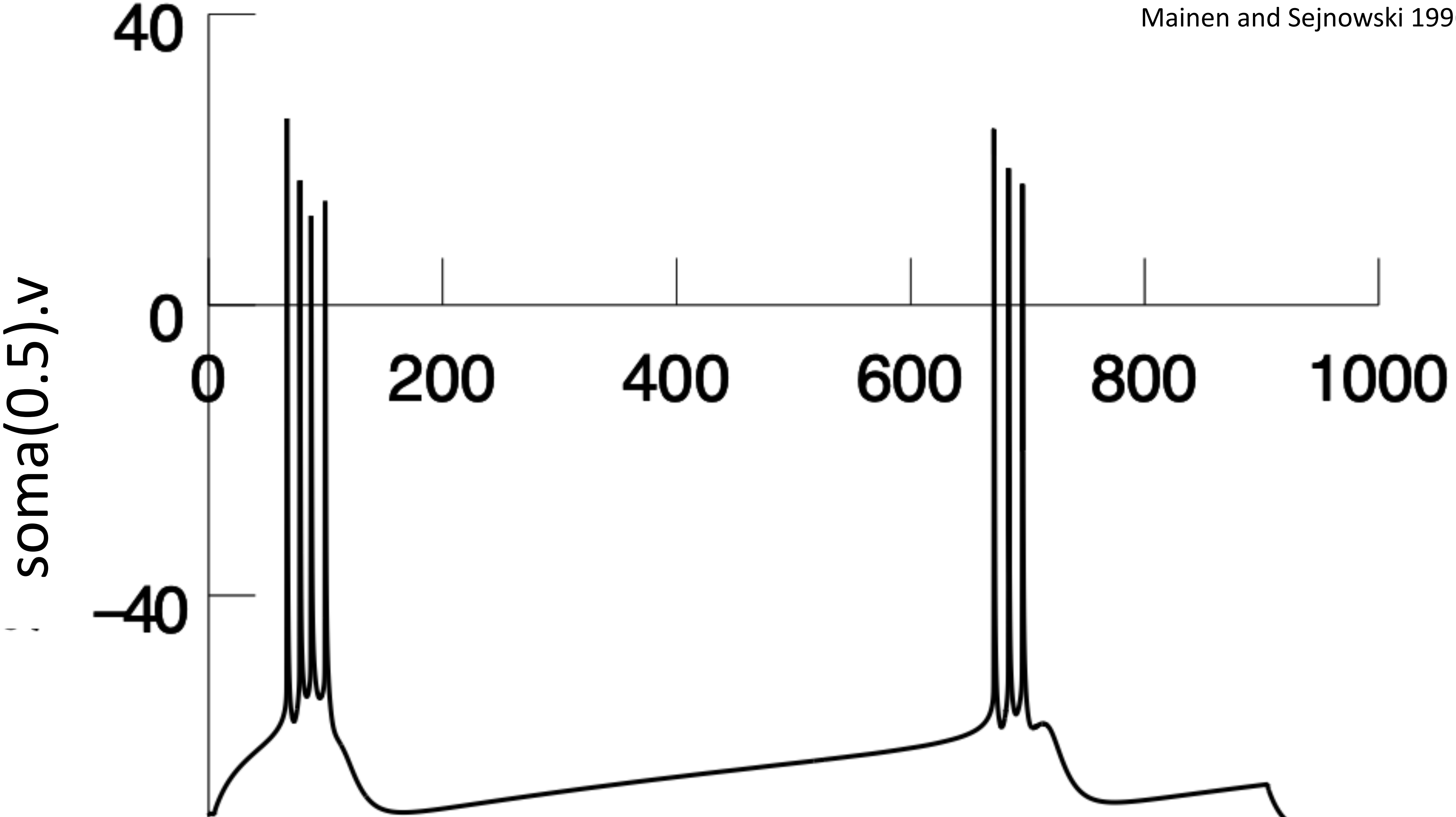
Numerical Methods:

Adaptive Integration

Based on model of https://modeldb.yale.edu/2488
Mainen and Sejnowski 1996



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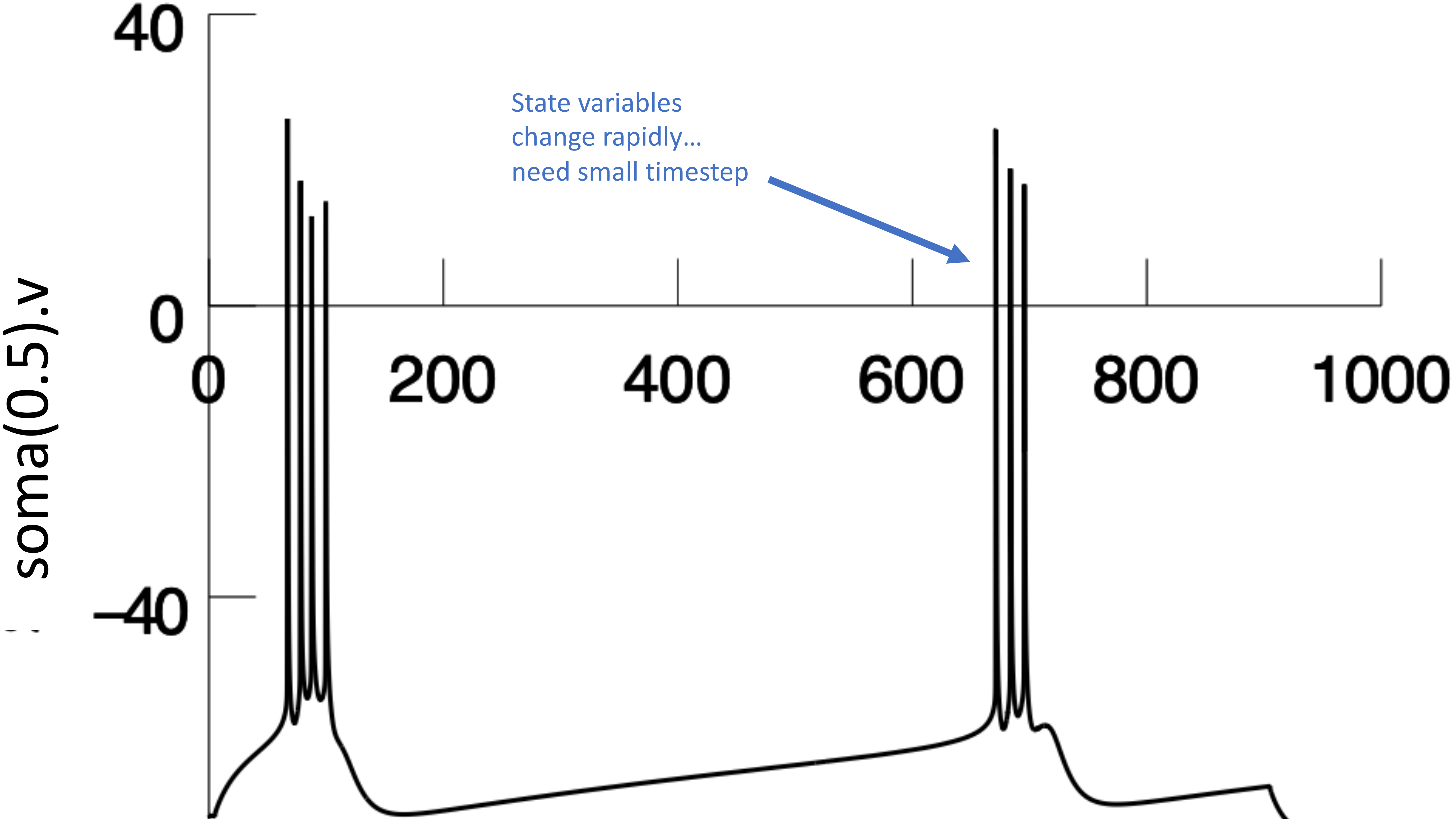

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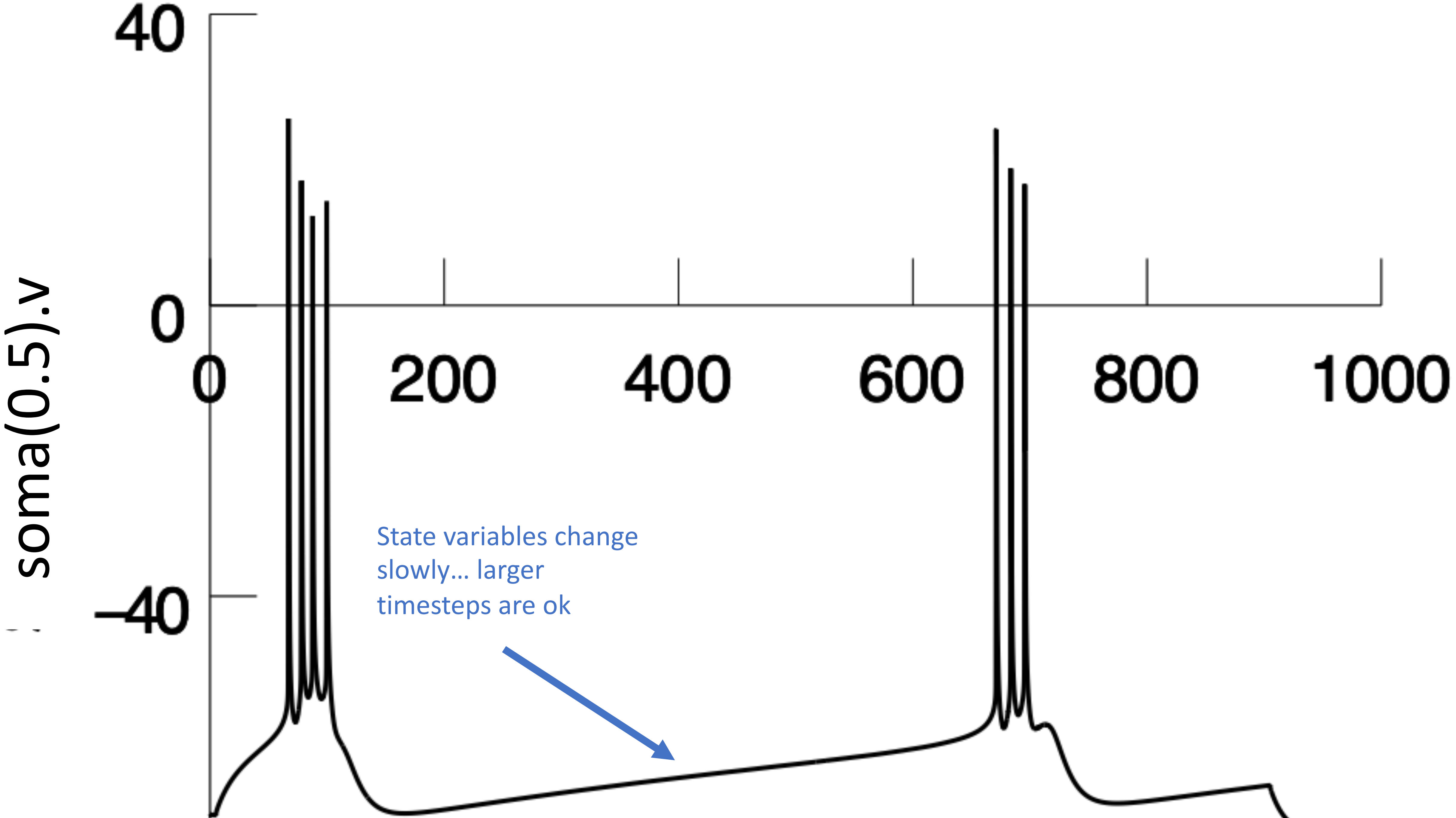

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But we don’t know in advance when either will happen, so what do we do?

Math!

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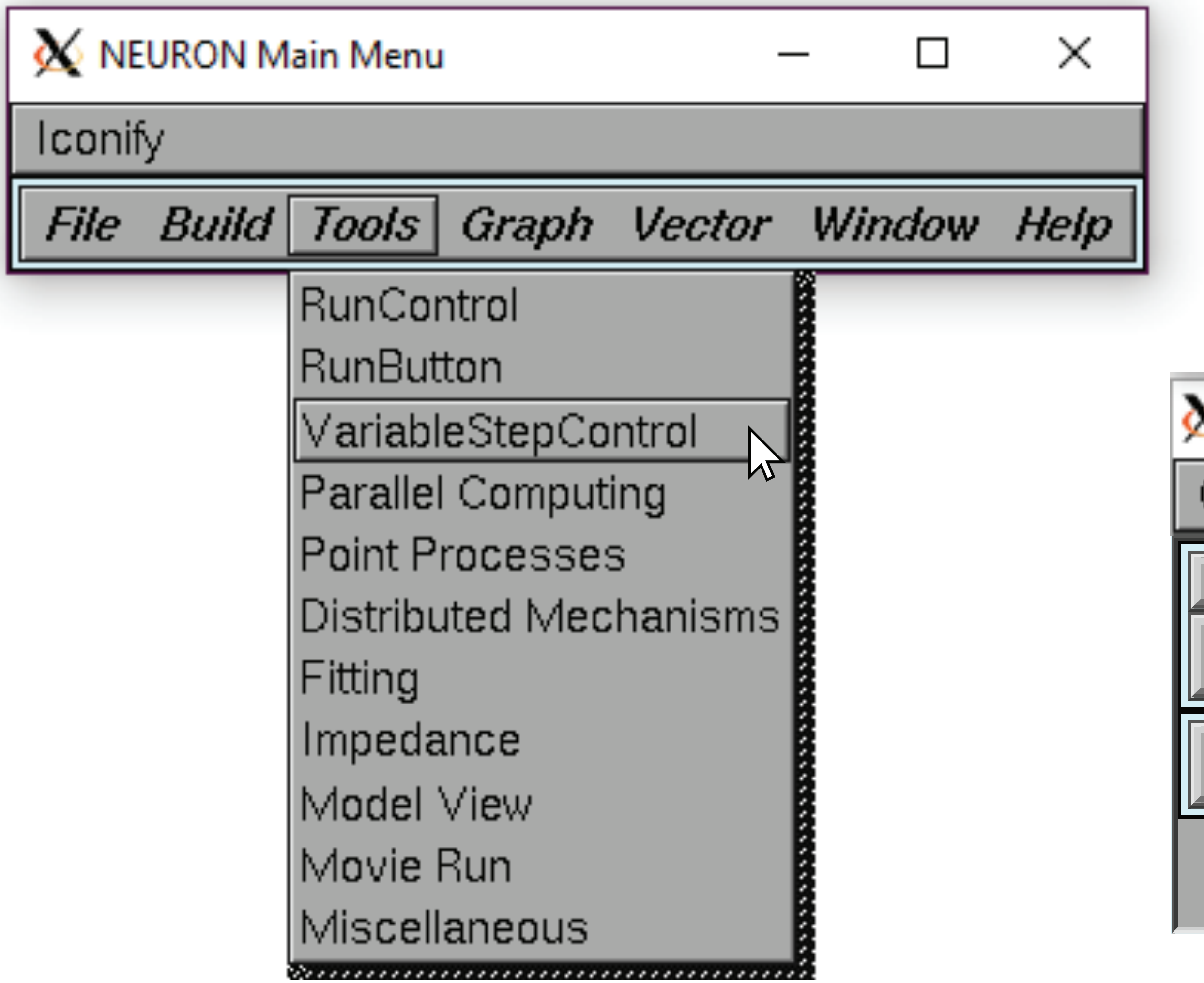
Variable step integration

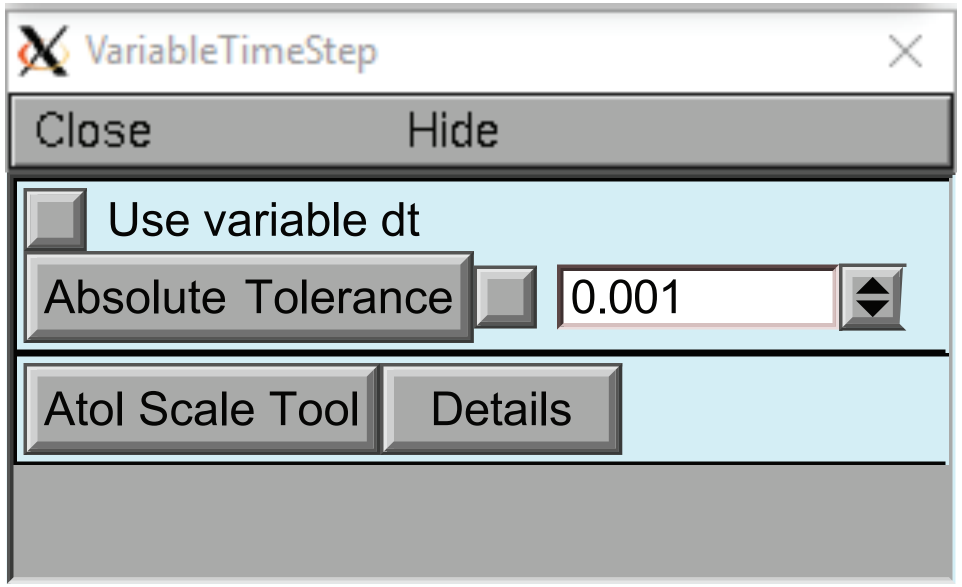
Enabling adaptive integration

`h.cvode_active(True)`

or

`h.CVode().active(True)`

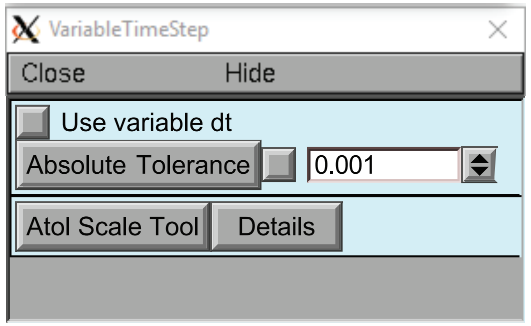


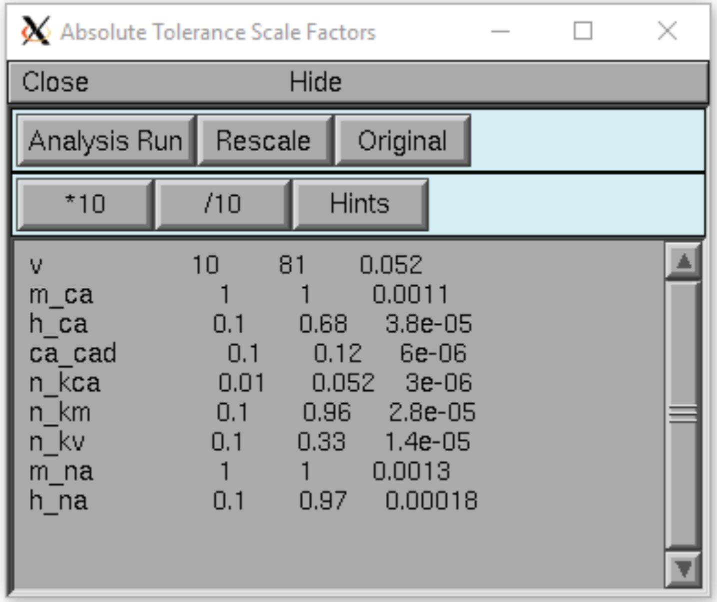


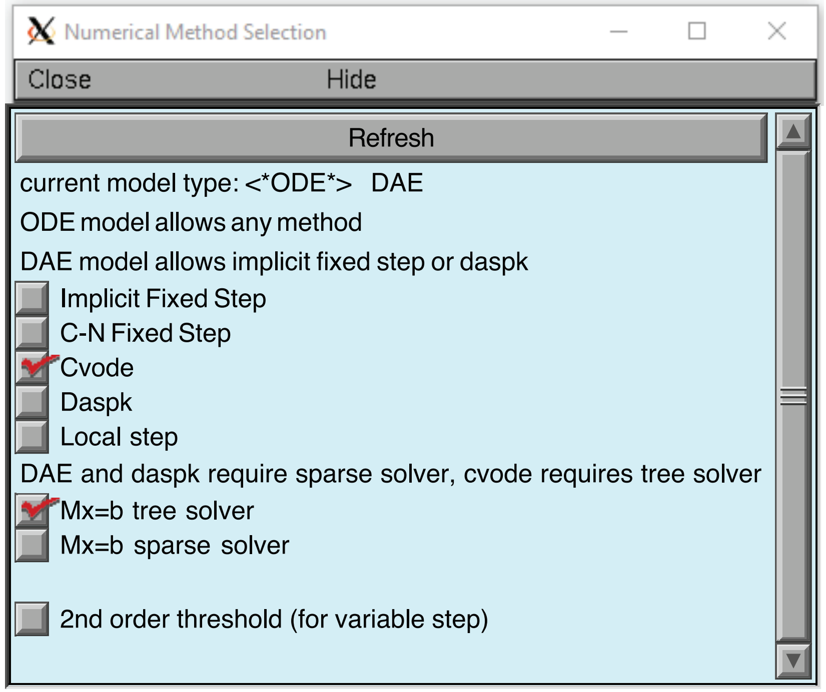
h.cvode active is defined in stdrun.hoc which is loaded automatically whenever the gui is imported.
This is a composite image, not a screenshot to allow combining the window decoration and vector-based window contents.

Options: per state variable tolerance, integration methods

```
h.CVode().atol(0.001)
```







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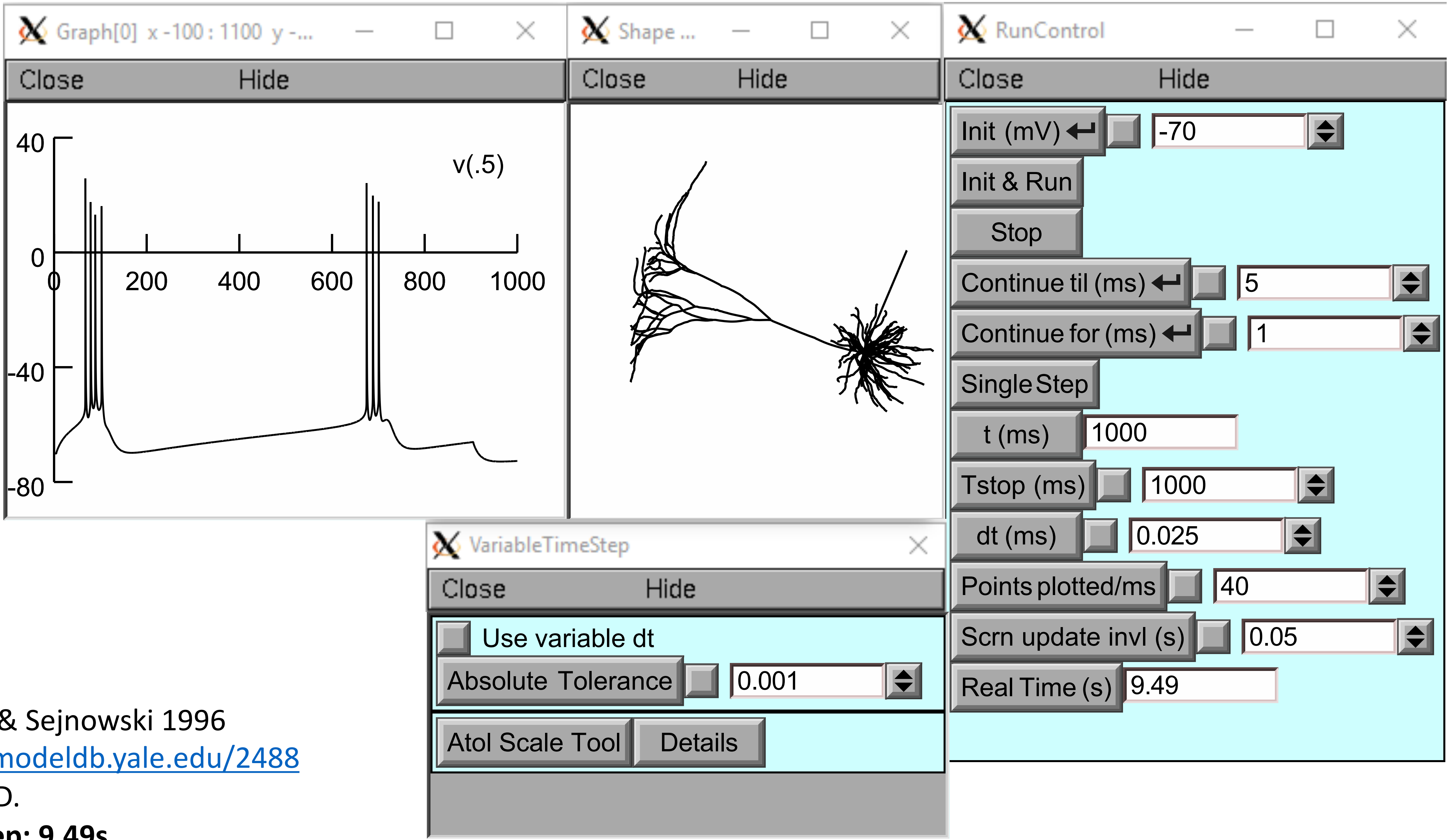

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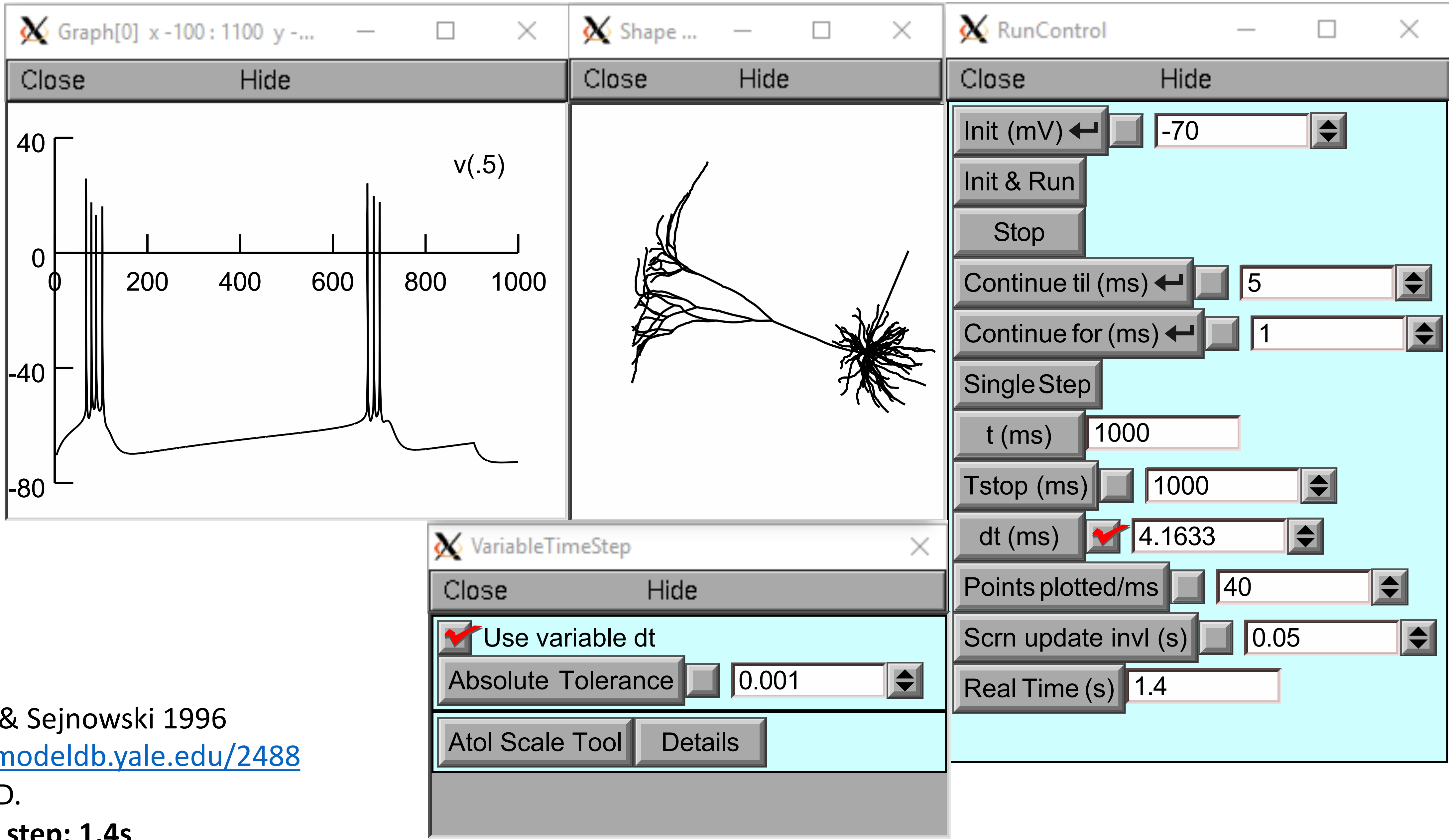
Figure 1D.
Fixed step: 9.49s
NEURON 7.5 on a 3.4 GHz i7-4770 with 24 GB RAM in WSL • composite image



Mainen & Sejnowski 1996

https://modeldb.yale.edu/2488

Figure 1D.

Variable step: 1.4s

NEURON 7.5 on a 3.4 GHz i7-4770 with 24 GB RAM in WSL • composite image

Membrane

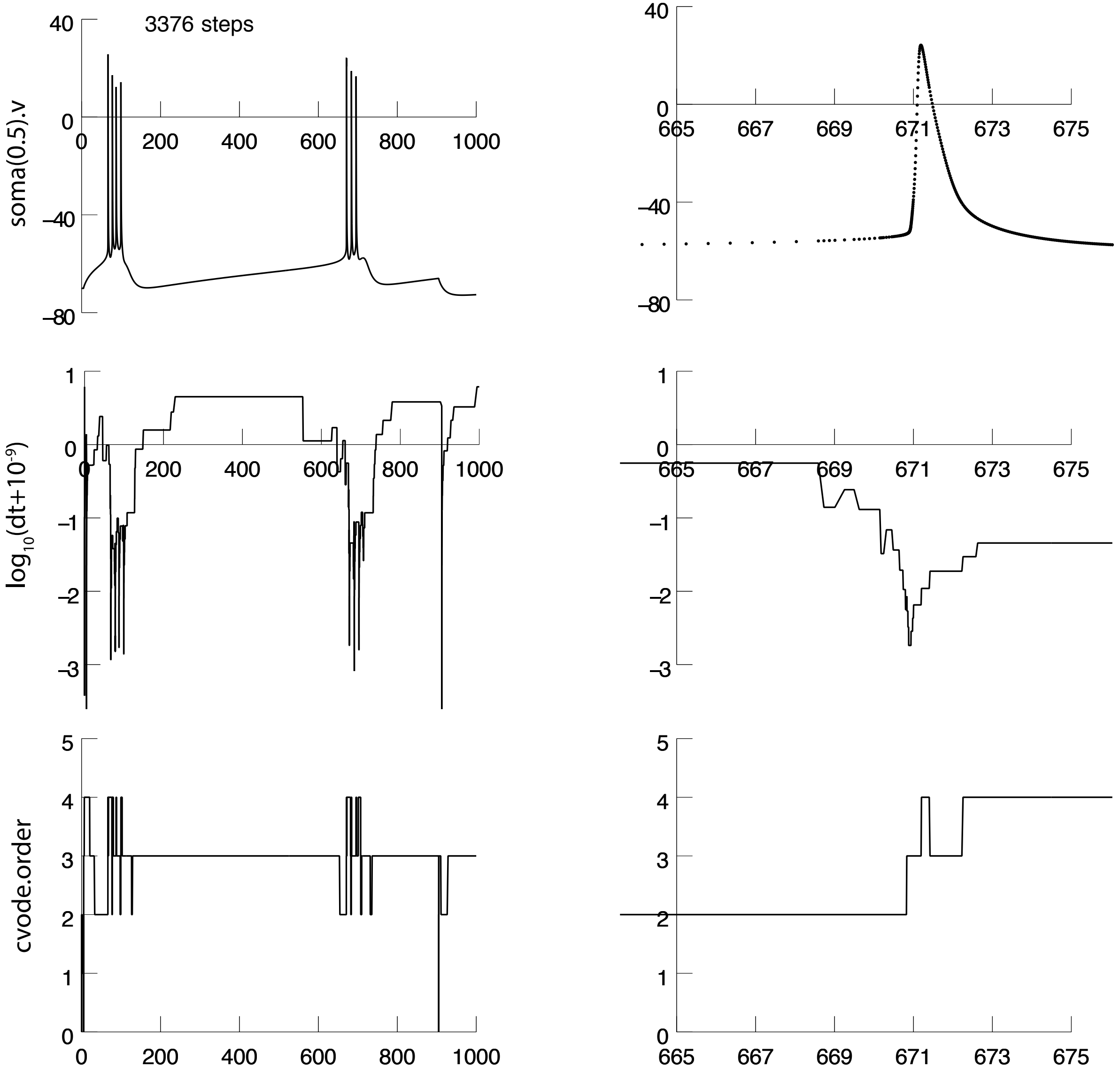
Potential

Timestep

Size

Order of

Integration Method



Running simulations: improving accuracy

Increase time resolution (by reducing time steps) via, e.g.

```
h.dt = 0.01 * ms
```

Enable variable step (allows error control):

```
h.CVode().active(True)
```

Set the absolute tolerance to e.g. 10^{-5}:

```
h.CVode().atol(1e-5)
```

Increase spatial resolution by e.g. a factor of 3 everywhere:

```
for sec in h.allsec(): sec.nseg *= 3
```