ASE 389P-7 Preliminary Exam 1

Posting Date: October 8, 2024

Exam Rules: Do all problems, writing or printing on standard 8 1/2 by 11 inch paper. Hand in the completed exam to Dr. Humphreys as you enter class on Wednesday, October 8, at 11 am, or slip it under his door beforehand. No collaboration or consultation is allowed with any other person besides Dr. Humphreys. He is willing to discuss problems if he's available. You may use non-human outside sources (e.g., books). If you use such sources, please list them.

1. **[15 points]** Problem set 1, Number 2, except use the file `trainout.wav` posted in the exam folder on Canvas. Turn in a paper copy of your source code and estimates of `xObs` and `dObs` to a precision of 0.1 meters. Note that to meet this precision, you will need to extract an accurate digital (not just visual) Doppler time history from `trainout.wav`. You can do this with Matlab's spectrogram, for example.

2. **[10 points]** Problem set 1, Number 4.

3. **[10 points]** Problem set 1, Number 5. The extra credit will be worth 1 point.

4. **[10 points]** Problem set 1, Number 9.

5. **[10 points]** Problem set 2, Number 2.

6. **[15 points]** Problem set 2, Number 9.

7. **[10 points]** Use the `generateLfsrSequence` function you wrote for Problem Set 2 and your lecture notes to answer the questions.

   Which of the following characteristic polynomials correspond to maximal length sequences for a 9-stage linear feedback shift register? Of those that do, which pairs of polynomials correspond to so-called *preferred pairs* of m-sequences, i.e., m-sequences that can be shifted and summed (modulo 2) to generate a family of Gold codes? Hand in your answers and a paper copy of your source code.

$$
\begin{aligned}
f_1(D) &= 1 + D^4 + D^9 \\
f_2(D) &= 1 + D^3 + D^5 + D^6 + D^9 \\
f_3(D) &= 1 + D^3 + D^5 + D^8 + D^9 \\
f_4(D) &= 1 + D^3 + D^4 + D^6 + D^9 \\
f_5(D) &= 1 + D^3 + D^7 + D^8 + D^9 \\
f_6(D) &= 1 + D^2 + D^9
\end{aligned}
$$

8. **[10 points]** Problem set 3, Number 1.

9. **[10 points]** Problem set 3, Number 4.