Integrate and Fire

Balazs B Ujfalussy

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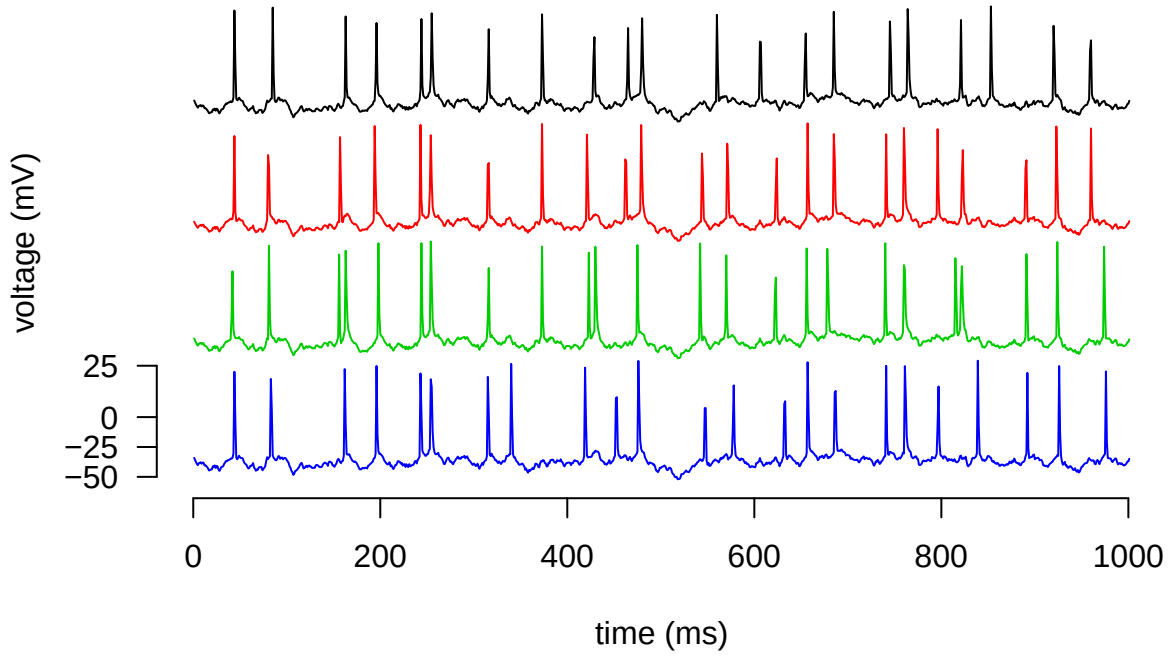
This is a demo for illustrating the response of different neuronal models to somatic current injections.

The models are compared with experimental data from *The quantitative single-neuron modeling competition*. In this experiments a cortical pyramidal neuron was stimulated by injection of randomly fluctuating currents of various amplitudes. Current was injected and voltage responses were recorded at the soma. For more details, see Fig. 1 of Jolivet et al., **The quantitative single-neuron modeling competition** Biol Cybern (2008) 99:417–426.

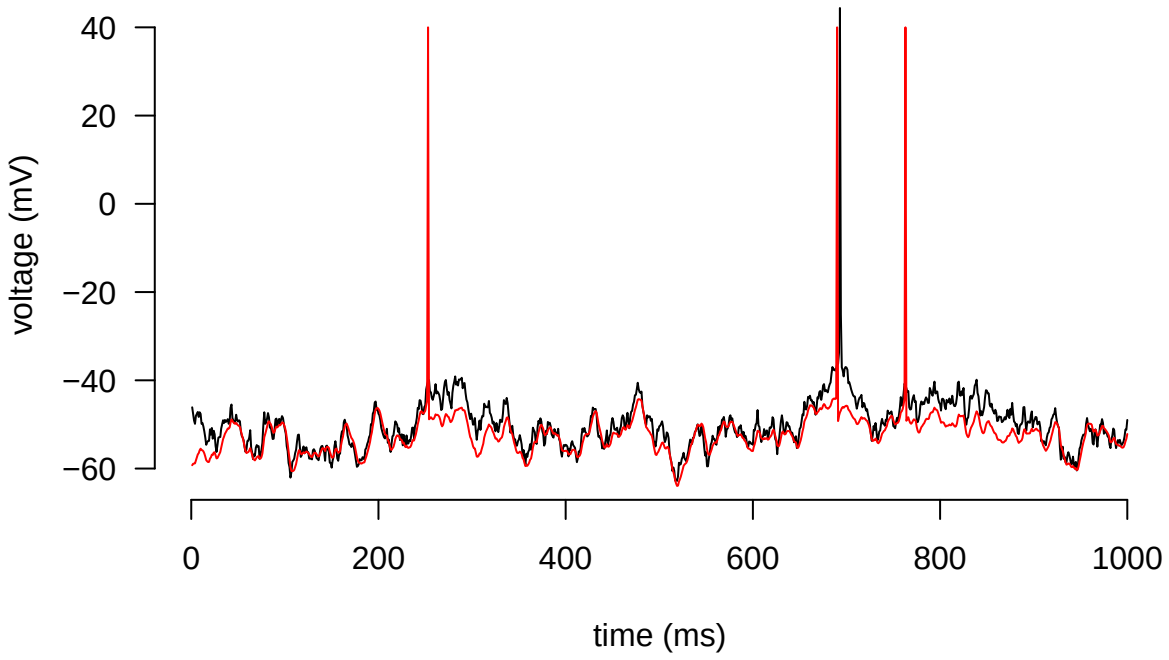
The experimental data is loaded from the `Data` folder - Jolivet_resp.RData and `Jolivet_stim.RData`. First we load the data and hen plot a short example of it.

```
load("Data/Jolivet_stim.RData")
load("Data/Jolivet_resp.RData")
matplot(t(resp[1:4+4,3000:4000] - c(0, 1, 2, 3)*100), t="l", lty=1, axes=F, xlab="time (ms)", ylab="vol
```



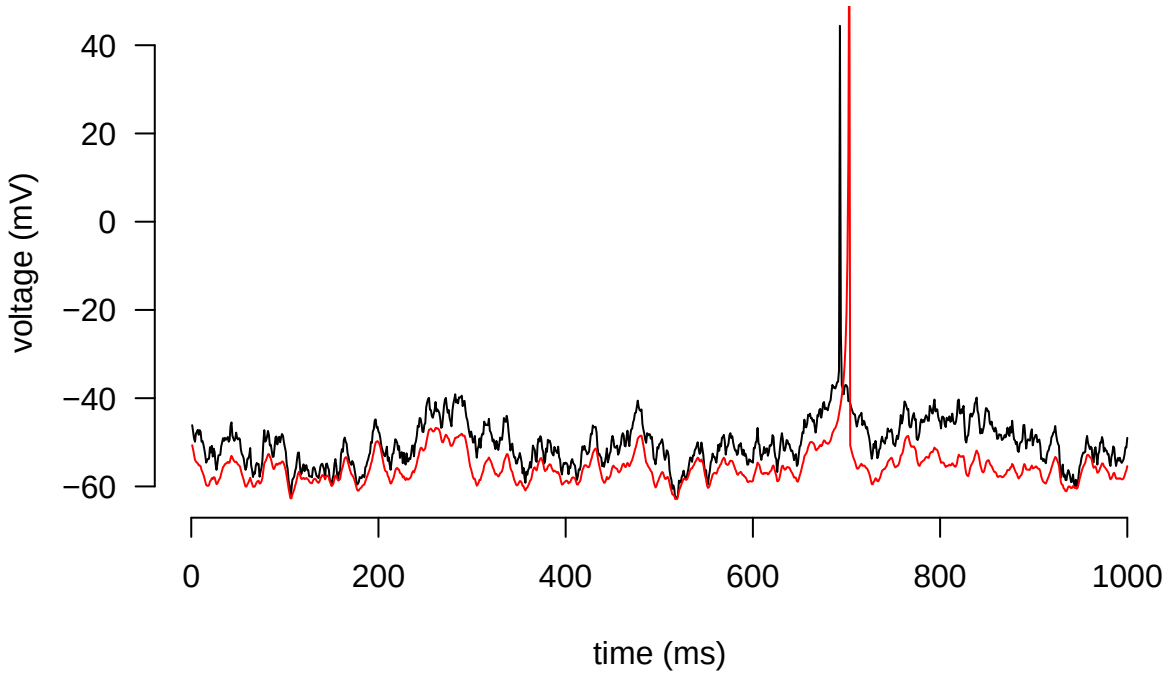
Next, we select a 1s long portion of the data - both the stimulus and the response. We will inject the same current to an integrate and fire neuron and record its response.

```
r.cell <- resp[9,3001:4000 ]
input <- stim[9, 3001:4000]
v.IF <- sim.IF(I=input, v.rest=-60, Rm=0.045, tau=10, v.threshold=-44, v.reset=-50)
plot(r.cell, t="l", lty=1, axes=F, xlab="time (ms)", ylab="voltage (mV)"); axis(1); axis(2, las=2)
lines(v.IF, col=2)
```



We repeat the same experiment now using an Izhikevich neuron.

```
v.Iz <- sim.Izhikevich(I=input, Rm=0.045, tau=10, v.init=-50)
plot(r.cell, t="l", lty=1, axes=F, xlab="time (ms)", ylab="voltage (mV)"); axis(1); axis(2, las=2)
lines(v.Iz, col=2)
```



We repeat the same experiment now using a Hodgkin-Huxley cell.

```
I.ext <- approxfun(1:1000, input/1000/1000/10, method = "linear", rule = 2) # this is necessary to prov
params <- c(gK=gK, gNa=gNa, gL=gL, cm=cm, E.Na=E.Na, E.K=E.K, E.L=E.L) # parameters of the system.
state <- c(v=-65, m=.053, h=.596, n=.317) # initial state of the system
times <- 1:1000
v.HH <- ode(y = state, times = times, func = sim.HH, parms = params)
```

```
plot(r.cell, t="l", lty=1, axes=F, xlab="time (ms)", ylab="voltage (mV)"); axis(1); axis(2, las=2)
lines(v.HH[,1], v.HH[,2], col=2)
```