

# Step Current Response of the HH Model

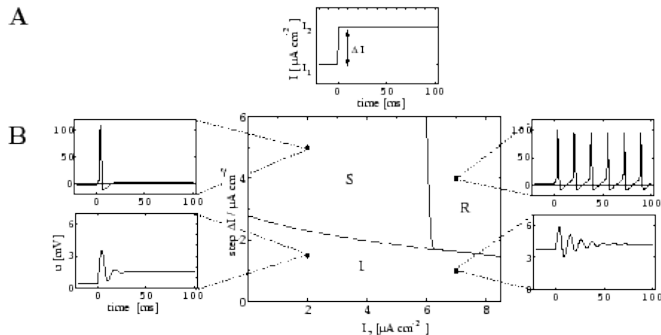
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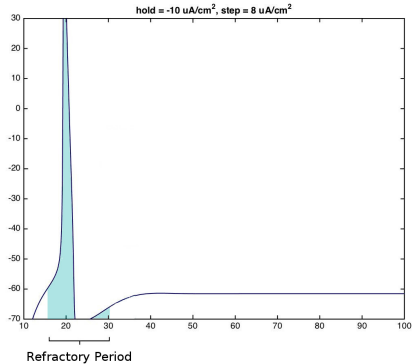
December 4, 2014

# HH Model Step Current Response

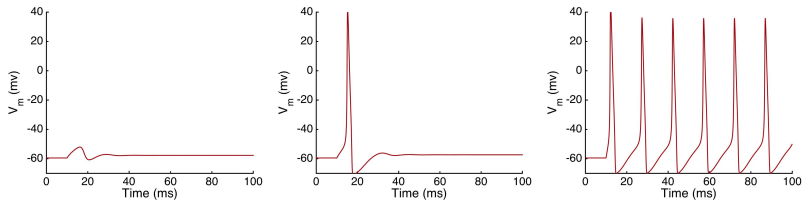


**Figure:** Step Current Stimulation Phase diagram

# Applications: Refractory Period



**Figure:** Reducing the Refractory Period can lead to faster reflexes.



**Figure:** Response in the *Ringing*, *Single AP* and *AP Train* regions

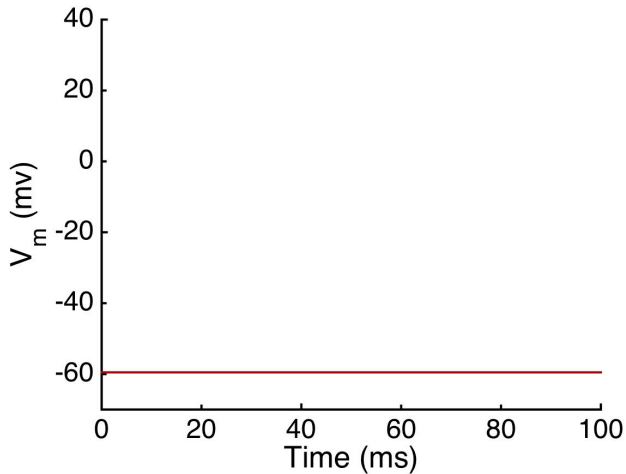


Figure: HH Model's step current response starting at  $0 \mu A/cm^2$

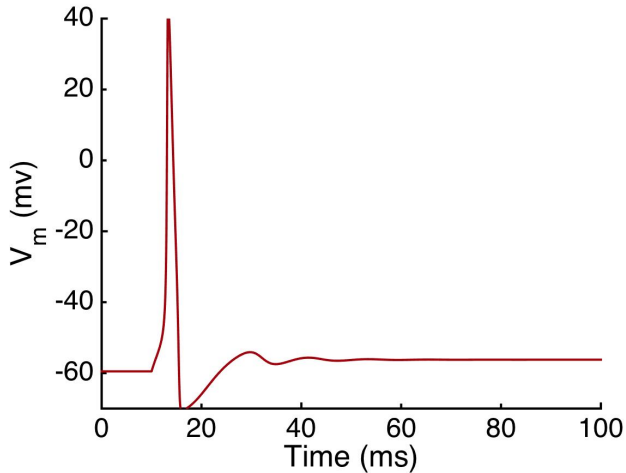


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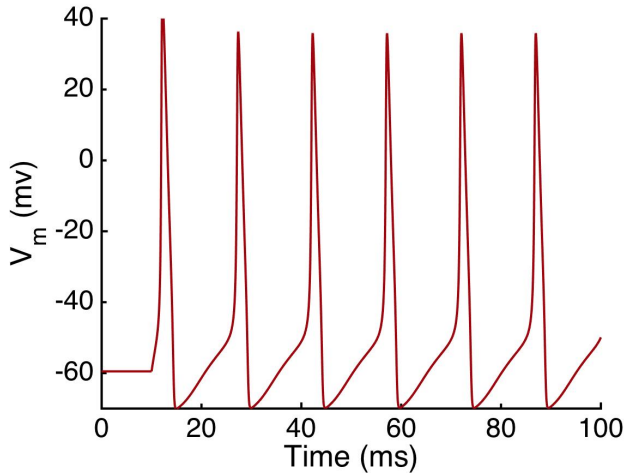


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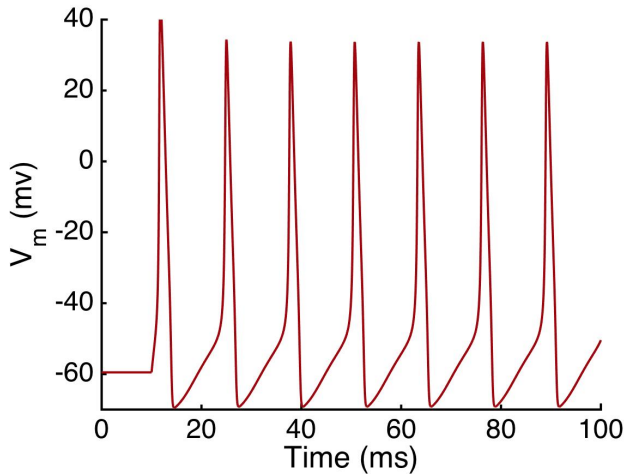


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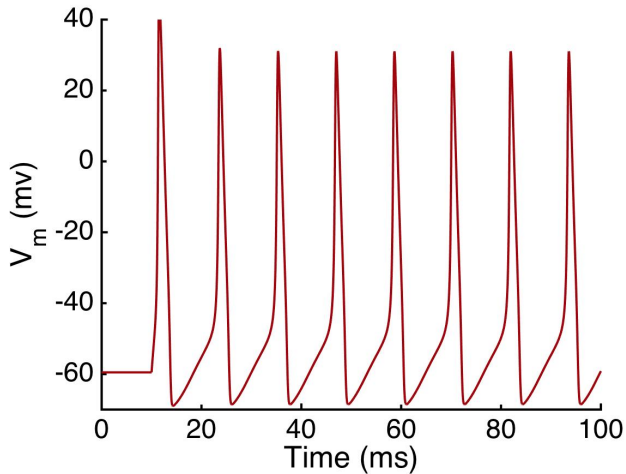


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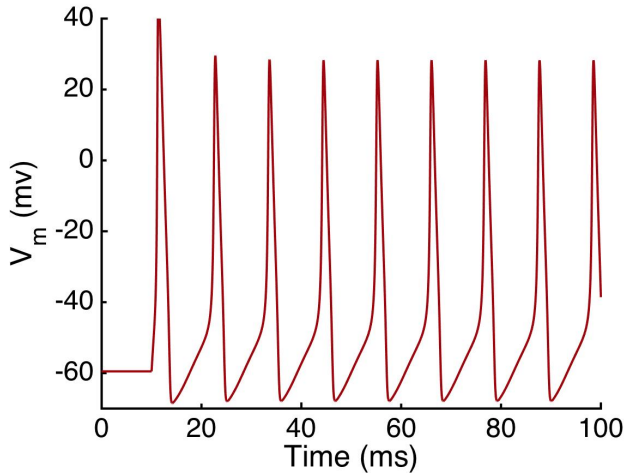


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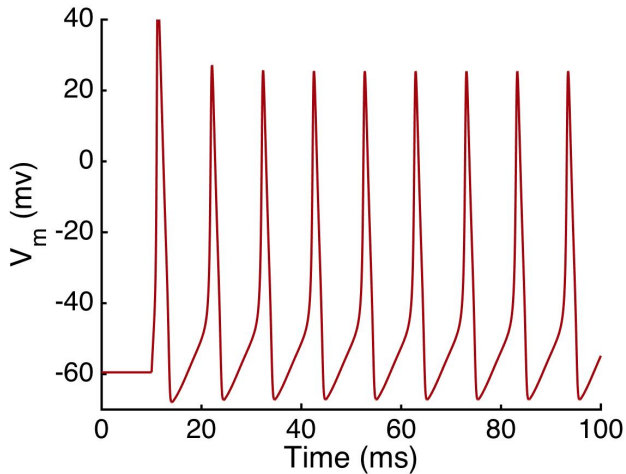


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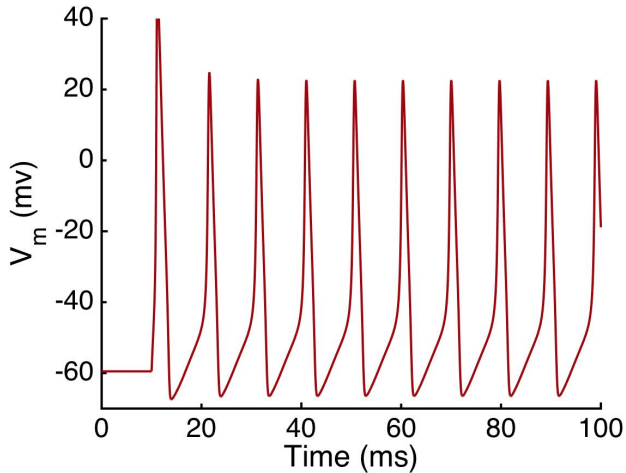


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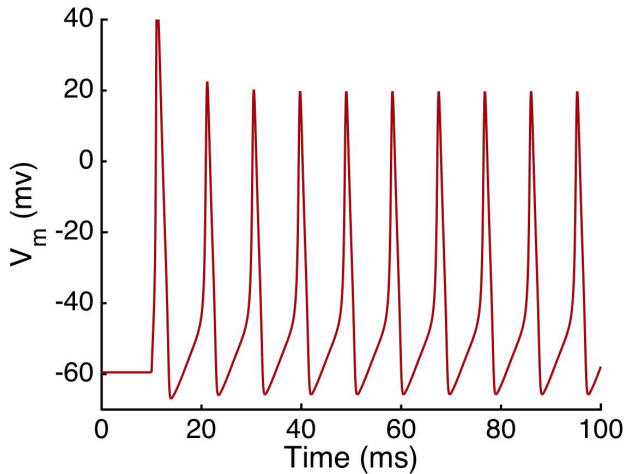


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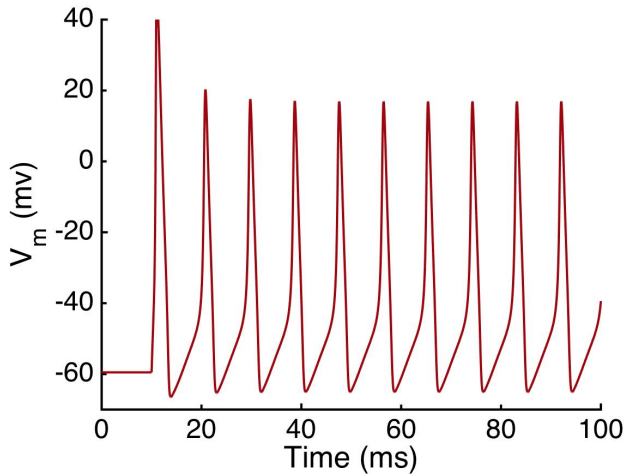


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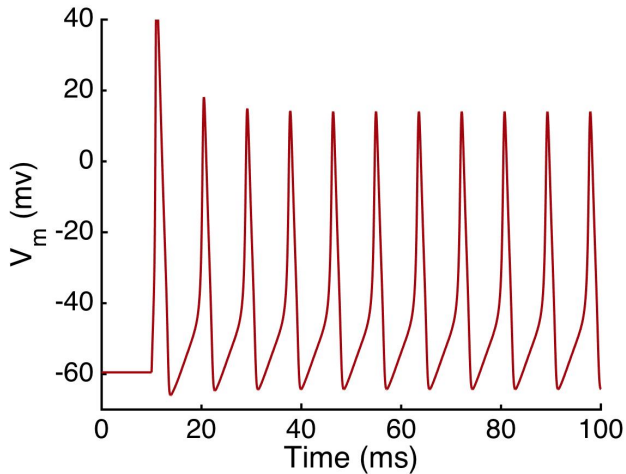


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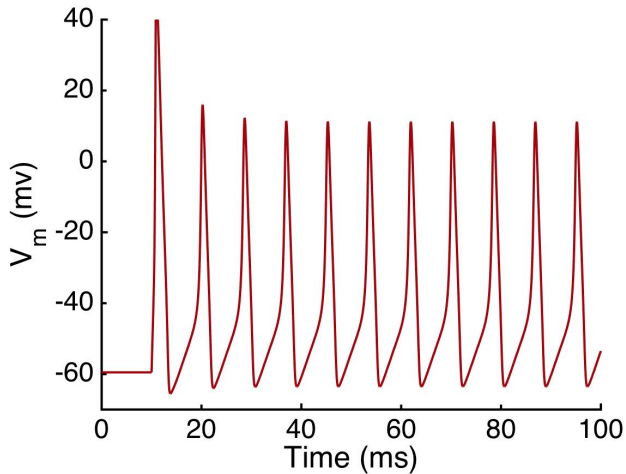


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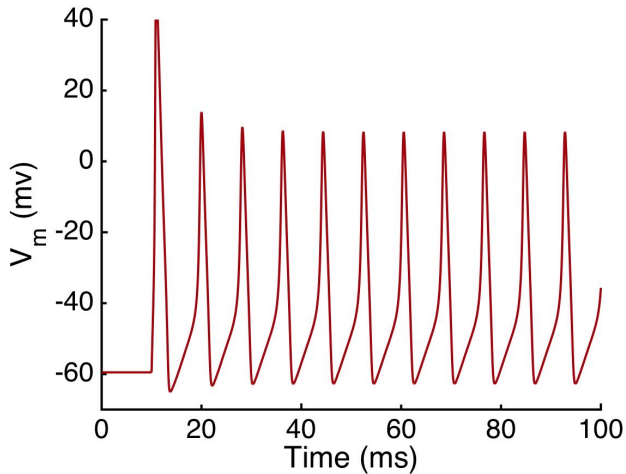


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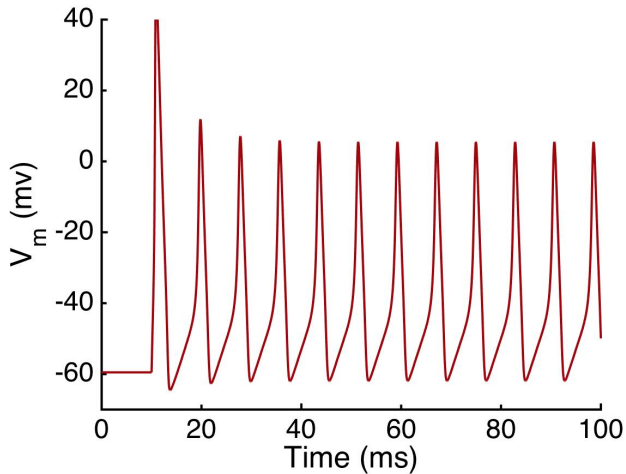


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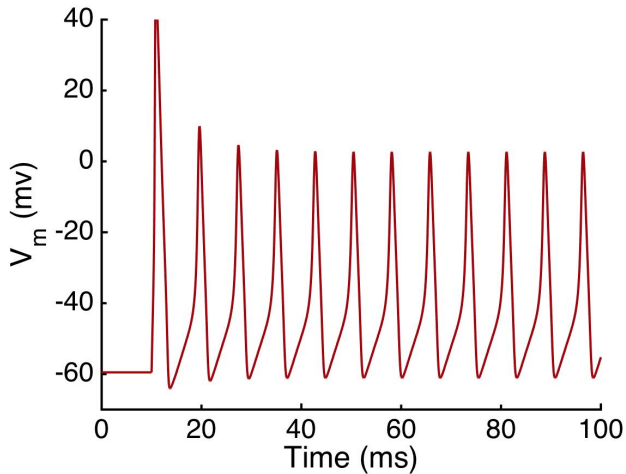


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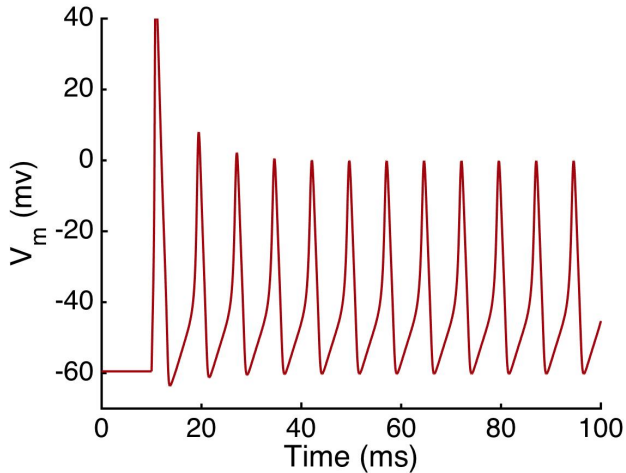


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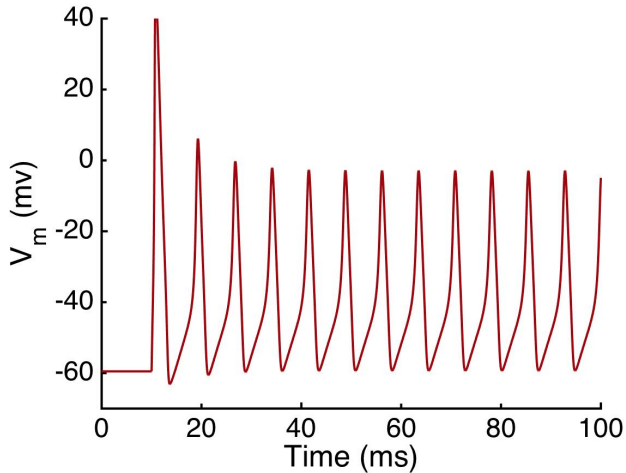


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# Naive Mechanism

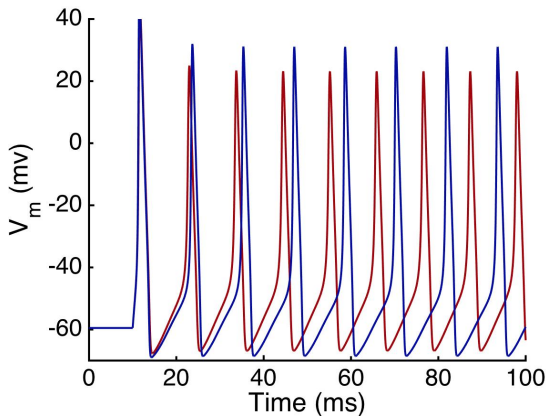


Figure: Equal ratio of current to capacitance

# Mechanism

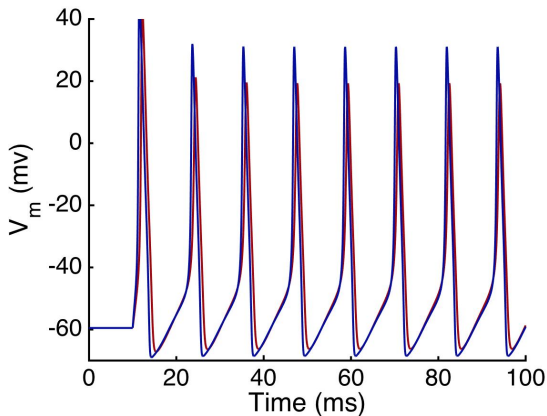
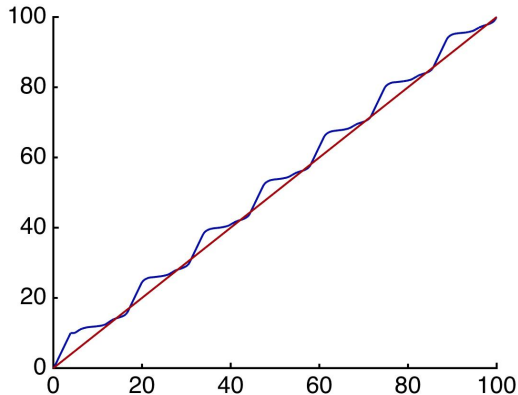


Figure: Unequal ratio of current to capacitance

# DFT insufficient



**Figure:** Discrete Fourier Transform insufficient due to variable time intervals.



# Least-squares spectral analysis

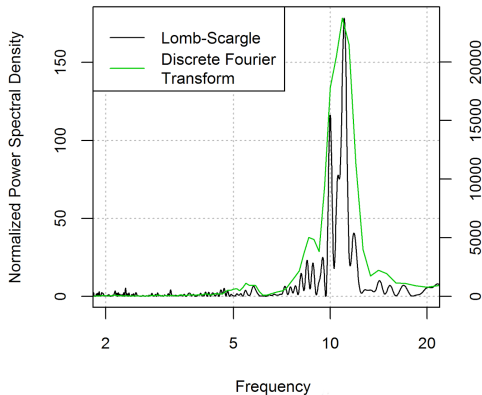
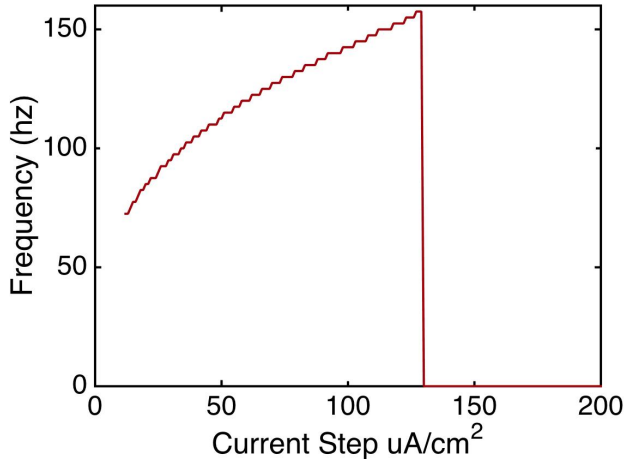


Figure: The Lomb-Scargle Periodogram works with variable intervals.

## Train frequency over increasing input step



# Issues with precision approximation

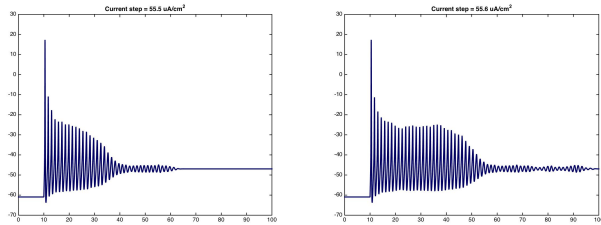


Figure: Incorrect behavior due to low precision

# References

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- 2 Weiss, T. F. (1995). Cellular Biophysics. Volume 2: Electrical Properties, MIT Press.
- 3 Blaustein, M.P., Kao, J.P.Y., Matteson, D.R. (2012). Cellular Physiology and Neurophysiology, 2nd edition, Elsevier-Mosby.
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- 5 Press, William H., and George B. Rybicki. "Fast algorithm for spectral analysis of unevenly sampled data." The Astrophysical Journal 338 (1989): 277–280.