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function twocell_nonoise
clc
clear all
close all

% -----
% ----- CONSTANTS -----
% -----
% Molecules (RR):           Coupling, delay (MM):
% 1: pher1                  1: uncoupled
% 2: pher7                  2: coupled, Tn = 36min
% 3: pdeltac                3: coupled, Tn = 56min
% 4: mher1
% 5: mher7
% 6: mdeltac

lag1 = [2.8, 1.7, 20.5, 12.6, 7.1, 16];
lag2 = lag1;
lag2([1,2,4,5])=0.9*lag2([1,2,4,5]); % create a 10% lag in her1, her7
lag = [lag1, lag2]; % lag = cell11, cell12

bPrintOnFile = 0; % 0 = false, 1 = true
RR = 6; % which molecule do you want?
MM = 1; % coupled, uncoupled, Tn?
tfinal = 1000; % tspan : tfinal

herr = {'pher1','pher7','pdeltac','mher1','mher7','mdeltac'};
arr = {'uncoupled','C36','C56'};
arrr = {'no coupling','coupled, Tn = 36 min','coupled, Tn = 56 min'};
strFilePath = ['C:\\SYSBIO\\fig4_',herr{RR},'_normal_',arr{MM}];
ttl = [herr{RR},', ',arrr{MM}];

if MM~=1
    s=[0,0,1,0];
    r=[0,0,0,1];
    if MM==3
        lag(6)=36;
    end
else
    s=[0,0,1,0];
    r=[0,0,1,0];
end
func = @(t,y,Z)ddefun(t,y,Z,r,s);
sol = dde23(func,lag,@ddehist,[0, tfinal]);

tint = linspace(0,tfinal,5000);
yint = deval(sol,tint);

if (bPrintOnFile)
    figure('Visible','off')
else
    figure
end

% determine plotted molecules!
plot(tint,yint(RR,:),tint,yint(RR+6,:));
% -----
title(ttl)
if RR<=3
    ylb = 'protein';
else

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        ylb = 'mRNA';
    end
    Ylabel(ylb)
    ylim([0 150])
    set(gca, 'YTick', 0:30:150)
    set(gca, 'XTick', 0:200:1000, 'XTickLabel', {'0', '200', '400', '600', '800', 'time (min)'});
    set(gcf, 'Units', 'centimeters');
    afFigurePosition = [5 5 20 6];
    set(gcf, 'Position', afFigurePosition);
    set(gcf, 'PaperPositionMode', 'auto');
    set(gca, 'Units', 'normalized', 'Position', [0.15 0.2 0.75 0.7]);

    if (bPrintOnFile)
        print('-dpng', '-loose', sprintf('-r%d', 300), strcat(strFilePath, '.png'));
    end

function dydt = ddefun(t,y,Z,r,s)
    ylag1 = Z(:,1);
    ylag2 = Z(:,2);
    ylag3 = Z(:,3);
    ylag4 = Z(:,4);
    ylag5 = Z(:,5);
    ylag6 = Z(:,6);
    ylag7 = Z(:,7);
    ylag8 = Z(:,8);
    ylag9 = Z(:,9);
    ylag10 = Z(:,10);
    ylag11 = Z(:,11);
    ylag12 = Z(:,12);

    a = 4.5;
    b = 0.23;
    c = 0.23;

    % ---cell 1-----
    % Ph1: dydt(1) = a*mh1(t-delayph1) - b*ph1(t);
    % ph7: dydt(2) = a*mh1(t-delayph7) - b*ph7(t);
    % pd : dydt(3) = a*md(t-deplaypd) - b*pd(t);
    % mh1: dydt(4) = fh1(.....) - c*mh1(t);
    % mh7: dydt(5) = fh7(.....) - c*mh7(t);
    % md : dydt(6) = fd(.....) - c*md(t);
    % ----cell 2-----
    % Ph1: dydt(7) = a*mh1(t-delayph1) - b*ph1(t);
    % ph7: dydt(8) = a*mh1(t-delayph7) - b*ph7(t);
    % pd : dydt(9) = a*md(t-deplaypd) - b*pd(t);
    % mh1: dydt(10) = fh1(.....) - c*mh1(t);
    % mh7: dydt(11) = fh7(.....) - c*mh7(t);
    % md : dydt(12) = fd(.....) - c*md(t);

    dydt = [ a*ylag1(4)-b*y(1)
              a*ylag2(5)-b*y(2) % be aware it is mh1 or mh7
              a*ylag3(6)-b*y(3)
              ffh(ylag4(1),ylag4(2),ylag4(9),r)-c*y(4)
              ffh(ylag5(1),ylag5(2),ylag5(9),r)-c*y(5)
              ffd(ylag6(1),ylag6(2),ylag6(9),s)-c*y(6)
              a*ylag7(10)-b*y(7)
              a*ylag8(11)-b*y(8)
              a*ylag9(12)-b*y(9)
              ffh(ylag10(7),ylag10(8),ylag10(3),r)-c*y(10)
              ffh(ylag11(7),ylag11(8),ylag11(3),r)-c*y(11)
              ffd(ylag12(7),ylag12(8),ylag12(3),s)-c*y(12)];

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% -----
function s = ddehist(t)
% Constant history function for dde23.
s = zeros(12,1);

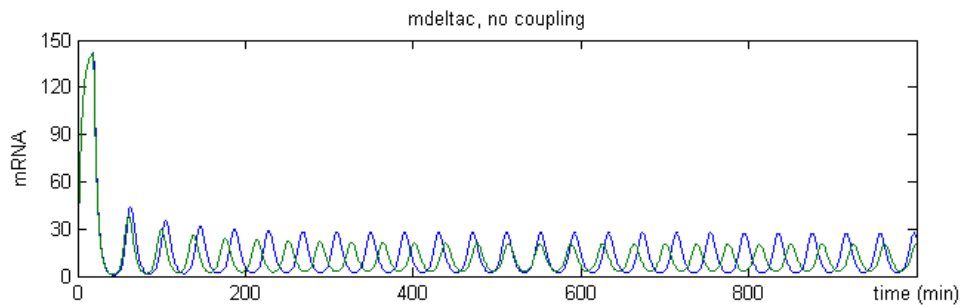
function f = ffh(ph1,ph7,pd,r)
% ffh function to calculate the f for her1 and her7
k=33;
p0h=40;
p0d=1000;
tD = pd/p0d;
tH1= ph1/p0h;
tH7= ph7/p0h;

f=k*(r(1)+r(2)*(tD/(1+tD))+r(3)*(1/(1+tH1*tH7)) ...
    + r(4)*(tD/(1+tD))*(1/(1+tH1*tH7)));

function f = ffd(ph1,ph7,pd,s)
% ffd function to calculate the f for deltaC
k=33;
p0h=40;
p0d=1000;
tD = pd/p0d;
tH1= ph1/p0h;
tH7= ph7/p0h;

f=k*(s(1)+s(2)*(tD/(1+tD))+s(3)*(1/(1+tH1*tH7)) ...
    + s(4)*(tD/(1+tD))*(1/(1+tH1*tH7)));

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