(sinr)*min(sinr)





Exercício 9

Noise-limited case objective function = sum(sinr)*min(sinr)