Dwight Look College of
ENGINEERING
TEXAS A&M UNIVERSITY

Creating a Robust and Resilient Uplink

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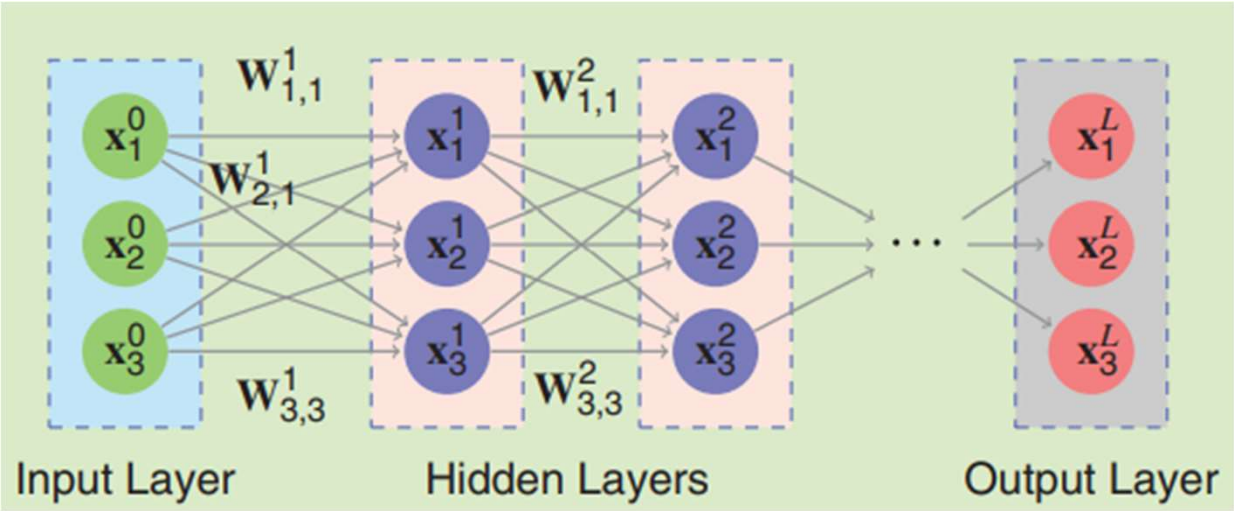
Background

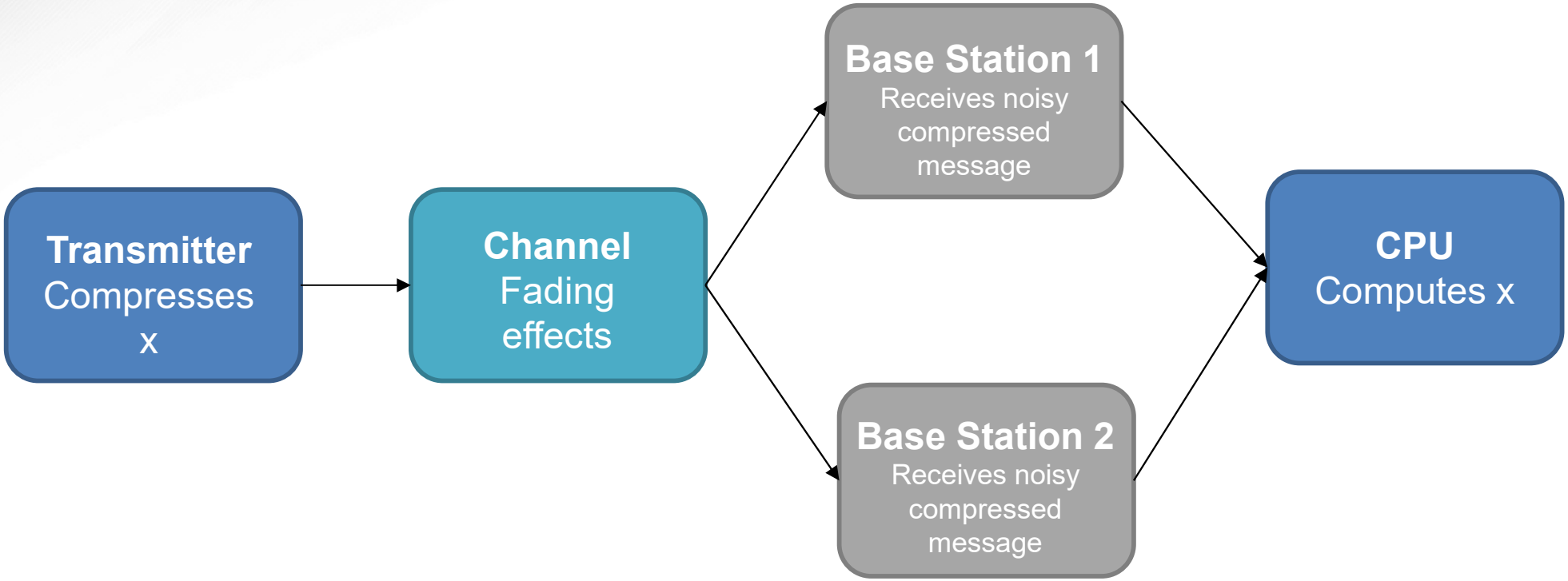
We are moving towards a cell free system where devices can communicate with multiple base stations.

My project focuses on massive machine type communication (URA).

We are utilizing deep learning to train base stations.



System Overview

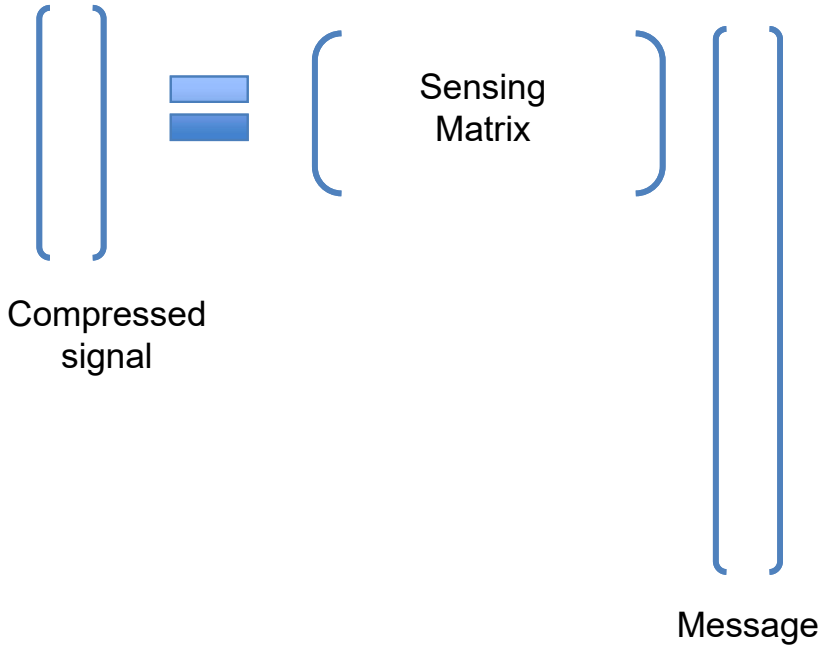


Transmitter and Channel

The transmitter's job is to compress the message to be sent and send it.

A message is compressed to one column of the sensing matrix.

All devices and base station agree upon the same sensing matrix.



Transmitter and Channel

For our model:

40 devices will each be transmitting 10 bit messages at once.

The message corresponds to the index of the non-zero value in the vector.

All the non-zero bits are one to keep our SNR the way we want it.

Currently:
Completed data training set
Architecture in place for LISTA

	X	Message
	0	
	0	
	0	
	1	00011
	0	
	0	
	0	
	0	
	0	
	0	
	0	
	0	
	0	

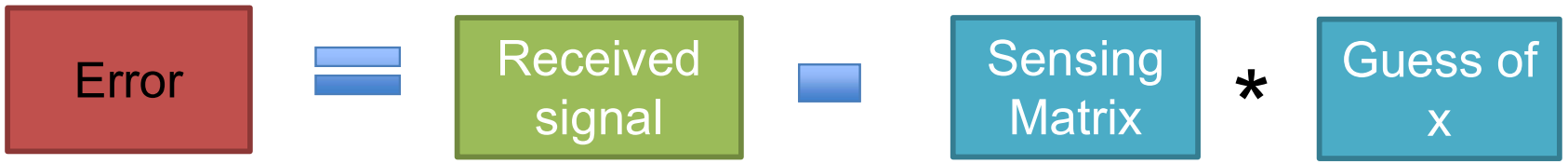
Base Stations

Each base station receives the compressed signal and noise is added.

Base Station knows the sensing matrix.

Checks error and updates the estimate of x.

Currently:
IST, AMP
Working on LISTA



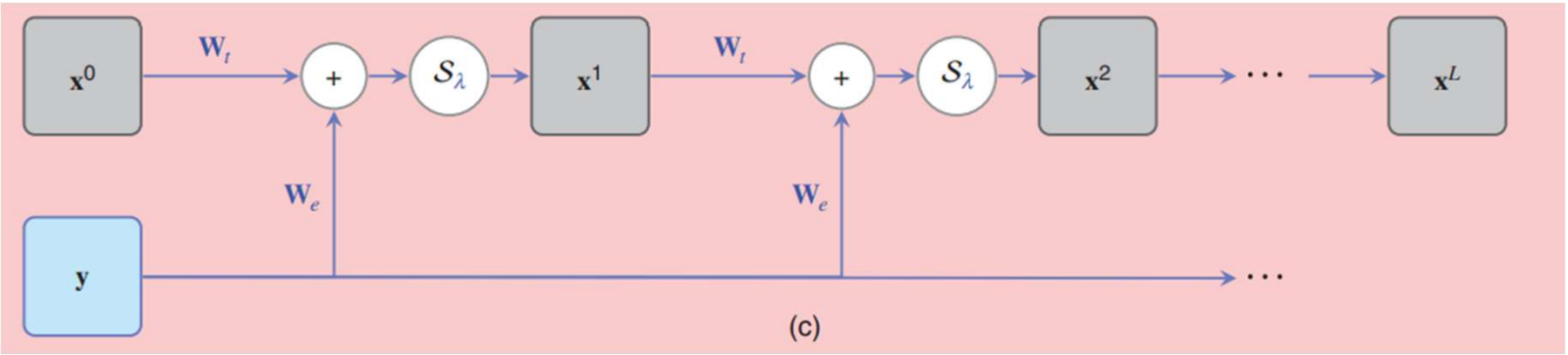
CPU

Compute the original signal through deep learning.

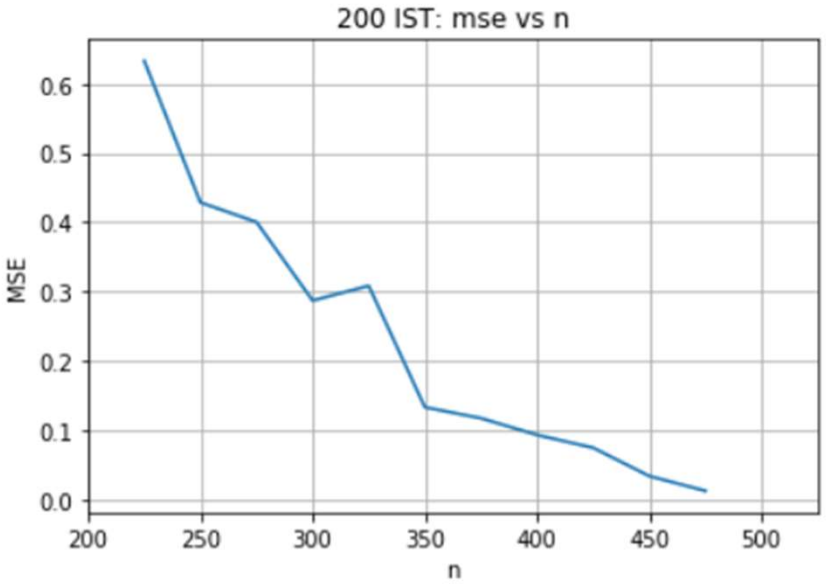
Utilizing LISTA .

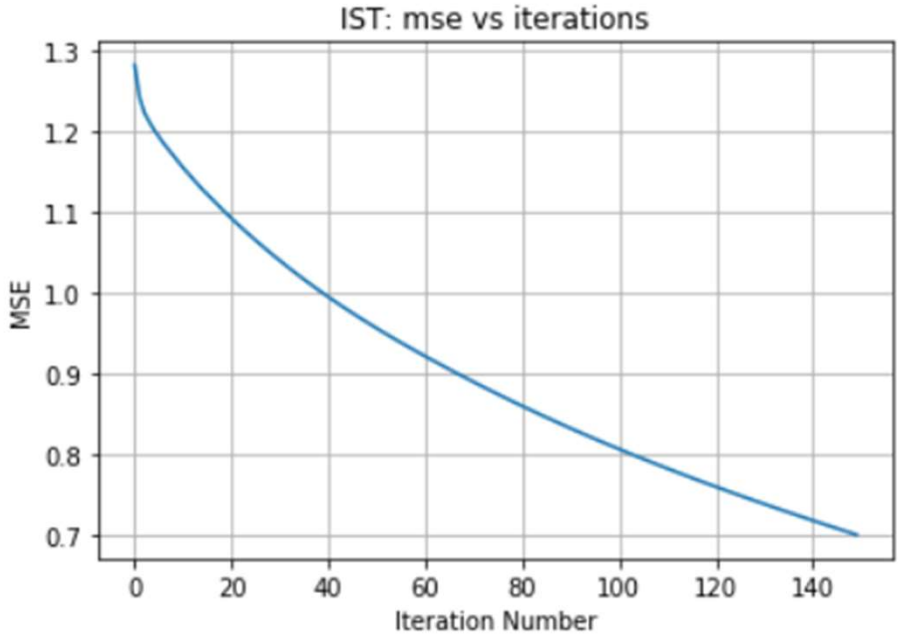
Data set of (x,y) pairs with a single sensing matrix to train the CPU.

MSE as our loss function.



Choosing n





Chose n so that IST still has low MSE, but it has to work hard. Plotted baseline for n = 205

`n = 205 | N = 1024 | k = 40`

n: number of measurements

Execution plan

9/20	10/5	10/24	11/15	11/25
Simulate and evaluate multi-bit transmission through noisy channel	Establish a baseline by comparing BER/MSE of different models	Create data set	Architecture developed	Expand to learned AMP
Monte Carlo performance tests	Read about algorithm unrolling and deep learning	Determine what parameters to compare with	Run training loop and test	Compare MSE of learned vs. unlearned
Read through papers regarding URA and channel modeling			Write background for thesis based on IST unrolling	Begin alterations based on performance evaluation results

Validation

Trying to improve in one of the following ways:

Does DL:

- yield the same results with fewer measurements?
- yield better results with same measurements?
- yield same results with less complexity?

We are evaluating MSE vs. iterations and vs. number of measurements. We have also looked at BER.

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