Investigation over NOMA with SIC in single antenna scheme

PHYSICAL LAYER SIMULATION

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Outline

- Previous work
- Introduction
- Simulation result (best MCS given pair)
- Scheduling Problem (single cell, 12 UEs)
- Algorithm
- Schedule Results

Recap of our previous works

- In the previous works, we surveyed and introduced literature on the physical and MAC layer techniques for non-orthogonal multiple access (NOMA)
- Based on the survey, we investigate theoretic and simulation models for NOMA to lay a solid ground for the resource allocation and scheduling to be studied in this project
- By the simulation result ,we observe effect of error propagation: Capacity is calculated assumes zero-error when decoding former stages before extracting users own signal, however once error occurs, SIC performance degrades.

Introduction

- As in the previous work, the requirement of BER threshold for simulation is set way too low, and supported MCS is too few, causing wide feasible region of power allocation factor α in most cases. Here, in this presentation, the issue is considered and some modifications are made.
- The algorithm initially purposed is evaluated with exhaustive search by CSG (coalition structure generation), however, by the visualized result, no further trivial attribute is found.

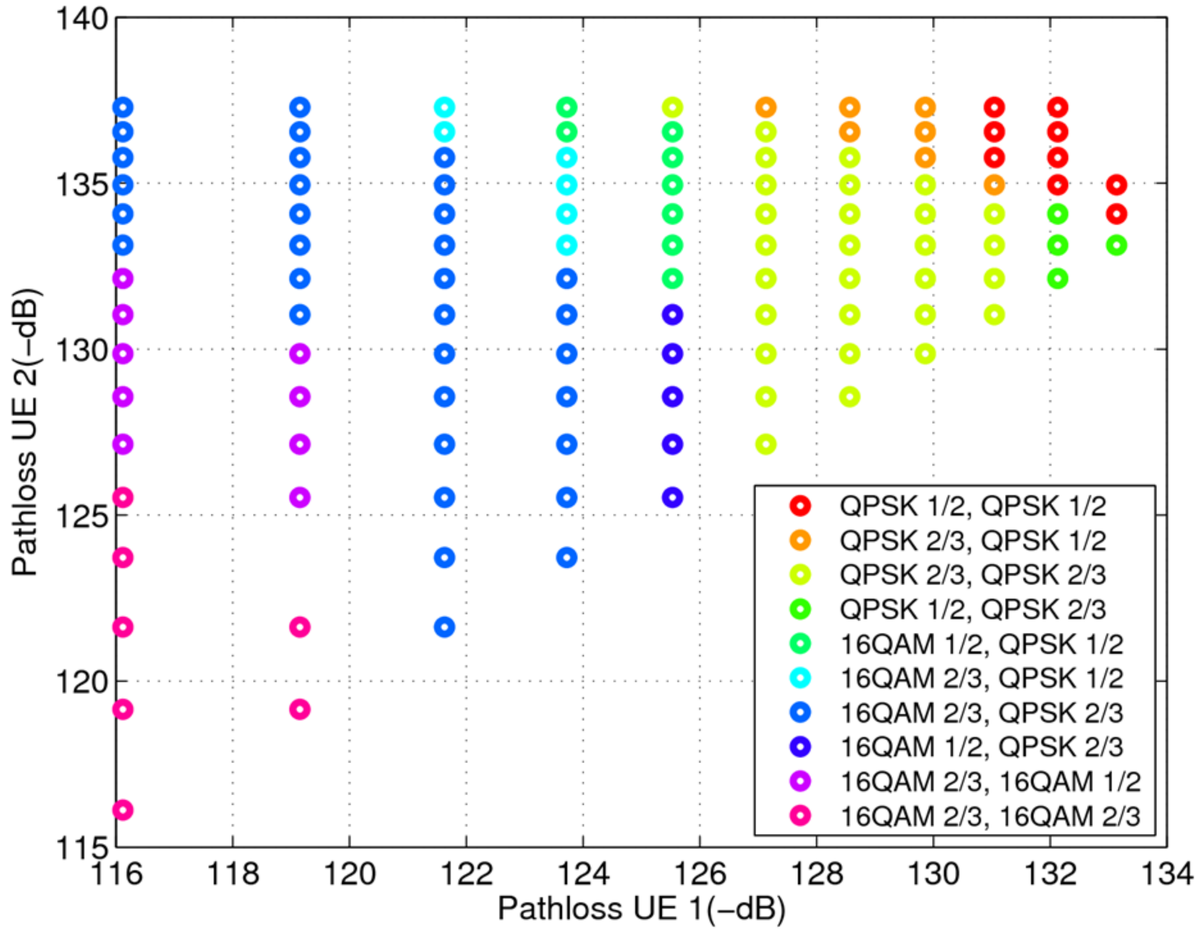
MCS adaption in SIC

- The power ratio factor is determined by linear search quantumized by (0.0125).
- Two user equipments are placed on position with distance multiple of 100m
- Both user has BER constraint no greater than 10^-4

Parameters	Simulation settings
FFT size	2048
Carrier frequency	2.6 GHz
Coding scheme	Convolutional Code (punctured)
Cyclic Prefix	144 samples
Modulation	BPSK (skipped), QPSK, 16QAM
Channel	AWGN, ITU pedestrian 3km/hr
BS power	4 W
Background noise	-144 dBm
Pathloss model	Hata model, medium sized city
Equalizer	FDE MMSE

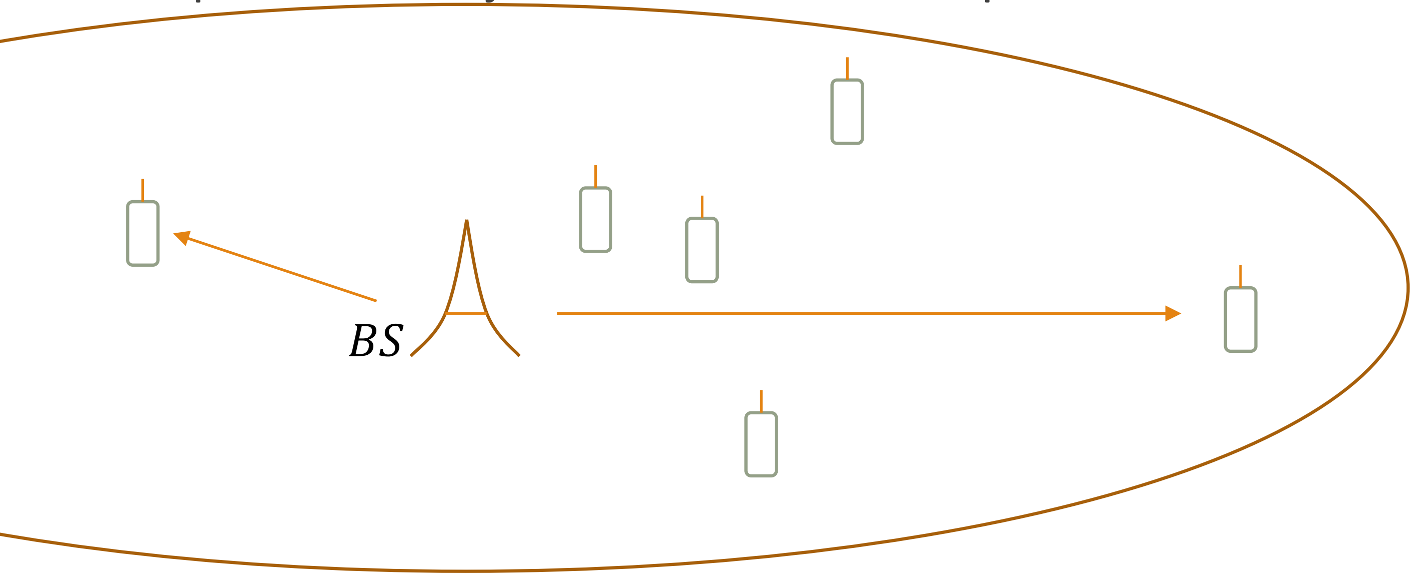
MCS adaption in SIC

- The marked MCS is the best in given channel condition and BER constraint.
- The overall system is bounded by far-end user (#2)



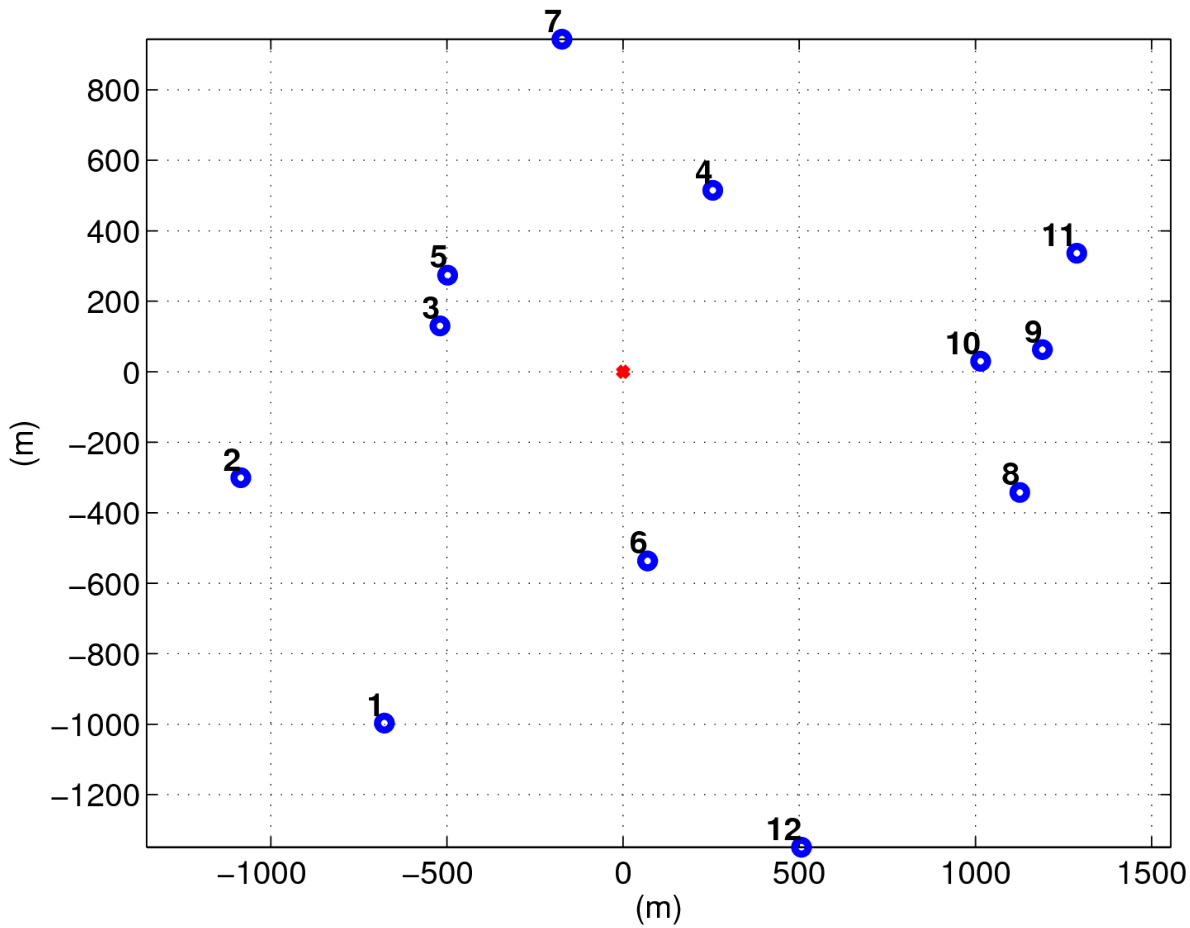
Scheduling problem

- Consider scheduling users in a single cell, all users has to be scheduled once in given time window.
- Assume there are 12 users randomly scattered in 2800 square meter plane. The objective is to maximize spectrum utilization.



Scheduling problem - scenario

- This is a sample of random topo-logy generated.
- The red spot at the origin is BS



Algorithm

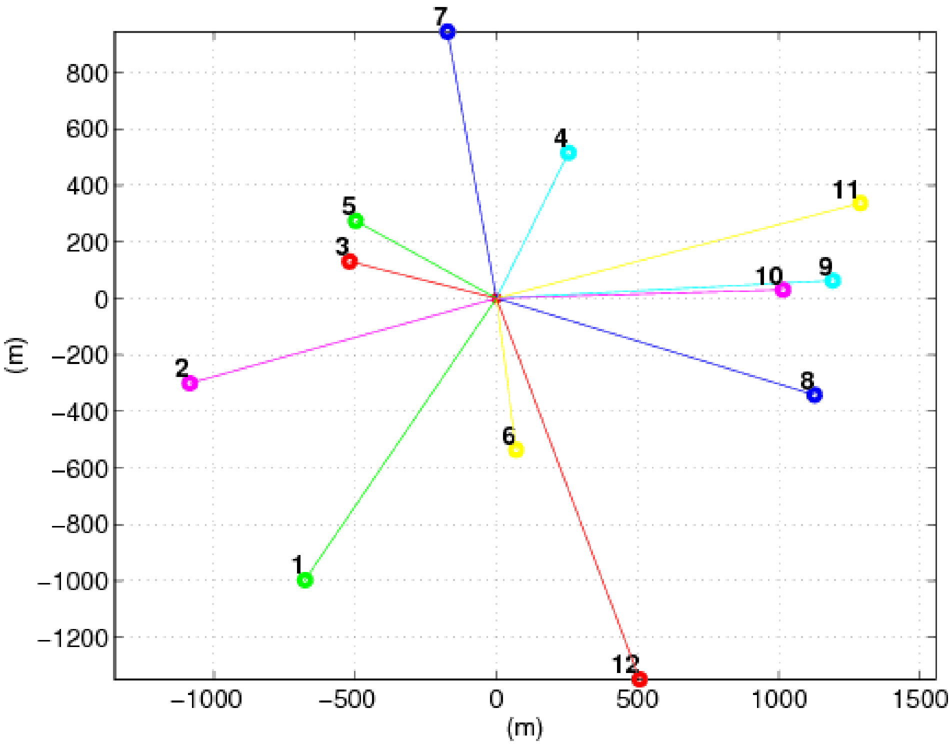
- It is observed that scheduling pairs with great path loss difference can help achieve better system performance. Thus, the initial algorithm is designed as follows.

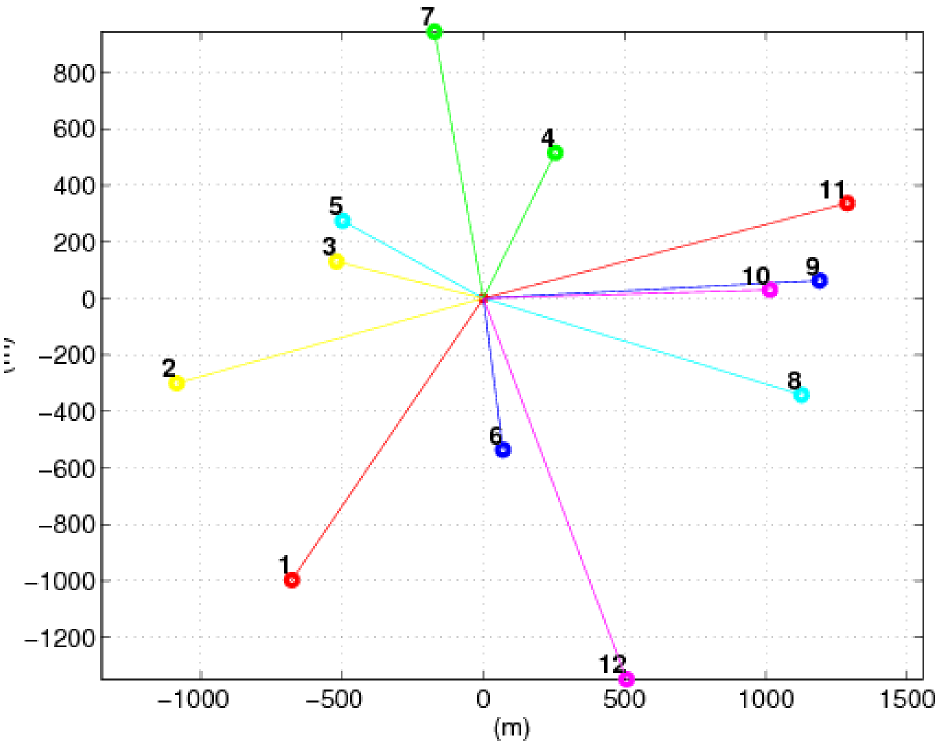
Algorithm 1 Scheduling transmission pairs iteratively

Input: a set of user equipments, i.e. $\mathbf{V}$
Initial: $CS \leftarrow \varnothing$ \\schedule set
Sort UEs by its pathloss increasingly.
$\mathbf{V}' = \{[v_1\ v_2 ... v_n] | PL(v_i) \leq PL(v_j) \forall i < j\}$
While $\mathbf{V}'$ is not empty
$u = \mathbf{V}'.first()$ \\select the first element
For $r \in \mathbf{V}'$, $r \neq u$
If $pair(u, r)$ is feasible for given constraint
$\mathbf{M} = pair(u, r).getMCS()$ \\feasible MCSs
For $W_m, m \in \mathbf{M}$
If $W_m > best$
$best \leftarrow W_m$
$r' \leftarrow r$
End If
End For
End For
If v' exists \\u can form a pair.
$\mathbf{V}' \leftarrow \mathbf{V}' \backslash \{r', u\}$, $CS \leftarrow CS \bigcup \{r', u\}$
Else
$\mathbf{V}' \leftarrow \mathbf{V}' \backslash \{u\}$, $CS \leftarrow CS \bigcup \{u\}$
End If
End While
Return $best$, CS

Scheduling results

- Left-hand side is generated by Algorithm 1, and figure on the right is optimal solution by exhaustive search. Alg. 1 reached 91.67% optimality.





Scheduling results (optimal)

Pair (Slot)	#1	#2	#3	#4	#5	#6
α (med)	0.1938	0.050	0.0375	0.05	0.05	0.1563
PLDiff(dB)	1.0	10.0	8.0	10.0	10.0	6.0

- The PL ratio in this case is less than 11.7.
- Power allocation factor α has to be small enough so the far-end user can decode correctly with less error propagation.
- Cannot be too large that the symbols of two users overlap with others.

Q&A

Thank you for your attention.