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ECE 5660

Final Programming Project Report

This report covers the programming project for communication systems. Six simulations were created to cover methods of phase and timing recovery for a receiver. Below is the table of values used through out the project. The BnT's changed the most and varied to allow more bandwidth for the images. The dampening factor remained constant at 1/sqrt(2) for all images.

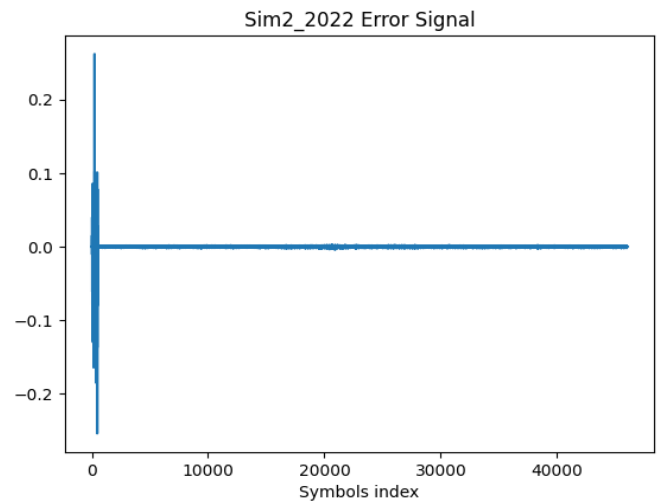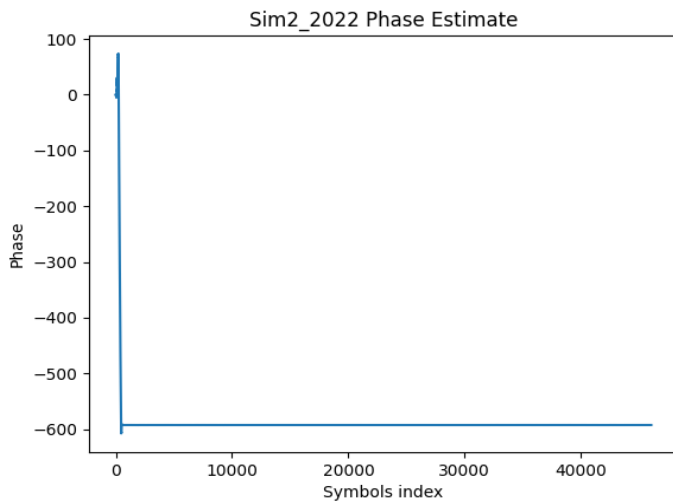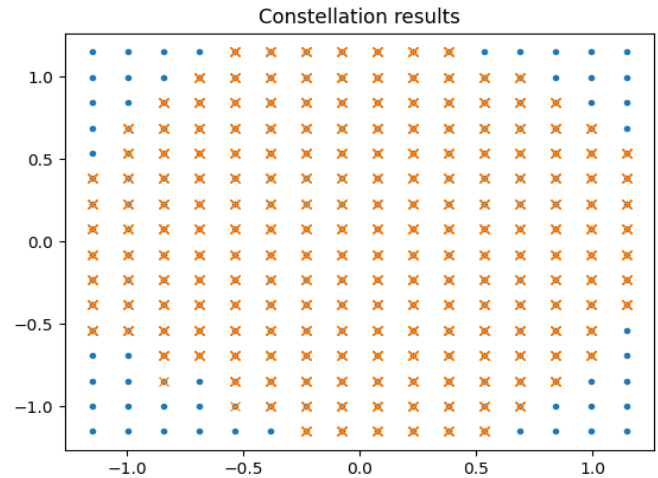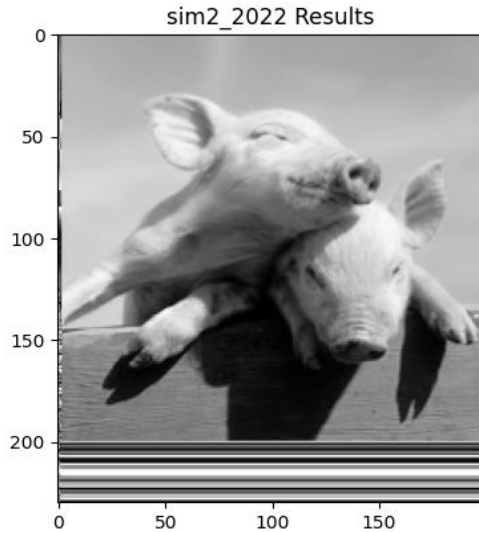| SIMULATION	BnT
Sim2	0.128
Sim3	0.6
Sim4	0.000001
Sim5	0.0225
Sim6	0.021

Sim1_2022

This simulation, titled *sim1_2022*, had no timing or phase offsets, which made reading in this image simple compared to the other simulated receivers. Below is the resulting image (with the attached unique word), and as well as the constellation plot. NOTE: for all constellation plots, blue represents the original LUT, and the X is the a(k) results
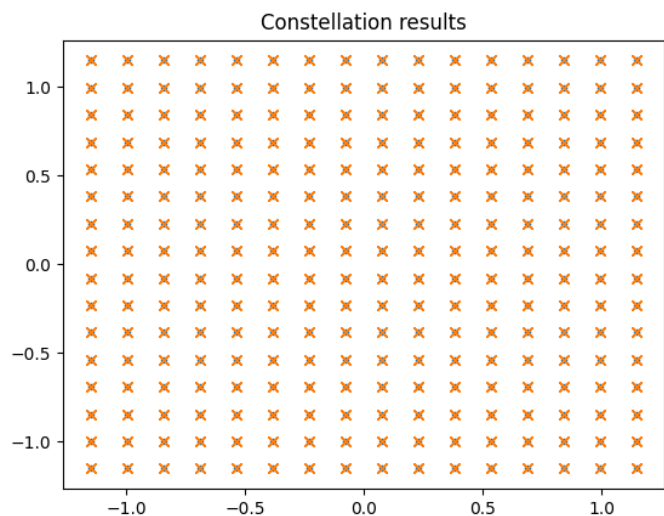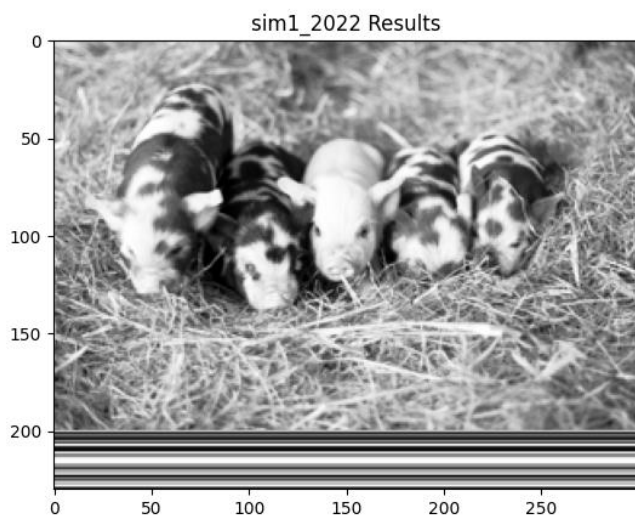
Sim2_2022

This simulation, titled *sim2_2022*, had a fixed phase offset, which made use of a phase recovery system. Below is the resulting image (with the attached unique word), and as well as the constellation plot, filtered phase error signal, and phase estimate. As seen below, the image has some phase recovery at the beginning columns.

sim2_2022 Results

Constellation results

Sim2_2022 Phase Estimate
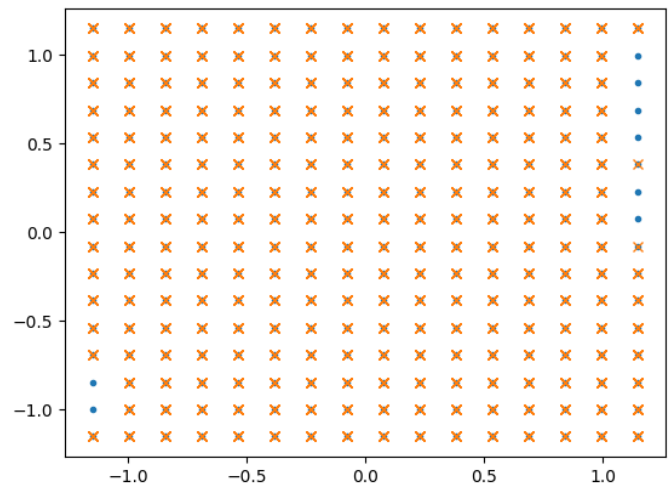

Sim2_2022 Error Signal

Sim3_2022

This simulation, titled *sim3_2022*, had a carrier frequency offset, which made use of a phase recovery system. This deemed a lot more difficult than the prior and resulted in changes on how the unique word was used. Below is the resulting image (with the attached unique word), and as well as the constellation plot, filtered phase error signal, and phase estimate.
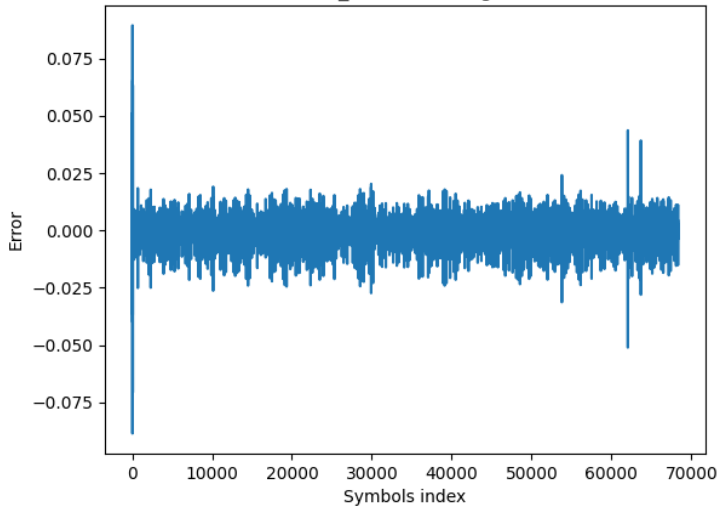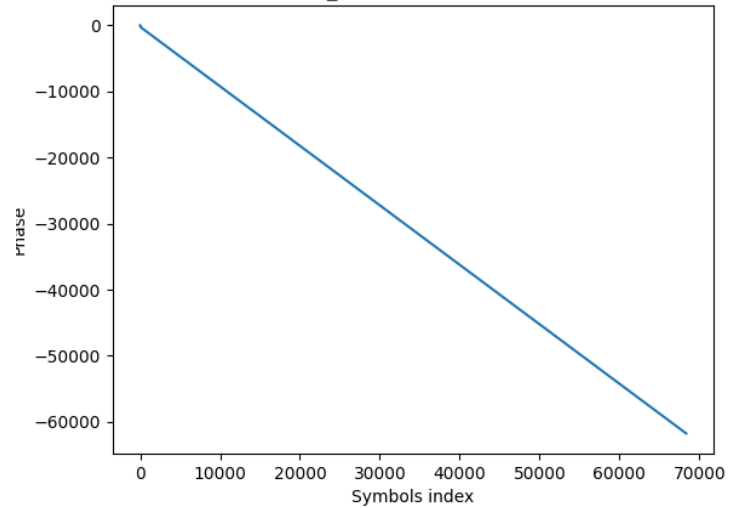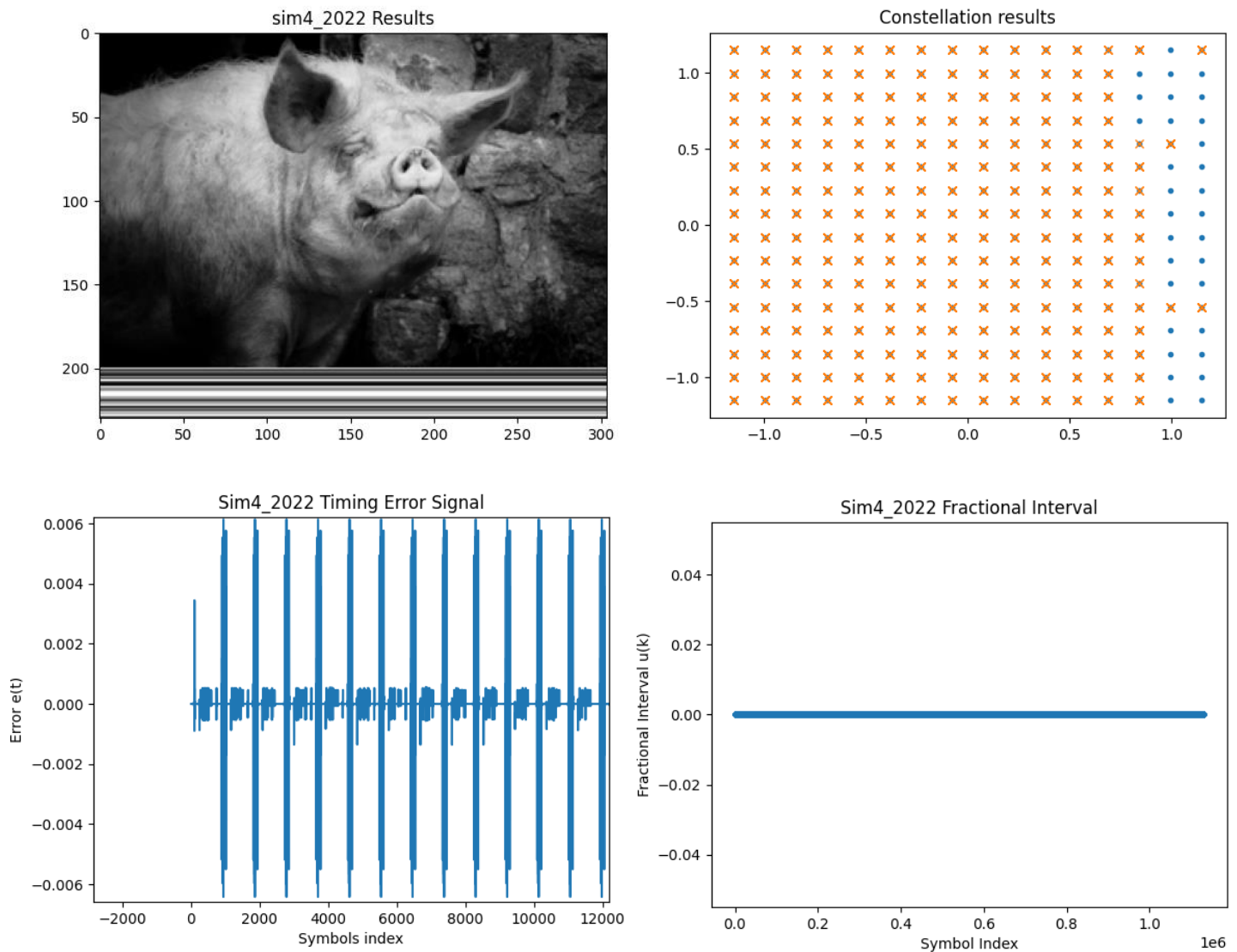
Sim4_2022

This simulation, titled *sim4_2022*, had a fixed timing offset, which made use of a timing recovery system. This involved processing the image with a farrow structured cubic interpolator. Below is the resulting image (with the attached unique word), and as well as the constellation plot, filtered timing error signal (zoomed in), and fractional interval.

Sim5_2022

This simulation, titled *sim5_2022*, had a timing clock frequency offset, which made use of a timing recovery system. This involved processing the image with a farrow structured cubic interpolator, which can be seen in the image when trying to track timing clock frequency.. Below is the resulting image (with the attached unique word), and as well as the constellation plot, filtered timing error signal, and fractional interval (zoomed in).
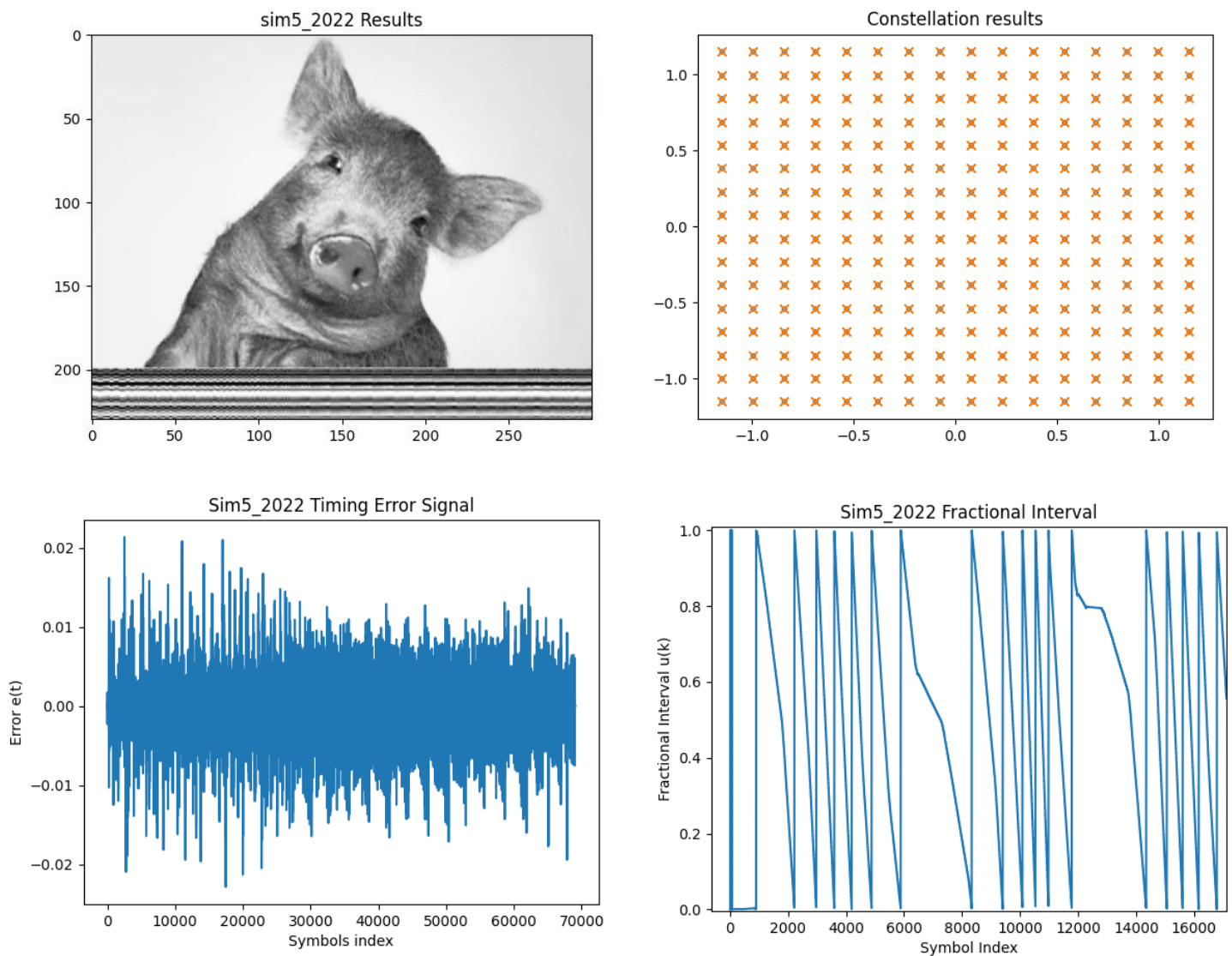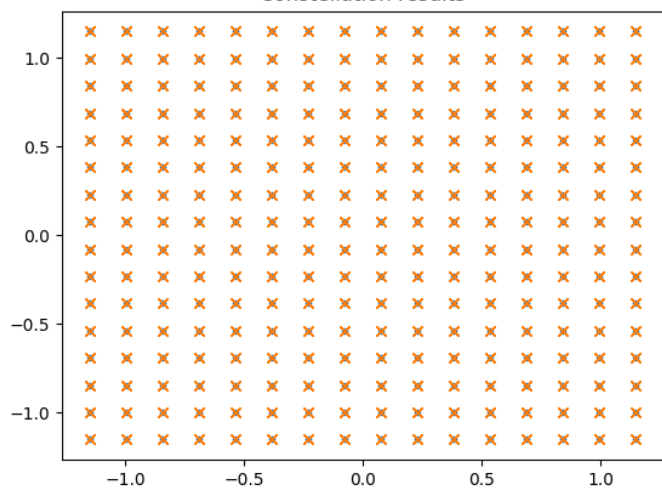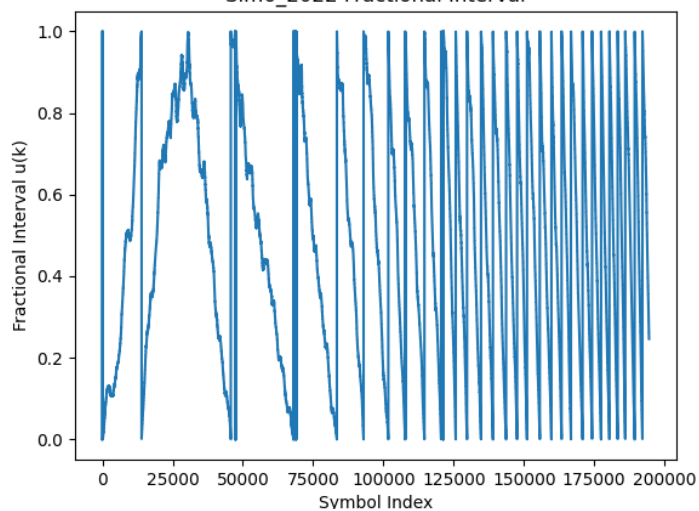
Sim6_2022

This simulation, titled *sim6_2022*, had a timing clock frequency offset and phase frequency offset, which made use of the full system as seen below. This deemed to be a lot more difficult compared to the other results. I was able to get an image, but it is not the correct result. I tried to rotate the phase by 90 degrees as seen in the quad image below, but no results were made. Unfortunately, the results could not be found in a timely manner. Below is the resulting image, and as well as the constellation plot, filtered timing error signal, and fractional interval, filtered phase error signal, and phase estimation.
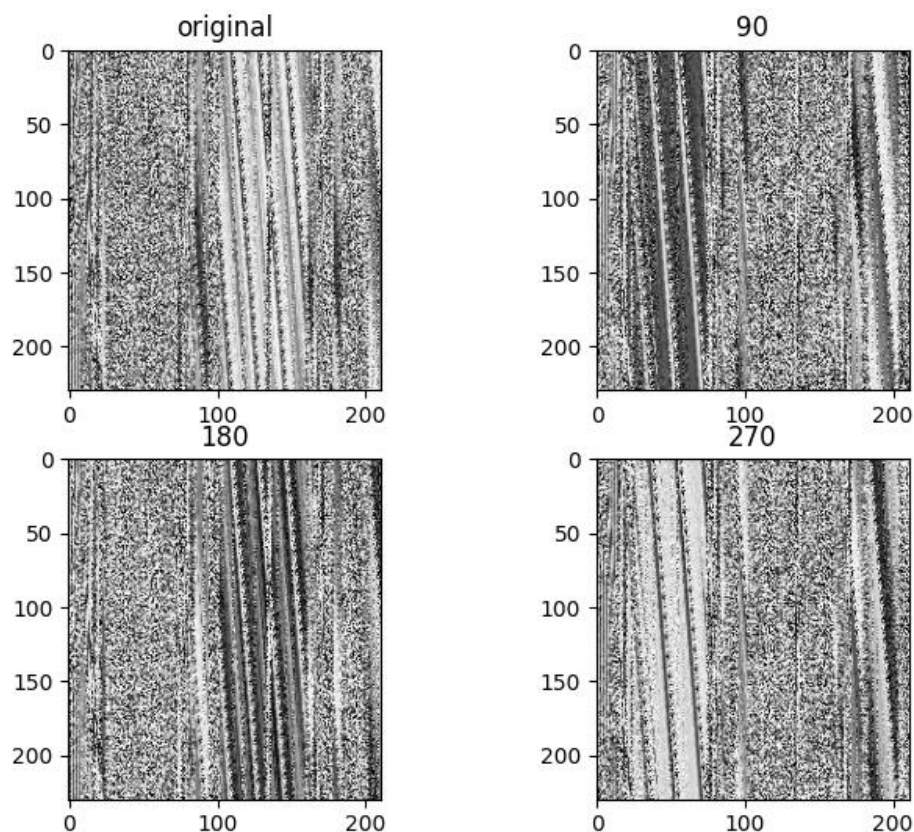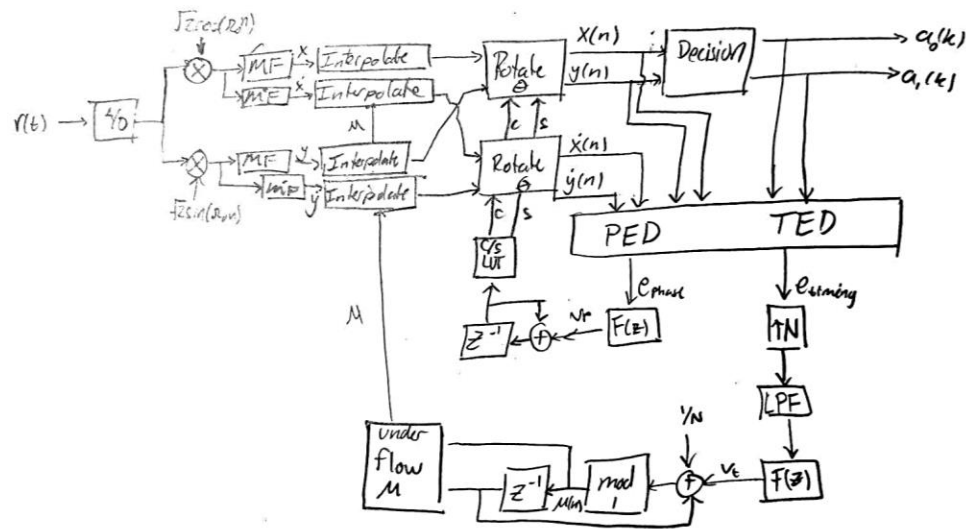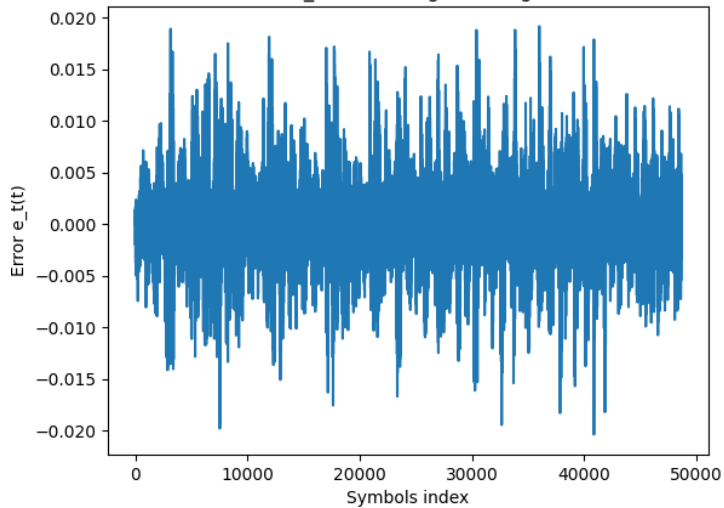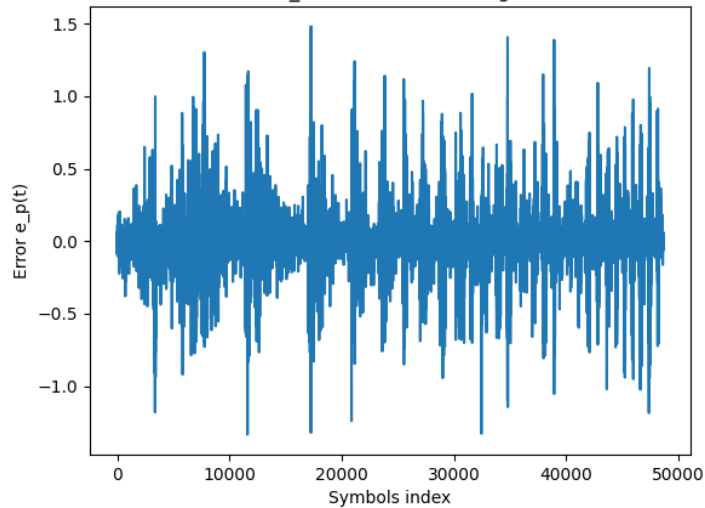
Constellation results

Sim6_2022 Fractional Interval

Sim6_2022 Timing Error Signal

Sim6_2022 Phase Error Signal

Sim6_2022 Phase Estimate