Neurodynamics

Week 3 Computational Lab

Problem 1 A

Nullclines: https://mcb.berkeley.edu/courses/mcb137/exercises/Nullclines.pdf

1. Set up the ML or HH models like in the last homework assignment

Input the ML functions given in the assignment

2. Create matrix of V-w values:

v = np.linspace(vmin, vmax, pointcount); *what are reasonable min/max values for V? Try ~30 points*

w = np.linspace(wmin, wmax, pointcount); *what is w? So, what are reasonable min/max values? (30 points again)*

[V, W] = np.meshgrid(v, w); *creates matrix of v, w values*

3. Use the functions given in the example code:

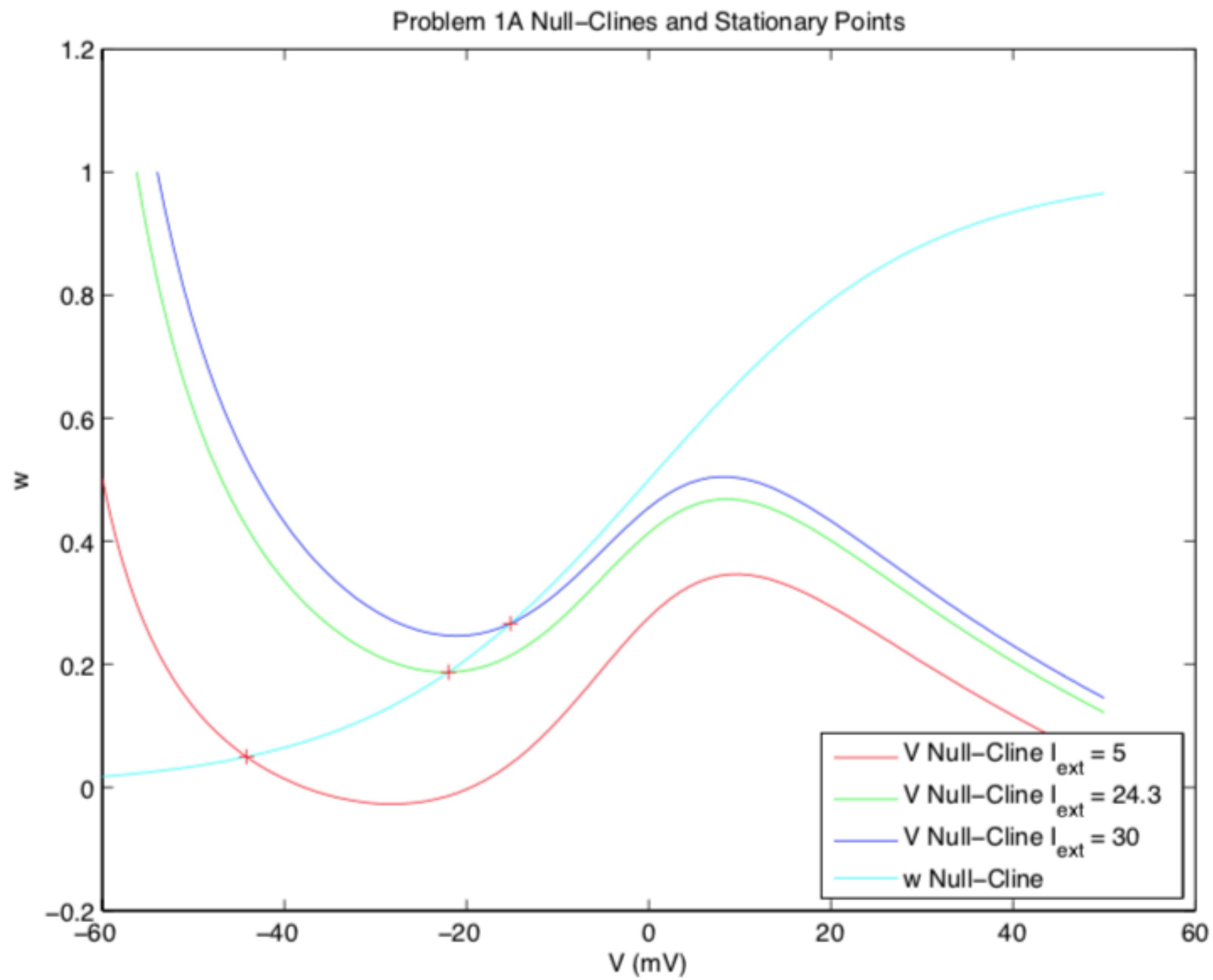
[X_null_V_1, Y_null_V_1] = **getNullcline**(dVdt(V, W, **I_ext_1**); % repeat for other currents (I_ext_2 …)

[X_null_w, Y_null_w] = **getNullcline**(dwdt(V, W), v, w);

[xint_1, yint_1] = **getCrossings**(X_null_V_1, Y_null_V_1, X_null_w, Y_null_w);

Problem 1 A (con't)

Should look something like this (different external current values)



Problem 1B, C, D

B: To determine stability of a stationary point, look at the eigenvalues.

```
J_1 = getJacobian(V, W, dVdt(V, W, I_ext_1), dwdt(V, W), xint_1, yint_1);

[V1, D1] = eig(J_1); % V and D have real and imaginary components
```

C: Verify the stability by plotting simulated trajectories starting from different initial points.

```
t = 0:0.001:100;

thetas = 0:45:180;

for i = 1:5:

    dXdt1 = @(t1, X1) [dVdt(X1(1), X1(2), I_ext_1); dwdt(X1(1), X1(2))];

    [t1, X1] = ode23(dXdt1, t, [xint_1 + cos(thetas(i) * (3.14159)/180), yint_1 + sin(thetas(i) * (3.14159)/180)]);

end
```

D: Repeat analysis in A, B, C for the fourth current.

Problem 2

- Same as Problem 1 but with Reduced HH model.
  - Compare the two.