```
Traceback (most recent call las
                              c> in <module>
                           yer differently depending on what layer i
                      = CRF LISTALayer(A tilde, L, init alpha,
                                                                             Dwight Look College of
                 idx layer == 0:
                                    2 frames
       autograph generated filelkjh3inp.py in
     10
                         try:
     11
                             do return =
                             retval
---> 12
fscope)
          ag .converted call(ag
                         except:
     13
     14
                             do
```

TypeError: Exception enco

in user code:

File "<ipv

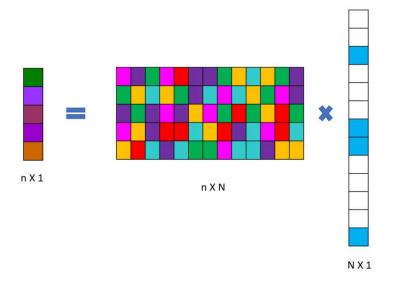
Team 64: Enhancing User Detection Bi-Weekly Update 2

Holly Roper Sponsor: Dr. Krishna Narayanan Jamison Ebert TA: Max Lesser



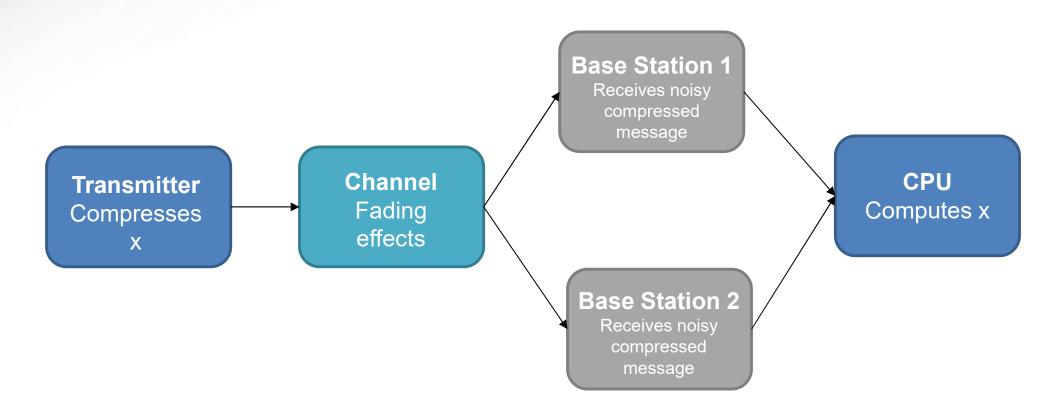
Project Summary

- We are seeking to enhance compressed sensing algorithms with deep learning
- Focusing on user detection
- Converting IST to a neural network (LISTA, TISTA)





Project Overview





Project Timeline

| Implement unlearned algorithms | Implement LISTA | Add noise to all algorithms | Implement TISTA ☆ | Add Complex Rayleigh fading | Unlearned algorithm two base station baseline | Learned algorithms two base station approach |
|--------------------------------------|--------------------|-----------------------------|-------------------------|-----------------------------------|--------------------------------------------------------|----------------------------------------------------------|
|--------------------------------------|--------------------|-----------------------------|-------------------------|-----------------------------------|--------------------------------------------------------|----------------------------------------------------------|



Unlearned Algorithms

Holly

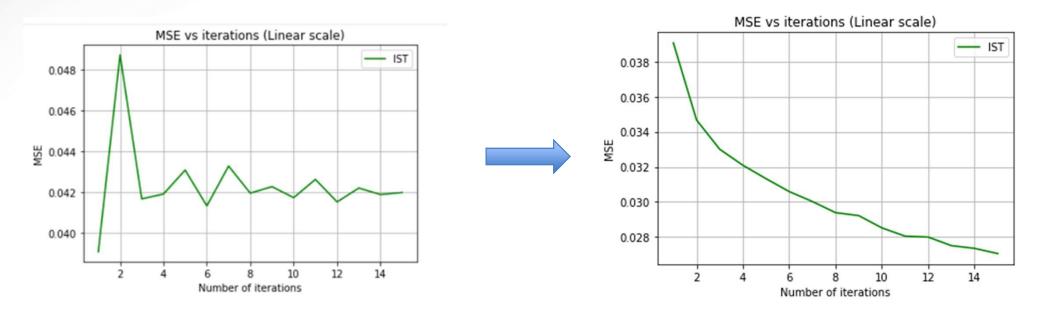
| Accomplishments since last pres 5 hrs of effort | Ongoing progress/problems and plans until the next presentation |
|-------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------|
| -Implemented a version of IST that can handle complex numbers -IST can now process with noise and Rayleigh fading | -CAMP* |

^{*}Complex AMP is, well, complex. At this time Dr. Narayanan has deemed it not worth our effort to pursue since our main focus is on IST.



Complex IST

Me, again



Found bug in my thresholding function and switched up SD with variance.



Learned Algorithms

Still me

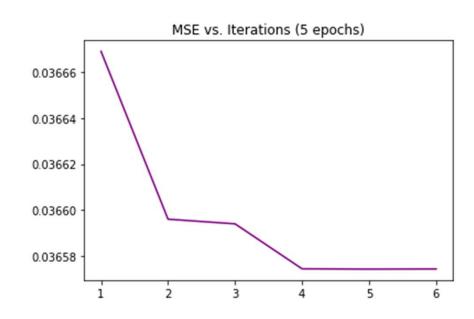
| Accomplishments since last pres 12 hrs of effort | Ongoing progress/problems and plans until the next presentation |
|------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| -Research on making LISTA able to handle complex values -Attempted to implement complex LISTA -Implemented TISTA | -Debugging LISTA, and getting a fresh set of eyes on it -Debugging TISTA, specifically determining why step size is not affecting performance |



Learned Algorithms

You guessed it...me

TISTA: very miniscule downward trend



in user code:

```
File "<ipython-input-7-4d563669d867>", line 18, in call *
    new_x = tf_cmplx_eta(update, self.alpha/self.L) # this is what makes it differ from other LISTA layer
File "<ipython-input-25-20de539ff5f3>", line 2, in tf_cmplx_eta *
    return tf.math.exp(1j*tf.math.angle(u)) * (tf.math.maximum(tf.math.abs(u)-T, 0))
```

TypeError: Expected float32, but got 1j of type 'complex'.

Call arguments received by layer "crf_lista_layer_11" (type CRF_LISTALayer):
 inputs=tf.Tensor(shape=(None, 1294), dtype=complex64)

Error as of last night



Execution Plan

| | 1-Sep | 15-Sep | 1-Oct | 1-Nov | 15-Nov | 1-Dec | 15-Jan | 1-Feb | 15-Feb | 1-Mar | 15-Mar | 1-Apr | 15-Apr | 30-Ap |
|--------------------------------------------------------------------------|-------|--------|-------|-------|--------|-------|--------|-------|--------|-------|--------|-------|--------|-------|
| Program unlearned algorithms | | | | | | | | | | | | | | |
| Generate baseline data | | | | | | | | | | | | | | |
| Learn about LISTA and develop simple network with preset layers | | | | | | | | | | | | | | |
| Develop custom layers for network rrain without noise | | | | | | | | | | | | | | |
| Train with noise | | | | | | | | | | | | | | |
| Add real rayleigh fading | | | | | | | | | | | | | | |
| Add complex rayleigh fading | | | | | | | | | | | | | | |
| Implement TISTA | | | | | | | | | | | | | | |
| Train with fading | | | | | | | | | | | | | | |
| Preparation for symposium | | | | | | | | | | | | | | |
| Unlearned baseline for 2 base station | | | | | | | | | | | | | | |
| Expand to two base station | | | | | | | | | | | | | | |
| approach Finalizing work and documentation | | | | | | | | | | | | | | |
| Compile into a single colab notebook | | | | | | | | | | | | | | |



Validation

We are evaluating MSE vs. iterations/layers. The project is considered a success if the ML outperforms IST:

- With no noise
- With noise
- With fading
- With noise and fading

So far ML has outperformed IST with and without noise.



Thanks!

