REDUCED CARDIAC TISSUE

Excitation, recovery and spatial coupling

Mitchell–Schaeffer reaction with homogeneous one-dimensional diffusion.

$$\partial_t v = D\partial_{xx} v + \frac{h v^2 (1 - v)}{\tau_{\mathrm{in}}} - \frac{v}{\tau_{\mathrm{out}}} + I_{\mathrm{stim}}$$

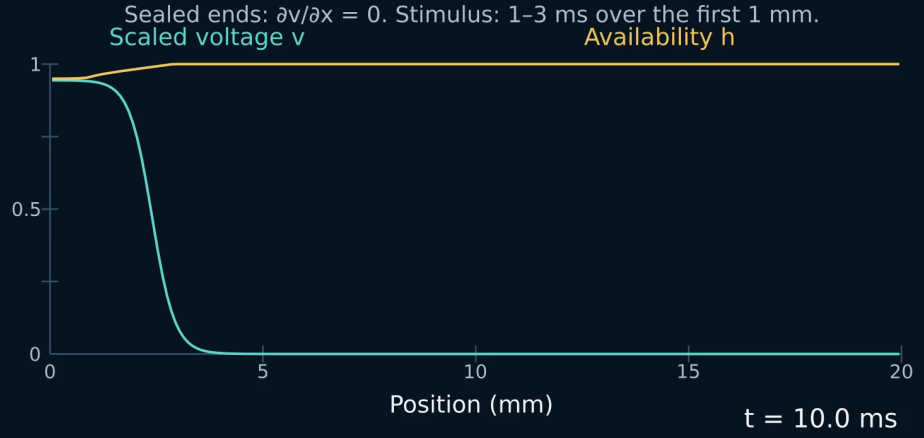
$$\partial_t h = \begin{cases} (1 - h)/\tau_{\mathrm{open}}, & v < v_{\mathrm{gate}}, \\ -h/\tau_{\mathrm{close}}, & v \geq v_{\mathrm{gate}}. \end{cases}$$

v: scaled voltage h: availability gate t: ms x: cm

This sequence shows the advancing front. Recovery takes longer than the displayed 80 ms window.

EXCITABLE CABLE

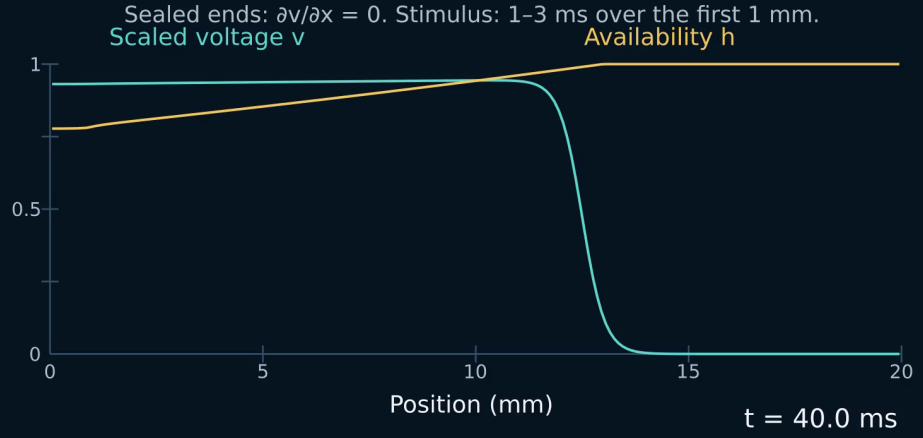
A localized stimulus launches a front



D = 0.001 cm²/ms; 200 finite-volume cells; first-order splitting with Δt ≤ 0.02 ms.

EXCITABLE CABLE

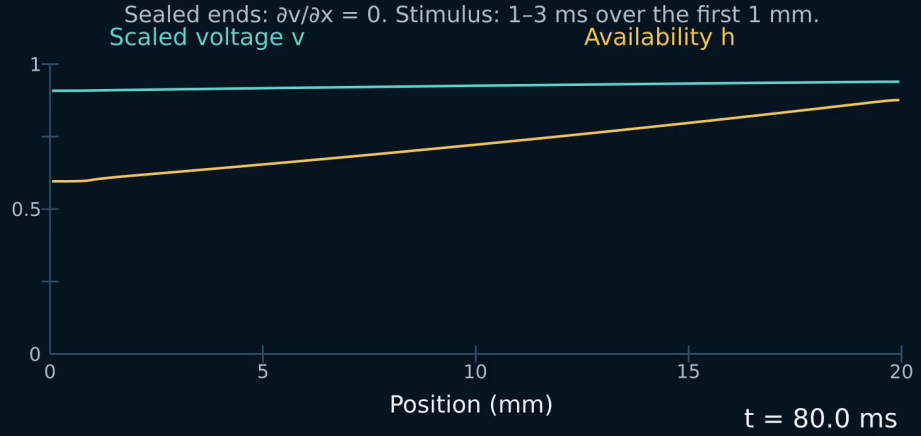
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EXCITABLE CABLE

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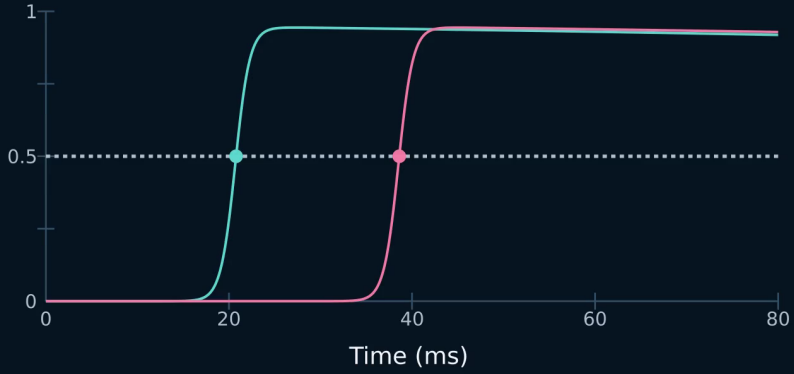


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ARRIVAL-TIME MEASUREMENT

Two fixed sensors define a measured speed

The threshold crossing time is interpolated between successive stored solver steps.



6 mm: 20.78 ms

12 mm: 38.61 ms

$$s = \frac{(12-6)\,\mathrm{mm}}{t_{12} - t_6}$$

= 0.337 m/s

The measured speed depends on model parameters and discretization. The lecture includes separate space/time refinement.