

```
1 %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
2 %%% fitzhugh function %%%
3 %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
4 function dydt = fitzhugh(t,y,a,b,c,I)
5
6 % voltage variable
7 v = y(1);
8
9 % refractory variable
10 w = y(2);
11
12 % define the 2d system
13 dv = -v^3 + (1+a)*v^2 -a*v -w + I;
14 dw = b*v-c*w;
15 dydt = [dv;dw];
16
17 %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
18 %%% runfitzhugh script %%%
19 %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
20 % a = 0.1; periodic
21 % a = 0.2; subthreshold
22 % a = 0.3; single spike
23 a = 0.3;
24 b = 0.01;
25 c = 0.01;
26
27 % input current
28 I=0.1;
29
30 vinit = 0.2; winit =0;T=400; deltaT = 0.05;
31
32 %set error bounds for integration
33 options=odeset('RelTol',10^(-10),'AbsTol',[10^(-10)*ones(1,2)]);
34
35 % use ode45 to solve the odes
36 [t,result] = ode15s(@(t,var) ...
37     fitzhugh(t,var,a,b,c,I),[0:deltaT:T-deltaT],[vinit winit],op
38
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```
39 v = result(:,1);
40 w = result(:,2);
41
42 % refractory var as a function of time
43 figure(1);
44 set(gca,'FontSize',18);
45 hold on; box on;
46 plot(t,w,'Color',[0 0 1]);
47 xlabel('t');ylabel('w')
48
49 % voltage as a function of time
50 figure(2);
51 set(gca,'FontSize',18);
52 hold on; box on;
53 plot(t,v,'Color',[0 0 1]);
54 xlabel('t');ylabel('v')
55
56 % phase space
57 figure(3);
58 set(gca,'FontSize',18);
59 plot(v,w);
60
61 % draw nulclines
62 hold on;
63 vval = [-2:0.01:2];
64
65 wl1 = -vval.^3 + (1+a)*vval.^2 -a*vval +I;
66 wl2 = b/c*vval;
67
68 plot(vval,wl1,'r');
69 plot(vval,wl2,'m');
70
71 axis([-0.4 1.2 -0.1 0.4])
72 xlabel('v');ylabel('w')
73
```