



Finding MIMO

Weekly Meeting: Week 5

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Goals

- Model receiver-side CEs to determine the best way to decode received signals
 - Choose equalization algorithm and parameters
 - Choose channel estimation technique
- Optimize Transmission and Receive Parameters for the best Bit Error Rate, Power Gain, or throughput



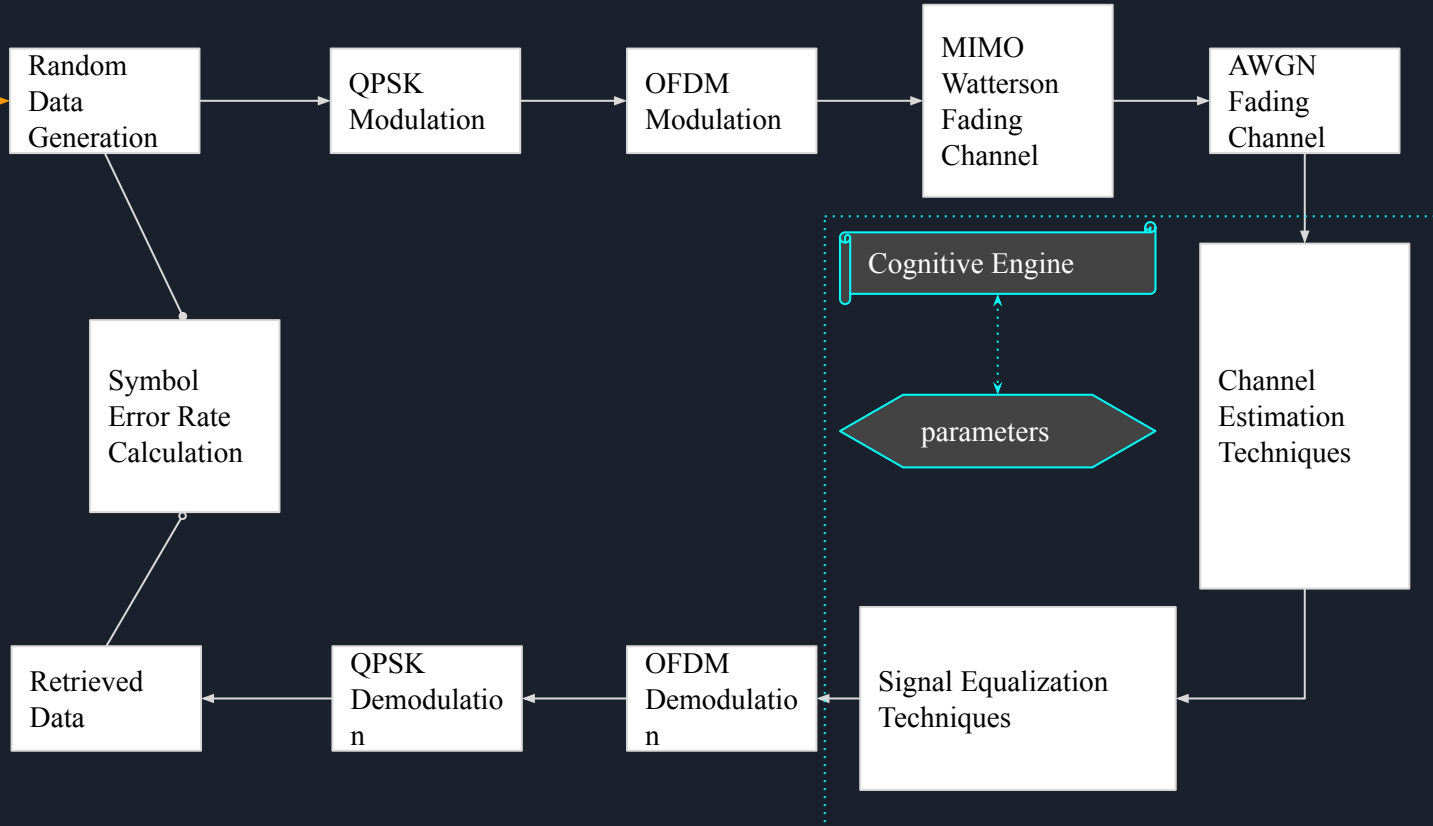


Progress

- Sophisticating parametrized MIMO function for Cognitive Engine.
- Decided to implement two ML techniques for the CE
 - Genetic Algorithm
 - Q-Learning Algorithm
- Equalizers (only MLSE, LMS + DFE)
 - Worked on Decision Feedback LMS /RLS/CMA
 - Interfacing to MATLAB
 - Trying Manual implementations
 - Worked on MLSE
- Worked on Genetic Algorithm Baseline and Q-Learning Baseline.



MIMO-OFDM Baseline

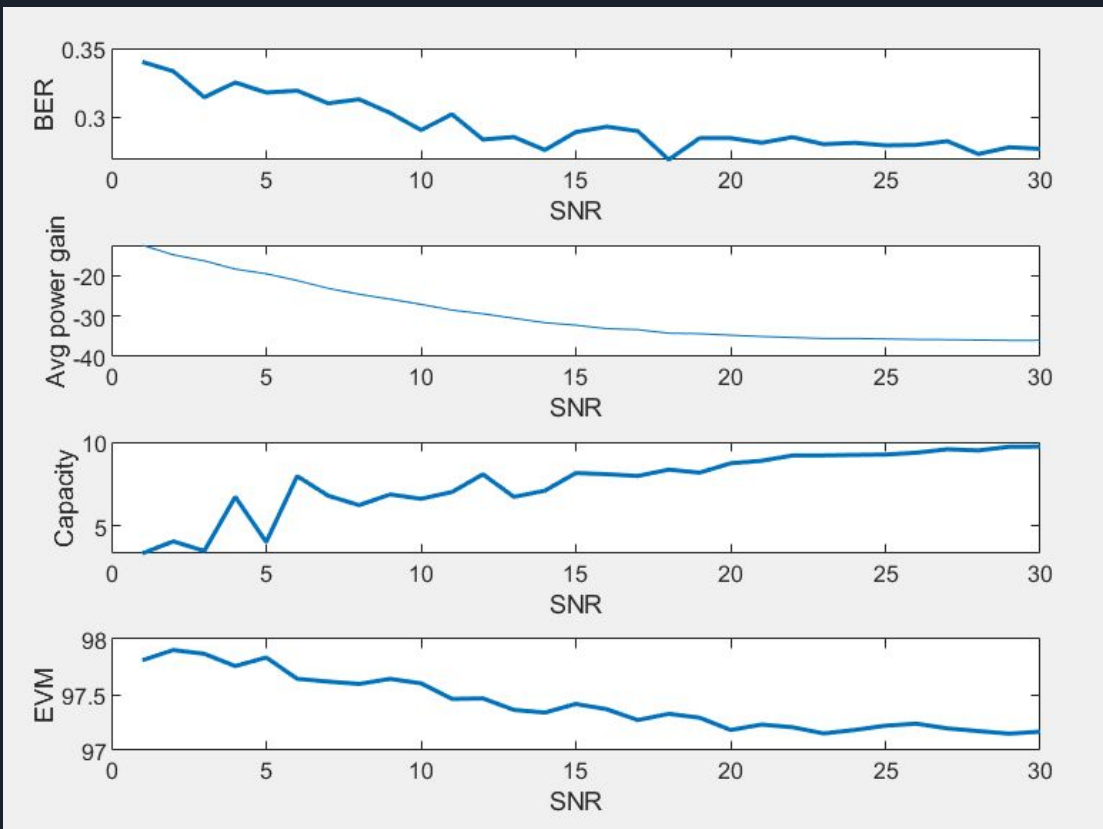


Parameterized MIMO function

```
function [E, P, C, EVM] = MIMO_PARAMATIZED_FUNC(...  
    data, chan, snr, ...  
    nTransmit, nReceive, ...  
    signal_power, PSK_order_power, nframes, FFT_len_power, ...  
    Algorithm, num_fts, num_fbts, step_size, RT, FF)
```

We have 13 possible variables that can be tuned simultaneously to optimize 4 possible values. However, there was some occasions where the function crashed when we tried to tune them without sophisticated constraints.

Parameterized MIMO function

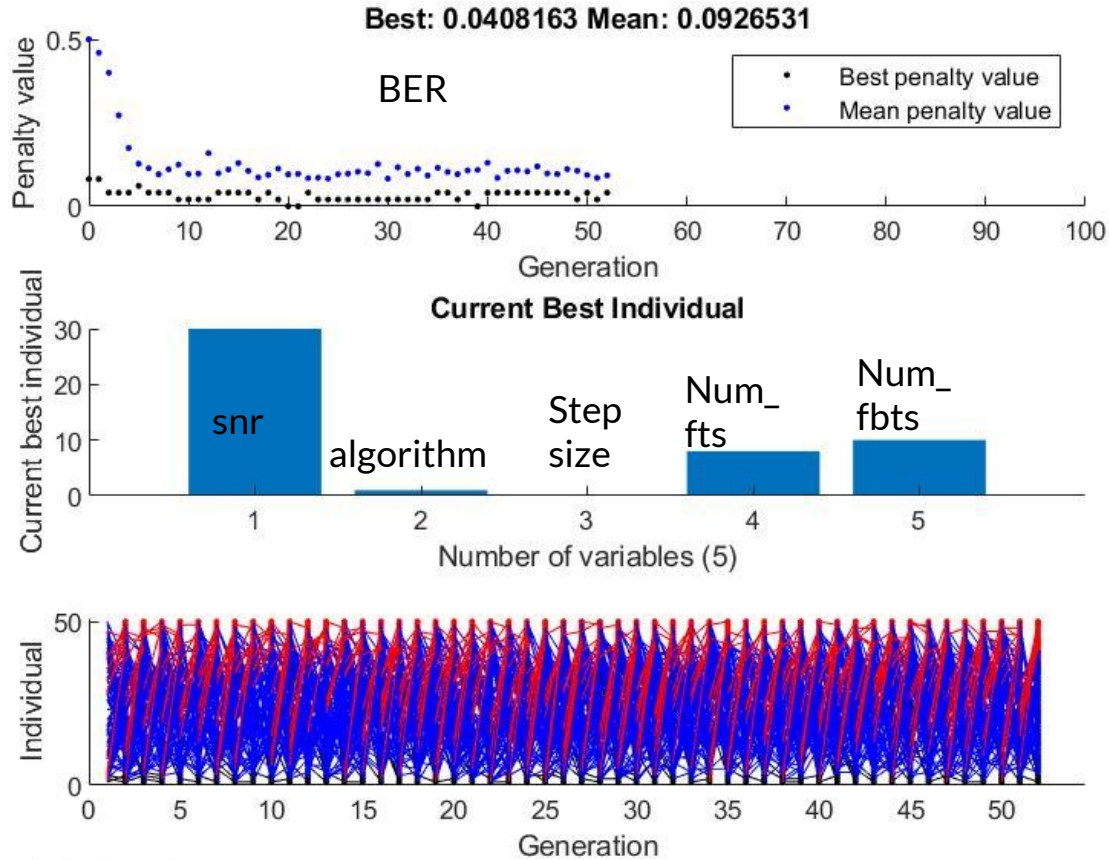




Genetic Algorithm for MIMO

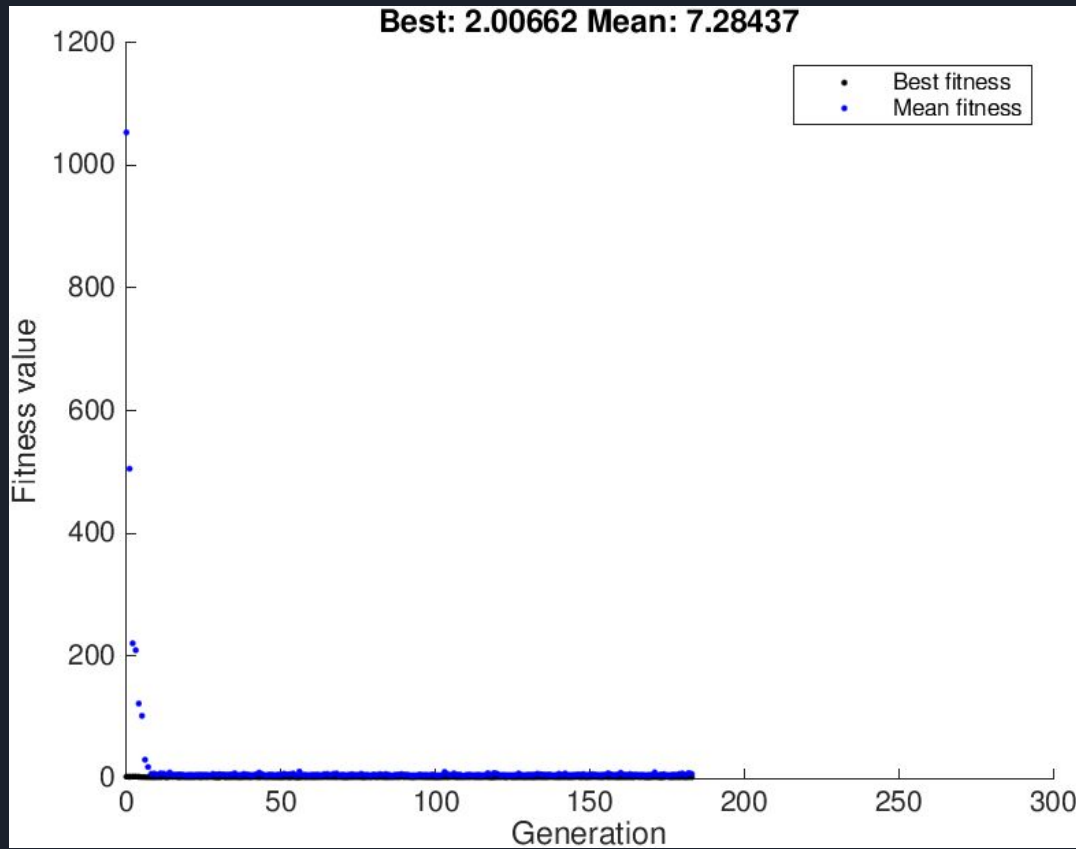
- Initial implementation achieved by using Genetic Algorithm Package from Matlab
- Current Variables
 - SNR
 - Equalizer algorithm choice
 - Step size
 - Number of forward taps
 - Number of feedback taps
- Optimizing (Minimizing) BER by Epsilon Greedy policy

Baseline Genetic Algorithm Simulation



Stop

Pause



First results from the GA given a very basic MIMO problem



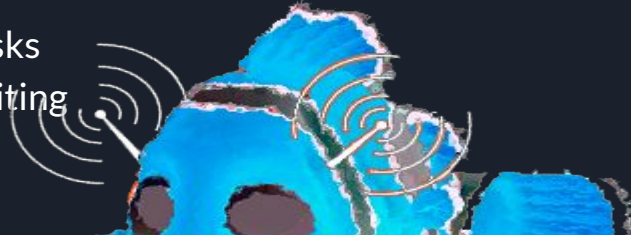
Challenges

- Lack of documentation about Q Learning in Matlab
- CE implementation issues has made it difficult to settle on effective parameters
- Need sophisticated constraints among parameters to make our parameterized function complete error-free.



Roadmap

- Week 5 - 6
 - Working on Q Learning Algorithm in Matlab
 - Sophisticating Genetic Algorithm engine baseline
 - Having handwritten implementation of channel estimation and equalization algorithms such as MLSEE
- Weeks 7
 - Work on producing data and derive novel and meaningful conclusion
 - Misc. issues
 - Optimization
- Week 8-10
 - Other tasks
 - paper writing



Questions?

