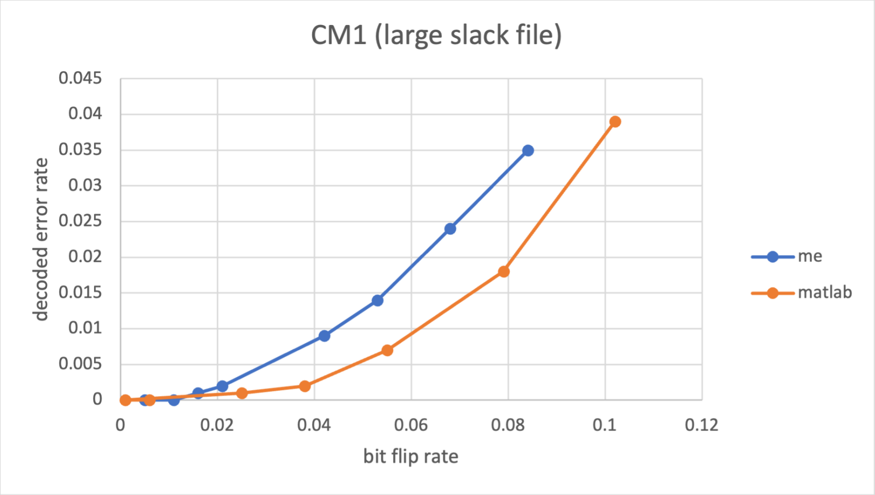
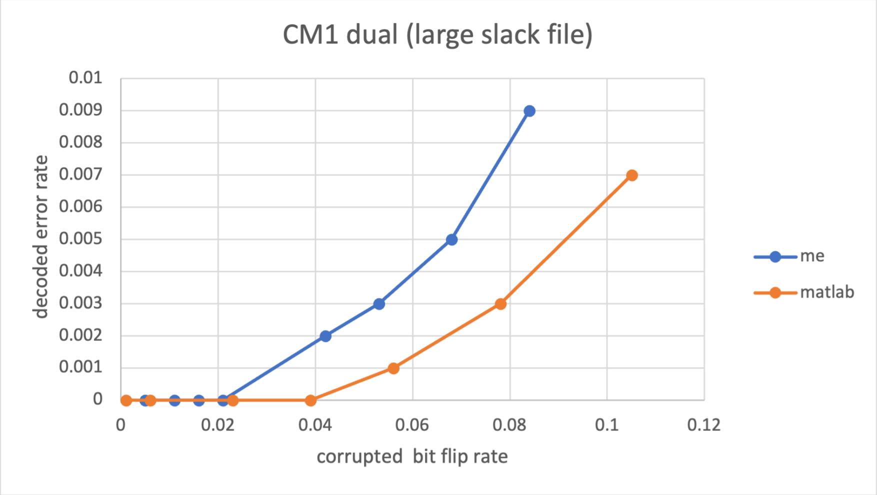
Raman Odgers

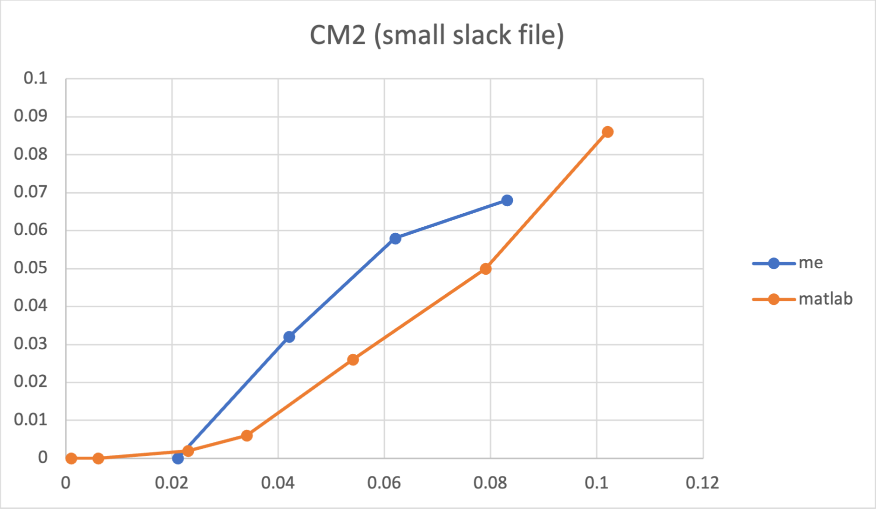
Performance Comparison: Native Matlab Comms Decoder vs RO Python Package

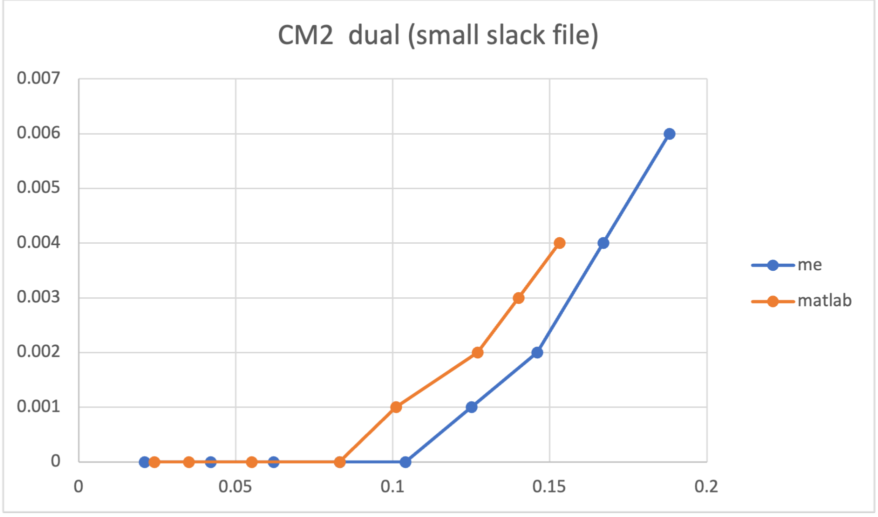
The following compares decoding performance between the python package that I wrote and the native matlab Comms toolbox ldpc decoding belief propagation function. Importantly, this is codeword decoding, which is further addressed in the Discussion section.

Results






CM2 (small slack file)
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0
0.02
0.04
0.06
0.08
0.1
0.12
me
matlab


CM2 dual (small slack file)
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
0
0.05
0.1
0.15
0.2
me
matlab

Discussion

- For 3 out of 4 parity check matrices, the matlab decoder performs marginally better and for the last matrix, the situation is reversed.
- ***Critically,***the matlab decoding package provides much more sophisticated information to its belief propagation decoder. Specifically, it modulates its input, adds white gaussian noise, calculates a variance on that noise, and provides analog LLR values, to the decoder. In contrast, *as required by our scenario*, my decoder only receives binary LLR values multiplied by the ratio:

  $$\log\left(\frac{\Pr\left(c_i = 0 \mid y_i\right)}{\Pr\left(c_i = 1 \mid y_i\right)}\right)$$

  The matlab LLR provides granular priors to the decoder and therefore should be expected to perform significantly better than my program in this context.
- One possible misunderstanding in previous discussions about my decoder, is that 'successful decoding rate' in previous results, is the percentage of inputs that are entirely recovered, not just the percentage correct bits overall.
- One important note is that the matlab decoder is much faster. I spent some time trying to deliver a compiled python package using the matlab functions and implemented in python using matlab runtime. However, there appears to be no support for syndrome decoding or the further modifications that I would have to make in my later projects, so I abandoned it. Instead I will be working on optimising my existing program.
- As above, this is codeword decoding. In the past, my syndrome decoder performed just as well as my codeword decoder but it might have been deprecated through previous days of tinkering and testing. I will bring it back up to speed.

Conclusion

With the critically important clarification that matlab provides analog LLR data to its decoder, it can be confirmed that my belief propagation framework performs optimally given the algorithm and context in which it is applied.