



Homework assignment 5: Towards OFDM

Due date: 2017-11-22

1. Optimization, local minima/maxima

In the context of OFDM, we need to look at a particular optimization problem: Optimization under inequality constraints. We will look at these techniques in class, but it cannot hurt if you:

- Freshen up your memory on simple optimization (finding local minima or maxima) of a real-valued function of real numbers. This is high-school material.
- Look up how this generalizes to optimization real-valued functions of multiple real numbers – this should definitely have been covered in your first-year analytics classes.
Hint: ∇ , Hessian matrix.
- Try to remember whether you have heard about optimizing under equality constraints (hint: Lagrangian multiplier)
- If you are familiar with optimization under inequality constraints and the Karush-Kuhn-Tucker conditions, you can probably skip big parts of next Monday :-).

2. **Modulation and Coding scheme adaptation** This is a little conceptual preparation exercise for a programming question on the next homework assignment. This is not a programming assignment itself, but please think through the steps you would need to take to make the results here concrete.

- Review your knowledge about different modulation schemes.
- Review your knowledge about basic forward error correction schemes (simple schemes like BCH codes are good enough for this assignment). Specifically, understand the notion of coding gain.

- For some representative modulation schemes (e.g., QPSK, 16QAM, 64QAM), find equations mapping the received signal strength to bit error rates.
Hint: <https://www.embedded.com/print/4017668> is quite concise; for details, look into a textbook.
- Fix a packet size. Think about how many symbols it takes to transmit such a packet, for a given choice of code rate and modulation scheme. How to compute expected number of transmissions, then?
- This needs to boil down into the following decision: Suppose you know (can estimate) a channel's attenuation, which combination of modulation and coding scheme should you choose? How to make this operational in a real system?