

Homework 4.3: Inhibitory rebound

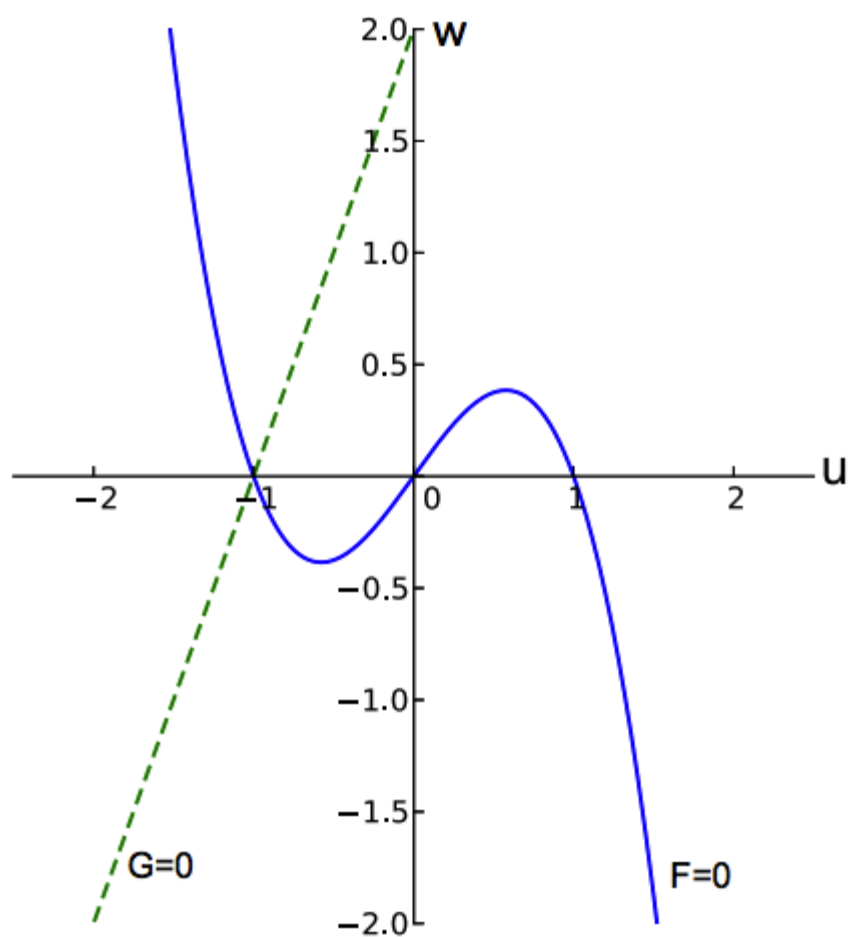
Inhibitory rebound 1

1/1 point (graded)

Consider the following two-dimensional Fitzhugh-Nagumo equations

$$\begin{cases} \frac{du}{dt} = u(1 - u^2) - w + I := F(u, w) \\ \frac{dw}{dt} = \epsilon(u - 0.5w + 1) := \epsilon G(u, w) \end{cases}$$

where $\epsilon \ll 1$. In the figure below you see the nullclines when there is no external current, i.e., $I = 0$.



Now suppose that an inhibitory current step is already applied:

$$I(t) = \begin{cases} -I_0 & t \leq 0 \\ 0 & t > 0 \end{cases}$$

Note that $I_0 > 0$. What would be the correct opinion about the fixed point of the system for $t \leq 0$ compared to the figure above?

- ☐ The fixed point moves away from the origin in the region $w > 0, u < 0$.
- ☐ The effect of an applied current is to horizontally shift the u -nullcline.
- ☒ As I becomes more negative, the fixed point moves away from the origin in the region $u, w < 0$.
- ☐ The effect of an applied current is to vertically shift the w -nullcline.



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You have used 1 of 1 attempt

✓ Correct (1/1 point)

Inhibitory rebound 2

1/1 point (graded)

What happens after the driving current is removed? (note that more than one option may be correct.)

☒ At the moment the current is switched off, the u -nullcline will instantaneously return to its original position.

☐ The fixed point of the system does not change when the current is switched off.

☒ The fixed point of the system will return back to its original position, i.e., $(u, w) = (-1, 0)$.

☒ If I_0 is large enough, the system emits an action potential.

☐ The system always emits an action potential no matter how large I_0 is.

☐ The w -nullcline is shifted to the left once the current is switched off.



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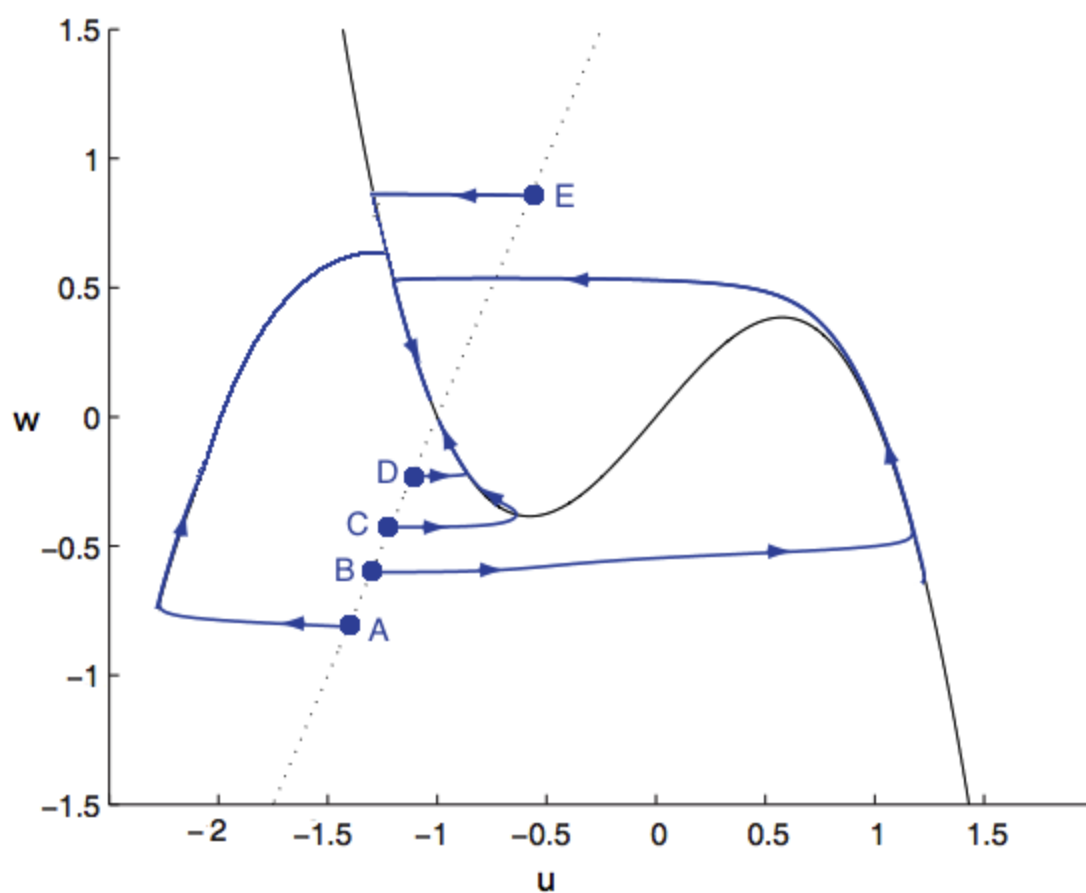
You have used 1 of 1 attempt

✓ Correct (1/1 point)

Possible trajectories

1/1 point (graded)

Which of the followings are possible trajectories for the system once the current is switched off? (Note that the injected current was inhibitory)



☐ A

☒ B

☒ C

☒ D

☐ E



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You have used 1 of 1 attempt