

Assignment 7 (computer project 1) DOUBLE ASSIGNMENT

The code for exercises 6.1 and 6.2 was prepared and ported to Python for you. We discussed it in class. We will now try to do a number of applications:

1. (Preliminary) Look at the code provided in the github in the *Assignment6.ipynb*, *Assignment6.py* and the new *ukf_voss.py* which has a new *ControllableNatureSystem(NatureSystem)*.
2. Experiment with different grid sizes. The program runs quite slowly with an 8x8 grid (64 sites). Moving to a 6x6 grid, for example, would almost halve the complexity (36 sites) but are the results still sensible? (10 points)
3. This Pinto-Ermentrout (modified Wilson-Cowan) system has a large repertoire of dynamical behaviors. The initial conditions and parameters used in the *Assignment6.ipynb* notebook produce rotating waves for example, but that's only one possibility. Experiment with different initial conditions and look for stationary waves, linearly propagating waves, waves propagating from one point and so on. First try things out in the code from the *Assignment6.ipynb* notebook, which does not estimate the Kalman filter so runs faster. When you get something interesting try to apply the Kalman Filter control and see if you get stable dynamics. Give at least 3 examples (20 points). Some hints:
 - a. Use uniform vs. non uniform initial conditions.
 - b. Create initial conditions using for example 1-D vs 2-D gaussian blobs
 - c. Try initial conditions with stripes
 - d. You have to specify both *u* and *a* initial conditions. In the given initial conditions *u* and *a* are shifted with respect to one another. What are the consequences of that? Experiment with conditions in which *u* and *a* are proportional to one another, and situations in which they are not.
4. Apply control to the original conditions and reproduce figure 3 and 4 of the Sauer and Schiff 2008 paper (25 points)
(<https://iopscience.iop.org/article/10.1088/1741-2560/5/1/001>)
5. NCE exercise 6.3 (Replace Wilson-Cowan equations with Fitzhugh-Nagumo) (15 points)

For all computer projects, deadline end of course