Table of Contents


```
% Projet d'optimisation

xi ;
yi ;

%clear; close all; clc %clear efface le workspace, close all ferme les
close all; clc

dbtype('ctls.m') ;
dbtype('grad_ctls.m') ;
dbtype('fletcher.m');
dbtype('quasi_newton.m');

ctls(0.2,0.2,xi,yi) ;

cx = linspace(-1,1,100); % Valeur prise par Cx
cy = linspace(-1,2,100); % Ensemble de valeur prise par Cy


% Intervalle -1 4
cx2 = linspace(-1,4,200);
cy2 = linspace(-1,4,200);


epsilon = zeros(100,100) ; % Premier intervalle

epsilon2 = zeros(200,200) ; % Second intervalle

for j = 1:100
    for k = 1: 100
        %epsilon = [epsilon, ctls( cx(j),cy(k),xi,yi ) ];
        epsilon(j,k) = ctls( cx(j),cy(k),xi,yi ) ;
    end

end


for j = 1:200
```

```
    for k = 1:200
        %epsilon = [epsilon, ctls( cx(j),cy(k),xi,yi ) ];
        epsilon2(j,k) = ctls( cx2(j),cy2(k),xi,yi ) ;
    end
end


% figure;
%     surf( cx,cy,epsilon)
% figure;
%     surf( cx2,cy2,epsilon2)


figure;
    contour( cx,cy,epsilon,100)
    xlabel ('cx')
    ylabel ('cy')
    axis equal
figure;
    contour( cx2,cy2,epsilon2,100)
    xlabel ('cx')
    ylabel ('cy')
    axis equal




% On remarque l'existence d'un maximum local, mais nous recherchons un/des
% minimums locaux/globaux

% On étudie la fonction sur deux intervalles différents, donc pour le
% graphe n2 on observe dans les valeurs de l'écart (la fonction de cout)
% De plus le nombre de points pour l'intervalle [-1,4] est identique que
% pour l'intervalle [-1 1] donc le graphe est moins précis
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

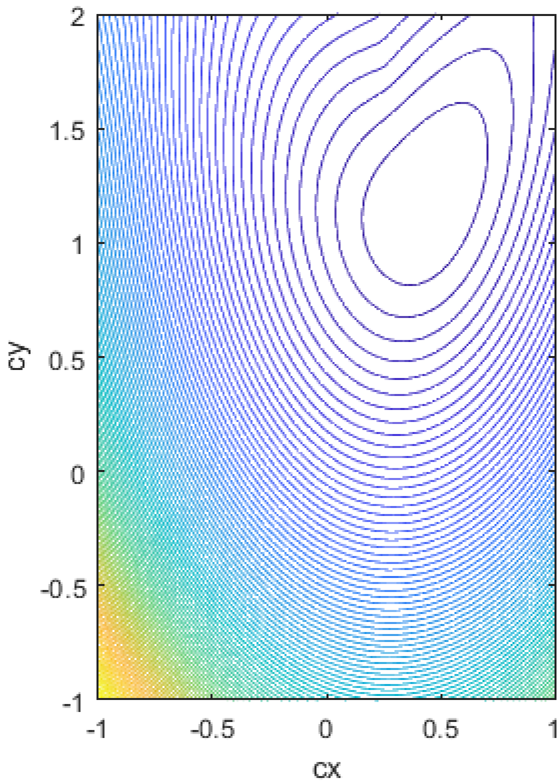
```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;
```

```

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

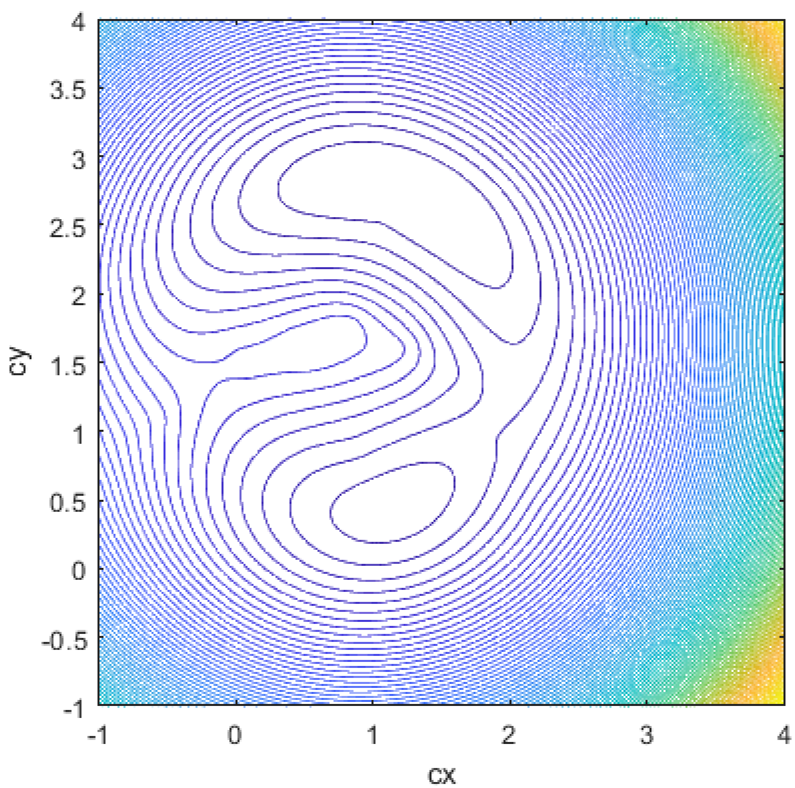
```


    %function[s]=fletcher_function(cx,cy,xi,yi,epsilon,cxo,cyo)
    function[s]=fletcher(cx,cy,a,d,xi,yi) % d est un doublet cx, cy
        dbtype('grad_ctls.m') ;
        dbtype('ctls.m') ;

        al = 0 ; % alpha left
        ar = inf ; % alpha right

        lambda = 20 ;

        B1 = 10^-3 ;
        B2 = 0.99 ;
        %y = 0 ; % : Gamma On le déclare et on lui donne sa valeur

        % Nous devons calculer gamma à partir de a,B1,B2, d est moins le
        % gradient

        y = -B1*(grad_ctls(cx,cy,xi,yi)') * d; % Il faut que d soit un vecteur colonne



        % Condition de Wolf 1 et Wolf 2 Il vaut mieux faire un while
        while (ctls(cx+a*d(1),cy+a*d(2),xi,yi) > ctls(cx,cy,xi,yi) - a*y ) || ((grad_ctls(cx+a*d(1),cy+a*d(2),xi,yi)')*d/((grad_ctls(cx,cy,xi,yi)')*d) > B2  ) % On calcule la fonction de cout et on vérifie

            % Condition de Wolf 1
            if(ctls(cx+a*d(1),cy+a*d(2),xi,yi) <= ctls(cx,cy,xi,yi) - a*y ) % Si la condition de Wolf 1 est respectée
                al = a;
                    if(ar >= inf )
                        a = lambda*a ;
                    else
                        a = (al+ar)/2 ;
                    end
            else % Si elle n'est pas respectée
```

```
                ar = a ;
                a = (al + ar)/2 ;
            end
        end
        s = a ;
    end
```

```
    function[s,result,counter]=quasi_newton(cx,cy,xi,yi,epsilon_newton) % d est un doublet cx, cy
        dbtype('grad_ctls.m') ;
        dbtype('ctls.m') ;
        dbtype('fletcher.m')
        % On initialise la matrice Hk à 0
        % Attention dans ce code je choisit la notation Hk mais ici en réalité
        % nous avons Hk^-1 c'est la matrice inverse de Hk

        I = eye(2);
        alpha = 1 ;
        Hk = eye(2); % On doit avoir une matrice de taille 2
        disp(Hk)
        result = [] ;
        counter = 0 ;


        Grad_fk = grad_ctls(cx,cy,xi,yi)

        while (norm(Grad_fk)>epsilon_newton)
            Grad_fk = grad_ctls(cx,cy,xi,yi)
            dk = -Hk*Grad_fk ;

            alpha = fletcher(cx,cy,alpha,dk,xi,yi);

            cx = cx + alpha*dk(1) ;
            cy = cy + alpha*dk(2) ;

            Grad_fk1 = grad_ctls(cx,cy,xi,yi) ;

            yk = Grad_fk1 - Grad_fk ;

            dk_ = alpha*dk ; % dk barre On peut aussi l'écrire comme la différence des xk+1 xk

            Hk = (I - dk_*(yk')/((dk_')*yk) )*Hk*(I- yk*(dk_')/((dk_')*yk) ) + dk_*(dk_')/((dk_')*yk) ;

            result = [result;[cx,cy]] ;
            counter = counter + 1
        end
        s = [cx,cy] ;

    end
```



2
1.5
1
0.5
0
-0.5
-1
cy
-1
-0.5
0
0.5
1
cx



4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
-1
cy
-1
0
1
2
3
4
cx

Question 2

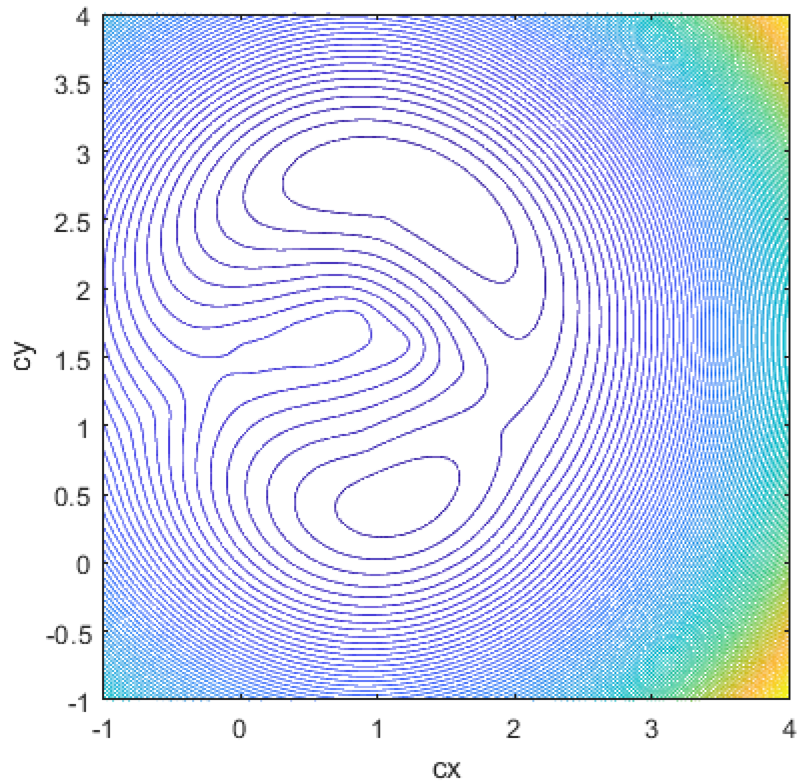
```
[min_cx,min_cy]=find(epsilon==min(epsilon(:)));
%cx(min_cx)
%disp(" LE Minimum de cy est :")
%cy(min_cy)

% On calcule un minimum de : 17.1935 pour cx = 0.4545 et cy = 1.1515 avec
% 100points


[min_cx2,min_cy2]=find(epsilon2==min(epsilon2(:)));

disp("Le Minimum de cx2 est :")
cx2(min_cx2)
disp("Le Minimum de cy2 est :")
cy2(min_cy2)

% On calcule un minimum de l'écarrt : 14.0446 pour cx2 = 2.6869 et cy =
% 1.3737 avec 100points

figure;
    plot(xi,yi,'+')
    %plot([cx(min_cx),cy(min_cy)])
    viscircles([0.4545,1.1515],1.5)
    viscircles([2.6869,1.3737],1.5)



% Le centre obtenu au second cercle semble cohérent, dû à la présence
% d'outlayer (le point tout à droite) est excentré donc à un "poiids" plus
% grand donc contribue à décaler le minimum global


% Ppour un intervalle de taille [-1,1]*[-1,2] On a besoin de
% (2/10^-4)*(3/10^-4) donc 600 Millions de valeurs

% Ppour un intervalle de taille [-1,4]*[-1,4] On a besoin de
% (5/10^-4)*(5/10^-4) donc 2.5 Milliards de valeurs

% On sait que pour chaque couple cx,cy on doit évaluer la fonction pour R
% [0.5,2.5]. On veut une précision de 10-4 près donc on doit multiplier le nom
% nombre d'évaluation de la fonction de coût que l'on a déterminé précédemment
 par 20 000.

% Nous allons donc chercher à trouver des algorithmes d'optimisations pour
% réduire le nombre d'évaluations de la fonciton de coût à réaliser
```

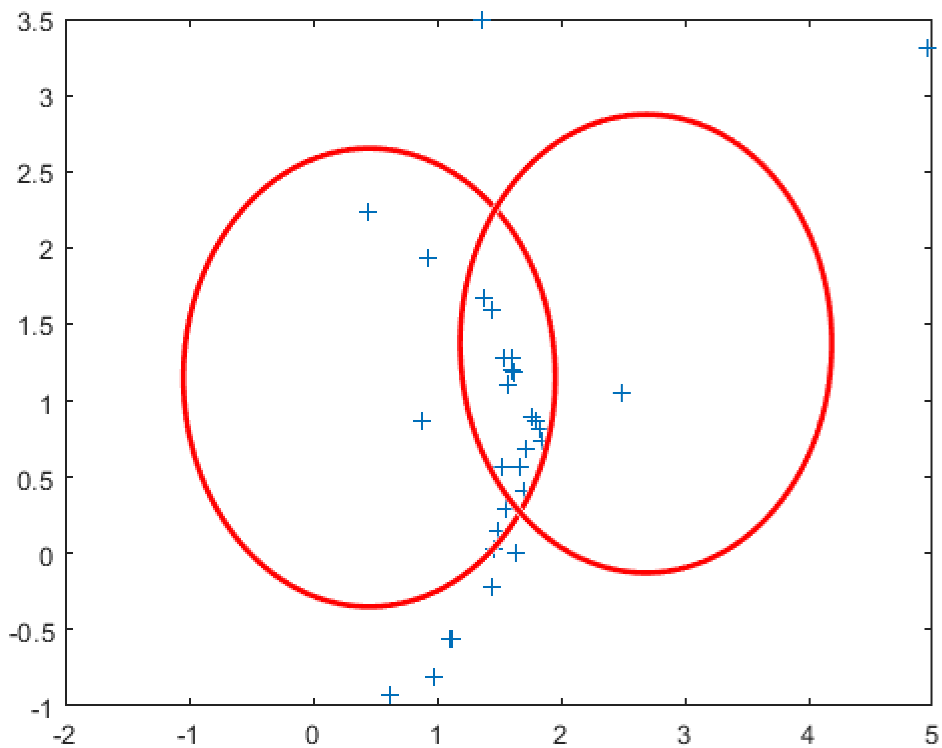
Le Minimum de cx2 est :

ans =

    2.7186

```
Le Minimum de cy2 est :

ans =

    1.3367


ans =

  Group with properties:

    Children: [2×1 Line]
     Visible: on
     HitTest: on

  Use GET to show all properties


ans =

  Group with properties:

    Children: [2×1 Line]
     Visible: on
     HitTest: on

  Use GET to show all properties
```


4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
-1
cy
-1
0
1
2
3
4
cx


3.5
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-2
-1
0
1
2
3
4
5

Question 3

Cf. feuille

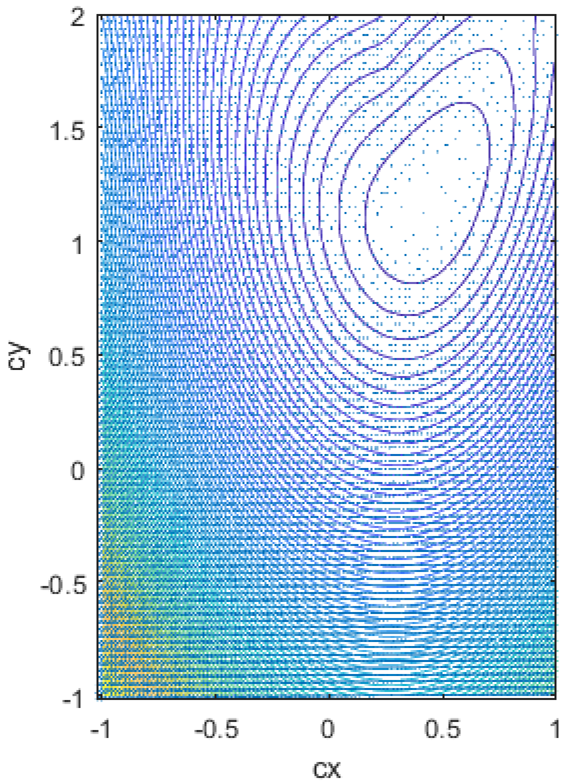
Question 4

```
%
%  [FX,FY] = gradient(ctls) ;
%
% FX(-1,-1,xi,yi)
% FY(-1,-1,xi,yi)
%

h = 10^(-8) ;


vtiq_cx = (ctls(-3+h,-2,xi,yi)-ctls(-3,-2,xi,yi) ) / h ;% Composante selon cx
vtiq_cy = (ctls(-3,-2+h,xi,yi)-ctls(-3,-2,xi,yi) ) / h ;% Composante selon cy
vexp = grad_ctls(-3,-2,xi,yi) ;

e_cx = (vtiq_cx - vexp(1))/vtiq_cx  % Ecart relatif
e_cy = (vtiq_cy - vexp(2))/vtiq_cy  % Ecart relatif


% Le calcul du gradient semble cohérent avec le calcul du gradient par
% difféerence fini


e_cx =

  -2.2779e-08


e_cy =

   1.1242e-08
```

Question 5

```
% On calcule lors de l'échantillonnage régulier

epsilon3 = zeros(100,100) ; % Premier intervalle
grad_epsilon3_cx = zeros(100,100) ; % Gradient selon cx
grad_epsilon3_cy = zeros(100,100) ; %  GRadient selon cy


epsilon3 = zeros(200,200) ; % Second intervalle

for j = 1:100
    for k = 1: 100
        epsilon3(j,k) = ctls( cx(j),cy(k),xi,yi ) ;
```

```
        %grad_epsilon3_cx(j,k) = grad_ctls(cx(j),cy(k),xi,yi)(1) ; % C'est une
 matrice de vecteur normalement
        %grad_epsilon3_cy(j,k) = grad_ctls(cx(j),cy(k),xi,yi)(2) ;

        G = grad_ctls(cx(j),cy(k),xi,yi); % On doit passer par une variable
 intermédiaire car lorsque le tableau est en lecture il ne peut pas etre en
 écriture au meme moment

        grad_epsilon3_cx(j,k) = G(1);
        grad_epsilon3_cy(j,k) = G(2);

    end

end

figure;
    contour( cx,cy,epsilon,100)
    xlabel ('cx')
    ylabel ('cy')
    axis equal
    hold on


    quiver(cx,cy,grad_epsilon3_cx,grad_epsilon3_cy);
    axis equal;

    hold off

% Plus le gradient
```



Question 6 Méthode de Fletcher le Maréchal

```
% Il faut que notre fonction gradient renvoie un vecteur colonne IMPORTANT

% ON CHERCHE LA DIRECTION Dk à xk fixé .On se servira surement du
 gradient_ctls
% On évalue le minimum de alpha tel que f(xk + alpha*dk)
% On calcule xk+1

% On vérifie que le gradient évaluée en xk ||Nabla(xk)|| <= v epsilon. Si ce
 n'est pas le cas on recommence

cxk = 2 ; % Première approximation du minimum en cx
cyk = 2 ; % Première approximation du minimum en cy

%a = 50 ;
b = 50 ;
d = -grad_ctls(0.5,0.5,xi,yi)
y = 0.5
%dbtype('fletcher.m');

% Il faut tester avec des valeurs opposées au gradient
d  = -grad_ctls(0.5,0.5,xi,yi)
```

```
fletcher(0.5,0.5,10^-6,-grad_ctls(0.5,0.5,xi,yi),xi,yi)  % Calcul de alpha
%fletcher_complet(0,3,10^-3,xi,yi,10^-4)


% ON utilise FLETCHER_Le_Marechal avec les coordonnées de départ (0.5,0.5)
[b, it, i] = fletcher_complet(-0.5,-0.5,10^-3,xi,yi,10^-4)

% Question 6.1 On représente l'ens des points
figure ;
    contour(cx2,cy2,epsilon2', 100)
    hold on
    axis equal

    plot(it(:,1), it(:,2))
    hold off
```

```
d =

   -2.7379
    7.5389


y =

    0.5000


d =

   -2.7379
    7.5389
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
```

```
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
ans =

    0.0080
```

```


    %function[s]=fletcher_function(cx,cy,xi,yi,epsilon,cxo,cyo)
    function[s]=fletcher(cx,cy,a,d,xi,yi) % d est un doublet cx, cy
        dbtype('grad_ctls.m') ;
        dbtype('ctls.m') ;

        al = 0 ; % alpha left
        ar = inf ; % alpha right

        lambda = 20 ;

        B1 = 10^-3 ;
        B2 = 0.99 ;
        %y = 0 ; % : Gamma On le déclare et on lui donne sa valeur

        % Nous devons calculer gamma à partir de a,B1,B2, d est moins le
        % gradient

        y = -B1*(grad_ctls(cx,cy,xi,yi)') * d; % Il faut que d soit un vecteur colonne



        % Condition de Wolf 1 et Wolf 2 Il vaut mieux faire un while
        while (ctls(cx+a*d(1),cy+a*d(2),xi,yi) > ctls(cx,cy,xi,yi) - a*y ) || ((grad_ctls(cx+a*d(1),cy+a*d(2),xi,yi)')*d/((grad_ctls(cx,cy,xi,yi)')*d) > B2  ) % On calcule la fonction de cout et on vérifie

            % Condition de Wolf 1
            if(ctls(cx+a*d(1),cy+a*d(2),xi,yi) <= ctls(cx,cy,xi,yi) - a*y ) % Si la condition de Wolf 1 est respectée
                al = a;
                    if(ar >= inf )
                        a = lambda*a ;
                    else
```

```
                a = (al+ar)/2 ;
            end
        else % Si elle n'est pas respectée
            ar = a ;
            a = (al + ar)/2 ;
        end
    end
    s = a ;
end
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;
    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;
    for k = 1:length(xi)
        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
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    R = 1.5 ;
    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;
    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
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    R = 1.5 ;
    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;
    for k = 1:length(xi)
```

```
            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
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        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
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    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
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    end
end
```

```
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    %syms k ;
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    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
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    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
```

```
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
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function[d]=grad_ctls(cx,cy,xi,yi)
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    end
end
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    for k = 1:30
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    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;
```

```

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

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        end
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    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
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        R = 1.5 ;

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    n = length(xi) ;
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        %syms k ;
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        n = length(xi) ;
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        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

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            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
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    end
```

```
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        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
```

```
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
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            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
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    end
```

```
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        end
    end
```

```
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        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
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```

```
        n = length(xi) ;
        d = [0;0] ;
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        %syms k ;
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    end
```

```
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        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
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    end
```

```
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            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
```

```
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
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    end
end

function[d]=ctls(cx,cy,xi,yi)
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    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
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end

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    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)
```

```

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
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```

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        end
    end
```

```
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        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
```

```
end

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    %syms k ;
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        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
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        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
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    R = 1.5 ;

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        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
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end
```


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    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
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```


```
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    R = 1.5 ;

    %syms k ;
```

```
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

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            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
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```

```
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        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
b =

    0.4496    1.1563


it =

   -0.5000   -0.5000
   -0.4498   -0.4603
   -0.4025   -0.4224
   -0.3580   -0.3861
   -0.3160   -0.3513
   -0.2764   -0.3180
   -0.2391   -0.2860
   -0.2039   -0.2553
   -0.1707   -0.2258
   -0.1394   -0.1975
   -0.1097   -0.1701
   -0.0818   -0.1438
   -0.0553   -0.1184
   -0.0303   -0.0939
   -0.0067   -0.0702
    0.0157   -0.0474
    0.0368   -0.0253
    0.0569   -0.0039
    0.0758    0.0168
    0.0938    0.0369
```

0.1107	0.0563
0.1268	0.0752
0.1421	0.0935
0.1565	0.1112
0.1702	0.1284
0.1831	0.1452
0.1954	0.1615
0.2070	0.1773
0.2180	0.1927
0.2285	0.2077
0.2384	0.2224
0.2477	0.2366
0.2566	0.2505
0.2650	0.2640
0.2730	0.2772
0.2805	0.2901
0.2877	0.3027
0.2944	0.3150
0.3008	0.3270
0.3069	0.3387
0.3126	0.3502
0.3180	0.3614
0.3232	0.3724
0.3280	0.3832
0.3326	0.3937
0.3369	0.4040
0.3410	0.4141
0.3449	0.4240
0.3485	0.4338
0.3520	0.4433
0.3552	0.4526
0.3583	0.4618
0.3612	0.4708
0.3639	0.4796
0.3664	0.4883
0.3688	0.4968
0.3711	0.5052
0.3732	0.5134
0.3752	0.5215
0.3771	0.5294
0.3789	0.5373
0.3805	0.5449
0.3821	0.5525
0.3835	0.5599
0.3849	0.5673
0.3861	0.5745
0.3873	0.5816
0.3884	0.5886
0.3895	0.5955
0.3904	0.6022
0.3913	0.6089
0.3922	0.6155
0.3929	0.6220
0.3936	0.6284

0.3943	0.6347
0.3949	0.6409
0.3955	0.6470
0.3960	0.6531
0.3965	0.6590
0.3970	0.6649
0.3974	0.6707
0.3977	0.6765
0.3981	0.6821
0.3984	0.6877
0.3987	0.6932
0.3990	0.6986
0.3992	0.7040
0.3994	0.7093
0.3996	0.7145
0.3998	0.7197
0.4000	0.7248
0.4001	0.7298
0.4002	0.7348
0.4004	0.7397
0.4005	0.7445
0.4006	0.7493
0.4007	0.7540
0.4007	0.7587
0.4008	0.7633
0.4009	0.7679
0.4009	0.7724
0.4010	0.7768
0.4010	0.7812
0.4011	0.7856
0.4011	0.7899
0.4012	0.7941
0.4012	0.7983
0.4013	0.8025
0.4013	0.8066
0.4014	0.8106
0.4014	0.8146
0.4014	0.8186
0.4015	0.8225
0.4015	0.8263
0.4016	0.8301
0.4016	0.8339
0.4017	0.8377
0.4017	0.8413
0.4018	0.8450
0.4018	0.8486
0.4019	0.8521
0.4020	0.8557
0.4020	0.8591
0.4021	0.8626
0.4022	0.8660
0.4023	0.8693
0.4024	0.8727
0.4025	0.8759

0.4025	0.8792
0.4026	0.8824
0.4028	0.8856
0.4029	0.8887
0.4030	0.8918
0.4031	0.8948
0.4032	0.8979
0.4033	0.9009
0.4035	0.9038
0.4036	0.9067
0.4037	0.9096
0.4039	0.9125
0.4040	0.9153
0.4042	0.9181
0.4043	0.9208
0.4045	0.9236
0.4046	0.9263
0.4048	0.9289
0.4050	0.9316
0.4051	0.9342
0.4053	0.9367
0.4055	0.9393
0.4057	0.9418
0.4059	0.9443
0.4061	0.9467
0.4063	0.9491
0.4064	0.9515
0.4066	0.9539
0.4068	0.9562
0.4071	0.9586
0.4073	0.9609
0.4075	0.9631
0.4077	0.9653
0.4079	0.9676
0.4081	0.9697
0.4083	0.9719
0.4086	0.9740
0.4088	0.9761
0.4090	0.9782
0.4092	0.9803
0.4095	0.9823
0.4097	0.9843
0.4099	0.9863
0.4102	0.9883
0.4104	0.9902
0.4106	0.9921
0.4109	0.9940
0.4111	0.9959
0.4114	0.9978
0.4116	0.9996
0.4119	1.0014
0.4121	1.0032
0.4123	1.0050
0.4126	1.0067

0.4128	1.0084
0.4131	1.0101
0.4133	1.0118
0.4136	1.0135
0.4138	1.0151
0.4141	1.0168
0.4143	1.0184
0.4146	1.0200
0.4148	1.0215
0.4151	1.0231
0.4153	1.0246
0.4156	1.0261
0.4158	1.0276
0.4161	1.0291
0.4163	1.0306
0.4166	1.0320
0.4168	1.0335
0.4171	1.0349
0.4173	1.0363
0.4176	1.0376
0.4178	1.0390
0.4181	1.0404
0.4183	1.0417
0.4186	1.0430
0.4188	1.0443
0.4191	1.0456
0.4193	1.0469
0.4196	1.0481
0.4198	1.0494
0.4201	1.0506
0.4203	1.0518
0.4206	1.0530
0.4208	1.0542
0.4210	1.0554
0.4213	1.0565
0.4215	1.0577
0.4217	1.0588
0.4220	1.0599
0.4222	1.0610
0.4225	1.0621
0.4227	1.0632
0.4229	1.0643
0.4232	1.0653
0.4234	1.0664
0.4236	1.0674
0.4238	1.0684
0.4241	1.0694
0.4243	1.0704
0.4245	1.0714
0.4247	1.0724
0.4250	1.0733
0.4252	1.0743
0.4254	1.0752
0.4256	1.0761

0.4258	1.0771
0.4261	1.0780
0.4263	1.0789
0.4265	1.0797
0.4267	1.0806
0.4269	1.0815
0.4271	1.0823
0.4273	1.0832
0.4275	1.0840
0.4277	1.0848
0.4279	1.0857
0.4281	1.0865
0.4283	1.0873
0.4285	1.0880
0.4287	1.0888
0.4289	1.0896
0.4291	1.0904
0.4293	1.0911
0.4295	1.0918
0.4297	1.0926
0.4299	1.0933
0.4301	1.0940
0.4303	1.0947
0.4305	1.0954
0.4306	1.0961
0.4308	1.0968
0.4310	1.0975
0.4312	1.0982
0.4314	1.0988
0.4315	1.0995
0.4317	1.1001
0.4319	1.1008
0.4321	1.1014
0.4322	1.1020
0.4324	1.1026
0.4326	1.1032
0.4328	1.1038
0.4329	1.1044
0.4331	1.1050
0.4332	1.1056
0.4334	1.1062
0.4336	1.1068
0.4337	1.1073
0.4339	1.1079
0.4340	1.1084
0.4342	1.1090
0.4344	1.1095
0.4345	1.1100
0.4347	1.1106
0.4348	1.1111
0.4350	1.1116
0.4351	1.1121
0.4353	1.1126
0.4354	1.1131

0.4355	*1.1136*
0.4357	*1.1141*
0.4358	*1.1146*
0.4360	*1.1150*
0.4361	*1.1155*
0.4362	*1.1160*
0.4364	*1.1164*
0.4365	*1.1169*
0.4366	*1.1173*
0.4368	*1.1178*
0.4369	*1.1182*
0.4370	*1.1186*
0.4372	*1.1190*
0.4373	*1.1195*
0.4374	*1.1199*
0.4376	*1.1203*
0.4377	*1.1207*
0.4378	*1.1211*
0.4379	*1.1215*
0.4380	*1.1219*
0.4382	*1.1223*
0.4383	*1.1227*
0.4384	*1.1231*
0.4385	*1.1234*
0.4386	*1.1238*
0.4387	*1.1242*
0.4389	*1.1245*
0.4390	*1.1249*
0.4391	*1.1252*
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        1048
```
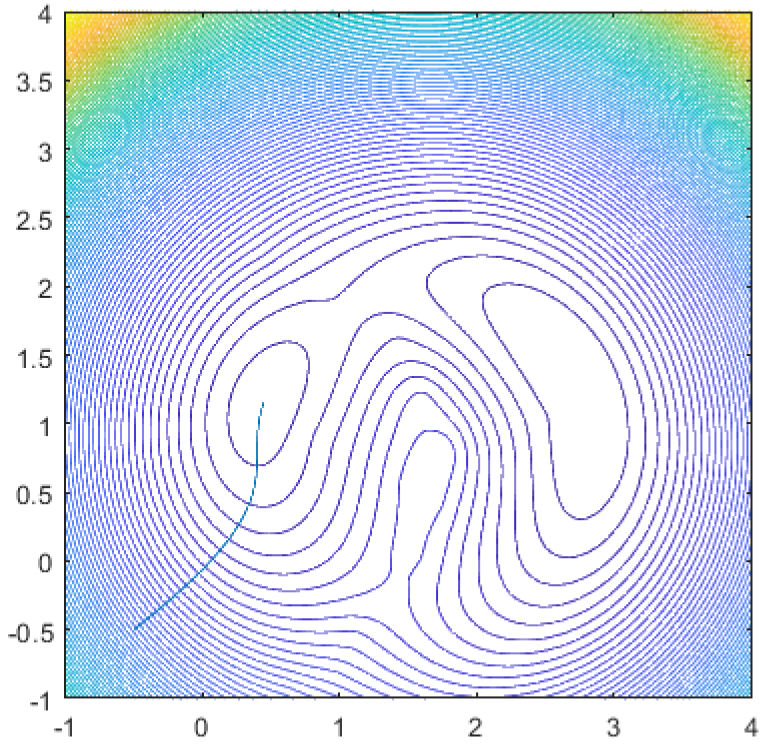



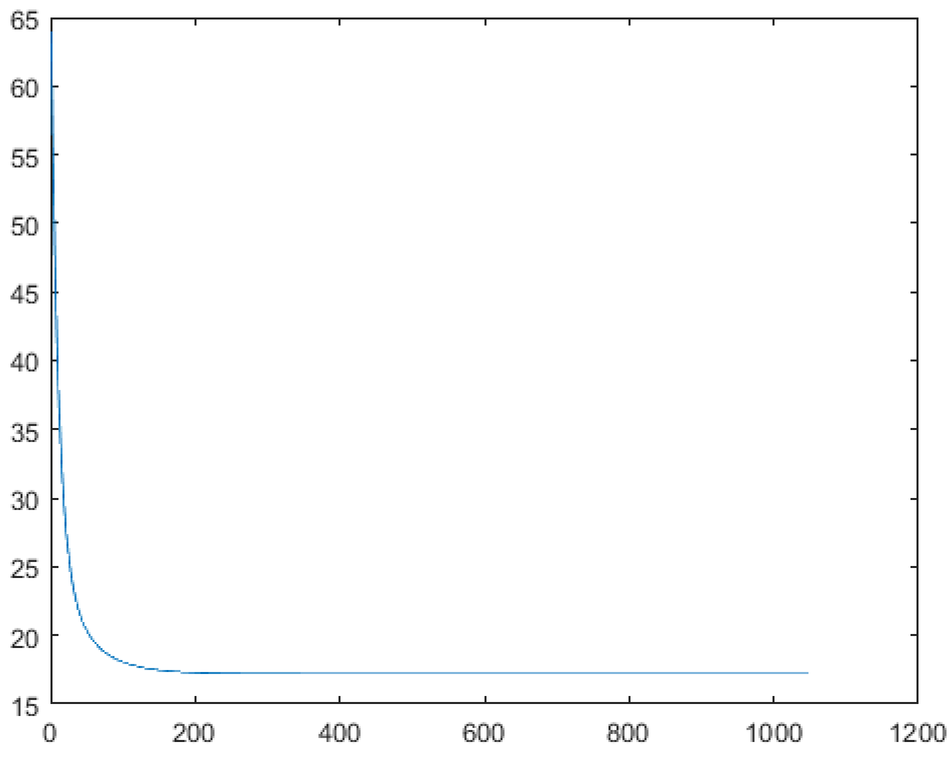
Attention important j'ai epsilon 2 qui est inversé donc probablement epsilon 1 aussi

```
 % Rapport sous forme d'un pdf, on peut le générer avec un rapport
 % automatique matlab. Il faut pouvoir interpréter les résultats obtenus
```

Question 6.2

```
% cx_itere= linspace(-1,4,1049) ;
% cy_itere= linspace(-1,4,1049) ;
%  figure;
%    contour(cx_itere,cy_itere,[it(:,1), it(:,2)]);
```

```
%  figure;
%    plot(ctls(it(:,1), it(:,2),xi,yi),i)
%

result_q6_2 = [] ;

 for (variable = 1:size(it))
    result_q6_2 = [result_q6_2;ctls(it(variable,1),it(variable,2),xi,yi) ]  ;
 end

figure;
    plot(result_q6_2)

%     hold on
%     plot(abs(it(:,1)-it(:,2)))
%
%     hold off
```



Question 8

```
[b_newton, it_newton, i_newton] = quasi_newton(0.5,0.5,xi,yi,10^-3);

[b_newton2, it_newton2, i_newton2] = quasi_newton(2.67,1.37,xi,yi,10^-3);
```

```
figure ;
    contour(cx2,cy2,epsilon2', 100)
    hold on
    axis equal

    plot(it_newton(:,1), it_newton(:,2))
    hold off

    % Test affichage des solutions de la fonction de ciyt
figure;
    plot(xi,yi,'+')
    %plot([cx(min_cx),cy(min_cy)])
    viscircles(b_newton,1.5)
    viscircles(b_newton2,1.5)%
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```


%function[s]=fletcher_function(cx,cy,xi,yi,epsilon,cxo,cyo)
function[s]=fletcher(cx,cy,a,d,xi,yi) % d est un doublet cx, cy
```

```
        dbtype('grad_ctls.m') ;
        dbtype('ctls.m') ;

        al = 0 ; % alpha left
        ar = inf ; % alpha right

        lambda = 20 ;

        B1 = 10^-3 ;
        B2 = 0.99 ;
        %y = 0 ; % : Gamma On le déclare et on lui donne sa valeur

        % Nous devons calculer gamma à partir de a,B1,B2, d est moins le
        % gradient

        y = -B1*(grad_ctls(cx,cy,xi,yi)') * d; % Il faut que d soit un vecteur colonne



        % Condition de Wolf 1 et Wolf 2 Il vaut mieux faire un while
        while (ctls(cx+a*d(1),cy+a*d(2),xi,yi) > ctls(cx,cy,xi,yi) - a*y ) || ((grad_ctls(cx+a*d(1),cy+a*d(2),xi,yi)')*d/((grad_ctls(cx,cy,xi,yi)')*d) > B2  ) % On calcule la fonction de cout et on vérifie

            % Condition de Wolf 1
            if(ctls(cx+a*d(1),cy+a*d(2),xi,yi) <= ctls(cx,cy,xi,yi) - a*y ) % Si la condition de Wolf 1 est respectée
                al = a;
                    if(ar >= inf )
                        a = lambda*a ;
                    else
                        a = (al+ar)/2 ;
                    end
            else % Si elle n'est pas respectée
                ar = a ;
                a = (al + ar)/2 ;
            end
        end
        s = a ;
    end
     1     0
     0     1


Grad_fk =

    2.7379
   -7.5389


Grad_fk =

    2.7379
```

```
   -7.5389
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

     1


Grad_fk =

   -3.5373
   -1.7487
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
```

```
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

     2


Grad_fk =

    2.4618
   -0.3485
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

```

```
        end
    end

    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end

counter =

     3


Grad_fk =

    2.3038
   -0.2934


    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end

    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
```

```
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

     4


Grad_fk =

    2.1584
   -0.2780
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =
```

```
     5


Grad_fk =

    2.0222
   -0.2608
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

     6


Grad_fk =

    1.8949
   -0.2448
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
```

```
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

     7


Grad_fk =

    1.7756
   -0.2298
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

```

```
            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

     8


Grad_fk =

    1.6639
   -0.2157
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
```

```
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

     9


Grad_fk =

    1.5593
   -0.2024
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
```

```
end
```

```
counter =

    10


Grad_fk =

    1.4614
   -0.1900
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    11


Grad_fk =

    1.3696
```

```
   -0.1783
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    12


Grad_fk =

    1.2836
   -0.1673
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
```

```
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    13


Grad_fk =

    1.2031
   -0.1569
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

```

```
        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    14


Grad_fk =

    1.1276
   -0.1472
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
```

```
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    15


Grad_fk =

    1.0569
   -0.1381
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =
```

```
    16


Grad_fk =

    0.9906
   -0.1296
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    17


Grad_fk =

    0.9285
   -0.1215
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
```

```
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    18


Grad_fk =

    0.8703
   -0.1140
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

```

```
            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    19


Grad_fk =

    0.8158
   -0.1069
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
```

```
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    20


Grad_fk =

    0.7647
   -0.1003
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
```

```
end
```

```
counter =

    21


Grad_fk =

    0.7168
   -0.0941
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    22


Grad_fk =

    0.6719
```

```
   -0.0882
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    23


Grad_fk =

    0.6299
   -0.0827
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
```

```
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    24


Grad_fk =

    0.5904
   -0.0776
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

```

```
        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    25


Grad_fk =

    0.5535
   -0.0728
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
```

```
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    26


Grad_fk =

    0.5188
   -0.0682
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =
```

```
    27


Grad_fk =

    0.4864
   -0.0640
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    28


Grad_fk =

    0.4559
   -0.0600
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
```

```
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    29


Grad_fk =

    0.4274
   -0.0563
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

```

```
            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;
        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;
        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    30


Grad_fk =

    0.4007
   -0.0528
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;
        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;
        for k = 1:length(xi)
            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
```

```
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    31


Grad_fk =

    0.3756
   -0.0495
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
```

```
end
```

```
counter =

    32


Grad_fk =

    0.3521
   -0.0464
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    33


Grad_fk =

    0.3301
```

```
   -0.0435
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    34


Grad_fk =

    0.3094
   -0.0408
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
```

```
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    35


Grad_fk =

    0.2901
   -0.0382
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

```

```
        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    36


Grad_fk =

    0.2719
   -0.0359
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
```

```
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    37


Grad_fk =

    0.2549
   -0.0336
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =
```

```
    38


Grad_fk =

    0.2390
   -0.0315
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    39


Grad_fk =

    0.2240
   -0.0296
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
```

```
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    40


Grad_fk =

    0.2100
   -0.0277
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

```

```
            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    41


Grad_fk =

    0.1969
   -0.0260
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
```

```
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    42


Grad_fk =

    0.1846
   -0.0244
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
```

```
end
```

```
counter =

    43


Grad_fk =

    0.1730
   -0.0228
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    44


Grad_fk =

    0.1622
```

```
   -0.0214


function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end

function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end

counter =

    45


Grad_fk =

    0.1521
   -0.0201


function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
```

```
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    46


Grad_fk =

    0.1426
   -0.0188
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

```

```
        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    47


Grad_fk =

    0.1337
   -0.0176
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
```

```
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    48


Grad_fk =

    0.1253
   -0.0165
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =
```

```
    49


Grad_fk =

    0.1175
   -0.0155
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    50


Grad_fk =

    0.1101
   -0.0145
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
```

```
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    51


Grad_fk =

    0.1032
   -0.0136
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

```

```
            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    52


Grad_fk =

    0.0968
   -0.0128
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
```

```
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    53


Grad_fk =

    0.0907
   -0.0120
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
```

```
    end
```

```
counter =

    54


Grad_fk =

    0.0851
   -0.0112
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    55


Grad_fk =

    0.0797
```

```
   -0.0105
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    56


Grad_fk =

    0.0748
   -0.0099
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
```

```
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    57


Grad_fk =

    0.0701
   -0.0093
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

```

```
        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    58


Grad_fk =

    0.0657
   -0.0087
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
```

```
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;
        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    59


Grad_fk =

    0.0616
   -0.0081
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;
        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;
        for k = 1:length(xi)
            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;
        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;
        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =
```

```
    60


Grad_fk =

    0.0577
   -0.0076
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    61


Grad_fk =

    0.0541
   -0.0072
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
```

```
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    62


Grad_fk =

    0.0508
   -0.0067
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

```

```
        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    63


Grad_fk =

    0.0476
   -0.0063
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
```

```
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    64


Grad_fk =

    0.0446
   -0.0059
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
```

```
end
```

```
counter =

    65


Grad_fk =

    0.0418
   -0.0055
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    66


Grad_fk =

    0.0392
```

```
   -0.0052
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    67


Grad_fk =

    0.0368
   -0.0049
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
```

```
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    68


Grad_fk =

    0.0345
   -0.0046
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

```

```
        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    69


Grad_fk =

    0.0323
   -0.0043
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
```

```
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    70


Grad_fk =

    0.0303
   -0.0040
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =
```

```
    71


Grad_fk =

    0.0284
   -0.0038
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    72


Grad_fk =

    0.0266
   -0.0035
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
```

```
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    73


Grad_fk =

    0.0250
   -0.0033
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

```

```
        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    74


Grad_fk =

    0.0234
   -0.0031
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
```

```
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    75


Grad_fk =

    0.0219
   -0.0029
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
```

```
end
```

```
counter =

    76


Grad_fk =

    0.0206
   -0.0027
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    77


Grad_fk =

    0.0193
```

```
   -0.0025
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29
  ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) -
 cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) -
 cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29
  ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    78


Grad_fk =

    0.0181
   -0.0024
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
```

```
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    79


Grad_fk =

    0.0169
   -0.0022
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

```

```
        end
    end

    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    80


Grad_fk =

    0.0159
   -0.0021
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end

    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
```

```
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    81


Grad_fk =

    0.0149
   -0.0020
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =
```

```
    82


Grad_fk =

    0.0140
   -0.0018
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    83


Grad_fk =

    0.0131
   -0.0017
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
```

```
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    84


Grad_fk =

    0.0123
   -0.0016
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

```

```
            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    85


Grad_fk =

    0.0115
   -0.0015
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
```

```
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    86


Grad_fk =

    0.0108
   -0.0014
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
```

```
end
```

```
counter =

    87


Grad_fk =

    0.0101
   -0.0013
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    88


Grad_fk =

    0.0095
```

```
   -0.0013
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    89


Grad_fk =

    0.0089
   -0.0012
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
```

```
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    90


Grad_fk =

    0.0083
   -0.0011
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

```

```
        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    91


Grad_fk =

    0.0078
   -0.0010
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
```

```
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    92


Grad_fk =

    0.0073
   -0.0010
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =
```

```
    93


Grad_fk =

    0.0069
   -0.0009
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    94


Grad_fk =

    0.0064
   -0.0009
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
```

```
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    95


Grad_fk =

    0.0060
   -0.0008
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

```

```
            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    96


Grad_fk =

    0.0057
   -0.0007
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
```

```
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    97


Grad_fk =

    0.0053
   -0.0007
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
```

```
end
```

```
counter =

    98


Grad_fk =

    0.0050
   -0.0007
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    99


Grad_fk =

    0.0047
```

```
   -0.0006
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

   100


Grad_fk =

    0.0044
   -0.0006
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
```

```
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

   101


Grad_fk =

    0.0041
   -0.0005
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

```

```
        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

   102


Grad_fk =

    0.0038
   -0.0005
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
```

```
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

   103


Grad_fk =

    0.0036
   -0.0005
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =
```

```
   104


Grad_fk =

    0.0034
   -0.0004
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

   105


Grad_fk =

    0.0032
   -0.0004
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
```

```
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

   106


Grad_fk =

    0.0030
   -0.0004
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

```

```
            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

   107


Grad_fk =

    0.0028
   -0.0004
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
```

```
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

   108


Grad_fk =

    0.0026
   -0.0003
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
```

```
end
```

```
counter =

   109


Grad_fk =

    0.0024
   -0.0003
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

   110


Grad_fk =

    0.0023
```

```
   -0.0003
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

   111


Grad_fk =

    0.0021
   -0.0003
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
```

```
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

   112


Grad_fk =

    0.0020
   -0.0003
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

```

```
        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

   113


Grad_fk =

    0.0019
   -0.0002
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
```

```
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

   114


Grad_fk =

    0.0018
   -0.0002
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =
```

```
   115


Grad_fk =

    0.0017
   -0.0002
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

   116


Grad_fk =

    0.0016
   -0.0002
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
```

```
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

   117


Grad_fk =

    0.0015
   -0.0002
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

```

```
            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

   118


Grad_fk =

    0.0014
   -0.0002
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
```

```
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

   119


Grad_fk =

    0.0013
   -0.0002
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
```

```
end
```

```
counter =

   120


Grad_fk =

    0.0012
   -0.0002
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

   121


Grad_fk =

    0.0011
```

```
   -0.0001
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

   122


Grad_fk =

    0.0011
   -0.0001
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
```

```
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

   123


Grad_fk =

   1.0e-03 *

    0.9900
   -0.1309
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
```

```
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

   124
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
```

```
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```


    %function[s]=fletcher_function(cx,cy,xi,yi,epsilon,cxo,cyo)
    function[s]=fletcher(cx,cy,a,d,xi,yi) % d est un doublet cx, cy
        dbtype('grad_ctls.m') ;
        dbtype('ctls.m') ;

        al = 0 ; % alpha left
        ar = inf ; % alpha right

        lambda = 20 ;

        B1 = 10^-3 ;
        B2 = 0.99 ;
        %y = 0 ; % : Gamma On le déclare et on lui donne sa valeur

        % Nous devons calculer gamma à partir de a,B1,B2, d est moins le
        % gradient

        y = -B1*(grad_ctls(cx,cy,xi,yi)') * d; % Il faut que d soit un vecteur colonne



        % Condition de Wolf 1 et Wolf 2 Il vaut mieux faire un while
        while (ctls(cx+a*d(1),cy+a*d(2),xi,yi) > ctls(cx,cy,xi,yi) - a*y ) || ((grad_ctls(cx+a*d(1),cy+a*d(2),xi,yi)')*d/((grad_ctls(cx,cy,xi,yi)')*d) > B2  ) % On calcule la fonction de cout et on vérifie

            % Condition de Wolf 1
            if(ctls(cx+a*d(1),cy+a*d(2),xi,yi) <= ctls(cx,cy,xi,yi) - a*y ) % Si la condition de Wolf 1 est respectée
                al = a;
                    if(ar >= inf )
                        a = lambda*a ;
                    else
                        a = (al+ar)/2 ;
                    end
            else % Si elle n'est pas respectée
                ar = a ;
                a = (al + ar)/2 ;
            end
        end
        s = a ;
    end
```

```
     1     0
     0     1
```

Grad_fk =

```
   -0.9336
   -0.3518


Grad_fk =

   -0.9336
   -0.3518
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

     1


Grad_fk =

    0.3894
    0.4062
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

     2


Grad_fk =

    0.3849
    0.3782
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

```

```
        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

     3


Grad_fk =

    0.3709
    0.3655
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

     4


Grad_fk =

    0.3595
    0.3541
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
```

```
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

     5


Grad_fk =

    0.3482
    0.3431
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

     6


Grad_fk =
```

```
    0.3374
    0.3324
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

     7


Grad_fk =

    0.3268
    0.3221
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

```

```
        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

     8


Grad_fk =

    0.3166
    0.3120
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
```

```
        end
    end

    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

     9


Grad_fk =

    0.3067
    0.3023
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end

    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
```

```
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    10


Grad_fk =

    0.2972
    0.2929
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =
```

```
    11


Grad_fk =

    0.2879
    0.2838
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    12


Grad_fk =

    0.2789
    0.2749
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
```

```
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    13


Grad_fk =

    0.2702
    0.2664
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

```

```
            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    14


Grad_fk =

    0.2618
    0.2581
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
```

```
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    15


Grad_fk =

    0.2536
    0.2500
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
```

```
end
```

```
counter =

    16


Grad_fk =

    0.2457
    0.2422
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    17


Grad_fk =

    0.2380
```

```
    0.2347
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    18


Grad_fk =

    0.2306
    0.2274
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
```

```
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    19


Grad_fk =

    0.2234
    0.2203
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

```

```
        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    20


Grad_fk =

    0.2164
    0.2134
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
```

```
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end

counter =

    21


Grad_fk =

    0.2096
    0.2068
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end

counter =
```

```
    22


Grad_fk =

    0.2031
    0.2003
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    23


Grad_fk =

    0.1967
    0.1941
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
```

```
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    24


Grad_fk =

    0.1906
    0.1880
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

```

```
        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    25


Grad_fk =

    0.1846
    0.1822
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
```

```
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    26


Grad_fk =

    0.1789
    0.1765
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
```

```
end
```

```
counter =

    27


Grad_fk =

    0.1733
    0.1710
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    28


Grad_fk =

    0.1679
```

```
    0.1657
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    29


Grad_fk =

    0.1626
    0.1605
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
```

```
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    30


Grad_fk =

    0.1576
    0.1555
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

```

```
        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    31


Grad_fk =

    0.1526
    0.1506
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
```

```
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    32


Grad_fk =

    0.1479
    0.1459
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =
```

```
    33


Grad_fk =

    0.1433
    0.1414
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    34


Grad_fk =

    0.1388
    0.1370
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
```

```
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    35


Grad_fk =

    0.1345
    0.1327
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

```

```
        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    36


Grad_fk =

    0.1303
    0.1286
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
```

```
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    37


Grad_fk =

    0.1262
    0.1246
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
```

```
    end

counter =

    38


Grad_fk =

    0.1222
    0.1207
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    39


Grad_fk =

    0.1184
```

```
    0.1169
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    40


Grad_fk =

    0.1147
    0.1133
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
```

```
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    41


Grad_fk =

    0.1111
    0.1097
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

```

```
        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    42


Grad_fk =

    0.1077
    0.1063
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
```

```
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    43


Grad_fk =

    0.1043
    0.1030
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =
```

```
    44


Grad_fk =

    0.1011
    0.0998
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    45


Grad_fk =

    0.0979
    0.0967
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
```

```
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    46


Grad_fk =

    0.0948
    0.0936
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

```

```
            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    47


Grad_fk =

    0.0919
    0.0907
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
```

```
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    48


Grad_fk =

    0.0890
    0.0879
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
```

```
end
```

```
counter =

    49


Grad_fk =

    0.0862
    0.0852
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    50


Grad_fk =

    0.0835
```

```
    0.0825
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    51


Grad_fk =

    0.0809
    0.0799
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
```

```
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    52


Grad_fk =

    0.0784
    0.0774
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

```

```
        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    53


Grad_fk =

    0.0759
    0.0750
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
```

```
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    54


Grad_fk =

    0.0736
    0.0727
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =
```

```
    55


Grad_fk =

    0.0713
    0.0704
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    56


Grad_fk =

    0.0690
    0.0682
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
```

```
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    57


Grad_fk =

    0.0669
    0.0661
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

```

```
            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    58


Grad_fk =

    0.0648
    0.0640
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
```

```
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    59


Grad_fk =

    0.0628
    0.0620
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
```

```
end

counter =

    60


Grad_fk =

    0.0608
    0.0601
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    61


Grad_fk =

    0.0589
```

```
    0.0582
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    62


Grad_fk =

    0.0571
    0.0564
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
```

```
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    63


Grad_fk =

    0.0553
    0.0546
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

```

```
    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;
    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;
    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    64


Grad_fk =

    0.0536
    0.0529
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;
    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;
    for k = 1:length(xi)
        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;
    %syms k ;
```

```
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    65


Grad_fk =

    0.0519
    0.0513
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =
```

```
    66


Grad_fk =

    0.0503
    0.0497
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    67


Grad_fk =

    0.0487
    0.0481
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
```

```
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    68


Grad_fk =

    0.0472
    0.0466
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

```

```
        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    69


Grad_fk =

    0.0457
    0.0452
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
```

```
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    70


Grad_fk =

    0.0443
    0.0437
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
```

```
end
```

```
counter =

    71


Grad_fk =

    0.0429
    0.0424
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    72


Grad_fk =

    0.0416
```

```
    0.0411
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    73


Grad_fk =

    0.0403
    0.0398
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
```

```
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    74


Grad_fk =

    0.0390
    0.0385
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

```

```
        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    75


Grad_fk =

    0.0378
    0.0373
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
```

```
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    76


Grad_fk =

    0.0366
    0.0362
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =
```

```
    77


Grad_fk =

    0.0355
    0.0350
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    78


Grad_fk =

    0.0343
    0.0339
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
```

```
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    79


Grad_fk =

    0.0333
    0.0329
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

```

```
            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    80


Grad_fk =

    0.0322
    0.0319
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
```

```
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    81


Grad_fk =

    0.0312
    0.0309
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
```

```
end
```

```
counter =

    82


Grad_fk =

    0.0303
    0.0299
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    83


Grad_fk =

    0.0293
```

```
    0.0290
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    84


Grad_fk =

    0.0284
    0.0281
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
```

```
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    85


Grad_fk =

    0.0275
    0.0272
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

```

```
        end
    end

    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end

counter =

    86


Grad_fk =

    0.0266
    0.0263


    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end

    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
```

```
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    87


Grad_fk =

    0.0258
    0.0255
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =
```

```
    88


Grad_fk =

    0.0250
    0.0247
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    89


Grad_fk =

    0.0242
    0.0239
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
```

```
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    90


Grad_fk =

    0.0235
    0.0232
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

```

```
        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    91


Grad_fk =

    0.0227
    0.0225
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
```

```
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    92


Grad_fk =

    0.0220
    0.0218
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
```

```
end

counter =

    93


Grad_fk =

    0.0213
    0.0211


function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end

function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end

counter =

    94


Grad_fk =

    0.0207
```

```
    0.0204
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

    95


Grad_fk =

    0.0200
    0.0198
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
```

```
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    96


Grad_fk =

    0.0194
    0.0192
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

```

```
        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    97


Grad_fk =

    0.0188
    0.0186
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
```

```
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

    98


Grad_fk =

    0.0182
    0.0180
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =
```

```
    99


Grad_fk =

    0.0176
    0.0174
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

   100


Grad_fk =

    0.0171
    0.0169
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
```

```
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

   101


Grad_fk =

    0.0166
    0.0164
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

```

```
            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

   102


Grad_fk =

    0.0160
    0.0158
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
```

```
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

   103


Grad_fk =

    0.0155
    0.0154
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
```

```
end
```

```
counter =

   104


Grad_fk =

    0.0150
    0.0149
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

   105


Grad_fk =

    0.0146
```

```
    0.0144
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

   106


Grad_fk =

    0.0141
    0.0140
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
```

```
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

   107


Grad_fk =

    0.0137
    0.0135
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

```

```
        end
    end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

   108


Grad_fk =

    0.0133
    0.0131
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
```

```
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

   109


Grad_fk =

    0.0128
    0.0127
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =
```

```
   110


Grad_fk =

    0.0124
    0.0123
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

   111


Grad_fk =

    0.0120
    0.0119
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
```

```
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

   112


Grad_fk =

    0.0117
    0.0115
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

```

```
            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

   113


Grad_fk =

    0.0113
    0.0112
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
```

```
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

   114


Grad_fk =

    0.0110
    0.0108
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
```

```
end
```

```
counter =

   115


Grad_fk =

    0.0106
    0.0105
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

   116


Grad_fk =

    0.0103
```

```
    0.0102
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

   117


Grad_fk =

    0.0100
    0.0098
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
```

```
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

   118


Grad_fk =

    0.0096
    0.0095
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

```

```
        end
    end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

   119


Grad_fk =

    0.0093
    0.0092
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
```

```
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

   120


Grad_fk =

    0.0091
    0.0089
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =
```

```
   121


Grad_fk =

    0.0088
    0.0087
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

   122


Grad_fk =

    0.0085
    0.0084
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
```

```
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

   123


Grad_fk =

    0.0082
    0.0081
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

```

```
            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

   124


Grad_fk =

    0.0080
    0.0079
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
```

```
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

   125


Grad_fk =

    0.0077
    0.0076
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
```

```
end
```

```
counter =

   126


Grad_fk =

    0.0075
    0.0074
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

   127


Grad_fk =

    0.0073
```

```
    0.0072
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

   128


Grad_fk =

    0.0070
    0.0069
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
```

```
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

   129


Grad_fk =

    0.0068
    0.0067
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

```

```
        end
    end

function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

   130


Grad_fk =

    0.0066
    0.0065
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
```

```
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

   131


Grad_fk =

    0.0064
    0.0063
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =
```

```
   132


Grad_fk =

    0.0062
    0.0061
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

   133


Grad_fk =

    0.0060
    0.0059
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
```

```
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

   134


Grad_fk =

    0.0058
    0.0057
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

```

```
        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

   135


Grad_fk =

    0.0056
    0.0056
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
```

```
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

   136


Grad_fk =

    0.0054
    0.0054
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
```

```
end
```

```
counter =

   137


Grad_fk =

    0.0053
    0.0052
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

   138


Grad_fk =

    0.0051
```

```
    0.0051
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

   139


Grad_fk =

    0.0050
    0.0049
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
```

```
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

   140


Grad_fk =

    0.0048
    0.0047
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

```

```
        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

   141


Grad_fk =

    0.0046
    0.0046
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
```

```
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

   142


Grad_fk =

    0.0045
    0.0045
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =
```

```
   143


Grad_fk =

    0.0044
    0.0043
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

   144


Grad_fk =

    0.0042
    0.0042
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
```

```
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

   145


Grad_fk =

    0.0041
    0.0040
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

```

```
        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

   146


Grad_fk =

    0.0040
    0.0039
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
```

```
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

   147


Grad_fk =

    0.0038
    0.0038
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
```

```
end

counter =

   148


Grad_fk =

    0.0037
    0.0037
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

   149


Grad_fk =

    0.0036
```

```
    0.0036
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

   150


Grad_fk =

    0.0035
    0.0035
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
```

```
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

   151


Grad_fk =

    0.0034
    0.0033
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

```

```
        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

   152


Grad_fk =

    0.0033
    0.0032
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
```

```
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

   153


Grad_fk =

    0.0032
    0.0031
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =
```

```
   154


Grad_fk =

    0.0031
    0.0030
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

   155


Grad_fk =

    0.0030
    0.0029
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
```

```
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

   156


Grad_fk =

    0.0029
    0.0029
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

```

```
            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

   157


Grad_fk =

    0.0028
    0.0028
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
```

```
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

   158


Grad_fk =

    0.0027
    0.0027
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
```

```
end
```

```
counter =

   159


Grad_fk =

    0.0026
    0.0026
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

   160


Grad_fk =

    0.0025
```

```
    0.0025
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

   161


Grad_fk =

    0.0025
    0.0024
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
```

```
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

   162


Grad_fk =

    0.0024
    0.0024
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

```

```
        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

   163


Grad_fk =

    0.0023
    0.0023
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
```

```
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

   164


Grad_fk =

    0.0022
    0.0022
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =
```

```
   165


Grad_fk =

    0.0022
    0.0021
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

   166


Grad_fk =

    0.0021
    0.0021
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
```

```
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

   167


Grad_fk =

    0.0020
    0.0020
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

```

```
        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

   168


Grad_fk =

    0.0020
    0.0019
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

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        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
```

```
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

   169


Grad_fk =

    0.0019
    0.0019
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
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```
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        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
```

```
end

counter =

   170


Grad_fk =

    0.0019
    0.0018
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

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```

```
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```

```
counter =

   171


Grad_fk =

    0.0018
```

```
    0.0018
```

```
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    n = length(xi) ;
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```

```
function[d]=ctls(cx,cy,xi,yi)
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    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
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```

```
counter =

   172


Grad_fk =

    0.0017
    0.0017
```

```
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    n = length(xi) ;
    d = [0;0] ;
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    %syms k ;
```

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        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

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```

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        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
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    end
```

```
counter =

   173


Grad_fk =

    0.0017
    0.0017
```

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```

```
        end
    end

    function[d]=ctls(cx,cy,xi,yi)
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        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

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            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
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    end
```

```
counter =

   174


Grad_fk =

    0.0016
    0.0016
```

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    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

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        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

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    function[d]=ctls(cx,cy,xi,yi)
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        R = 1.5 ;

        %syms k ;
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        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

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            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

   175


Grad_fk =

    0.0016
    0.0016
```

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        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =
```

```
   176


Grad_fk =

    0.0015
    0.0015
```

```
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    R = 1.5 ;

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```

```
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        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
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end
```

```
counter =

   177


Grad_fk =

    0.0015
    0.0015
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
```

```
        n = length(xi) ;
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        R = 1.5 ;

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```

```
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        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

   178


Grad_fk =

    0.0014
    0.0014
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

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        for k = 1:length(xi)

```

```
            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
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        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
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        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

   179


Grad_fk =

    0.0014
    0.0014
```

```
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        n = length(xi) ;
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        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
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```

```
        d = 0 ;
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        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

   180


Grad_fk =

    0.0013
    0.0013
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
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        end
    end
```

```
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        n = length(xi) ;
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        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
```

```
end

counter =

   181


Grad_fk =

    0.0013
    0.0013
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
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end
```

```
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        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
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end
```

```
counter =

   182


Grad_fk =

    0.0013
```

```
    0.0013
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
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```

```
counter =

   183


Grad_fk =

    0.0012
    0.0012
```

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        end
    end
```

```
counter =

   184


Grad_fk =

    0.0012
    0.0012
```

```
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```

```
        end
    end

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        d = 0 ;
        R = 1.5 ;

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            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
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counter =

   185


Grad_fk =

    0.0011
    0.0011


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    end

    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
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        %syms k ;
```

```
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

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            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

   186


Grad_fk =

    0.0011
    0.0011
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
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```

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        for k = 1:30
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        end
    end
```

```
counter =
```

```
   187


Grad_fk =

    0.0011
    0.0011
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
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    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

   188


Grad_fk =

    0.0010
    0.0010
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
```

```
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

   189


Grad_fk =

    0.0010
    0.0010
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

```

```
            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

   190


Grad_fk =

   1.0e-03 *

    0.9811
    0.9698
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

   191


Grad_fk =

   1.0e-03 *

    0.9504
    0.9395
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;
```

```

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

   192


Grad_fk =

   1.0e-03 *

    0.9207
    0.9101
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =
```

```
   193


Grad_fk =

   1.0e-03 *

    0.8920
    0.8817
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

   194


Grad_fk =

   1.0e-03 *

    0.8641
```

```
    0.8541
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

   195


Grad_fk =

   1.0e-03 *

    0.8371
    0.8275
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

```

```
    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

   196


Grad_fk =

   1.0e-03 *

    0.8109
    0.8016
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
```

```
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

   197


Grad_fk =

   1.0e-03 *

    0.7856
    0.7765
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
```

```
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

   198


Grad_fk =

   1.0e-03 *

    0.7610
    0.7523
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
```

```
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

   199


Grad_fk =

   1.0e-03 *

    0.7373
    0.7288
```

```
    function[d]=grad_ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = [0;0] ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:length(xi)

            d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
            d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

        end
    end
```

```
    function[d]=ctls(cx,cy,xi,yi)
        n = length(xi) ;
        d = 0 ;
        R = 1.5 ;

        %syms k ;
        %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

        for k = 1:30
            d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
        end
    end
```

```
counter =

   200
```

```
Grad_fk =

   1.0e-03 *

    0.7142
    0.7060
```

```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

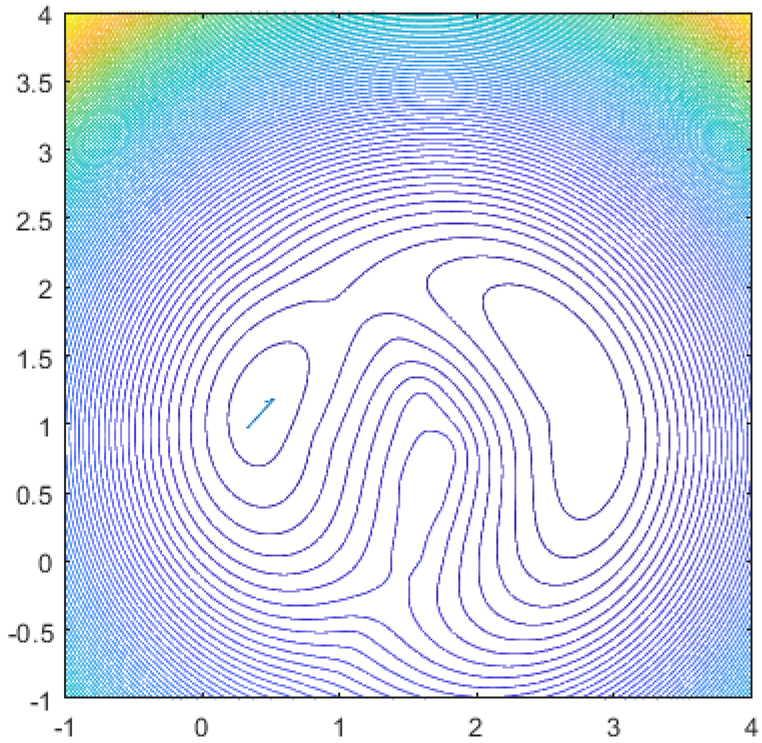
```
counter =

   201


Grad_fk =

   1.0e-03 *

    0.6919
    0.6839
```

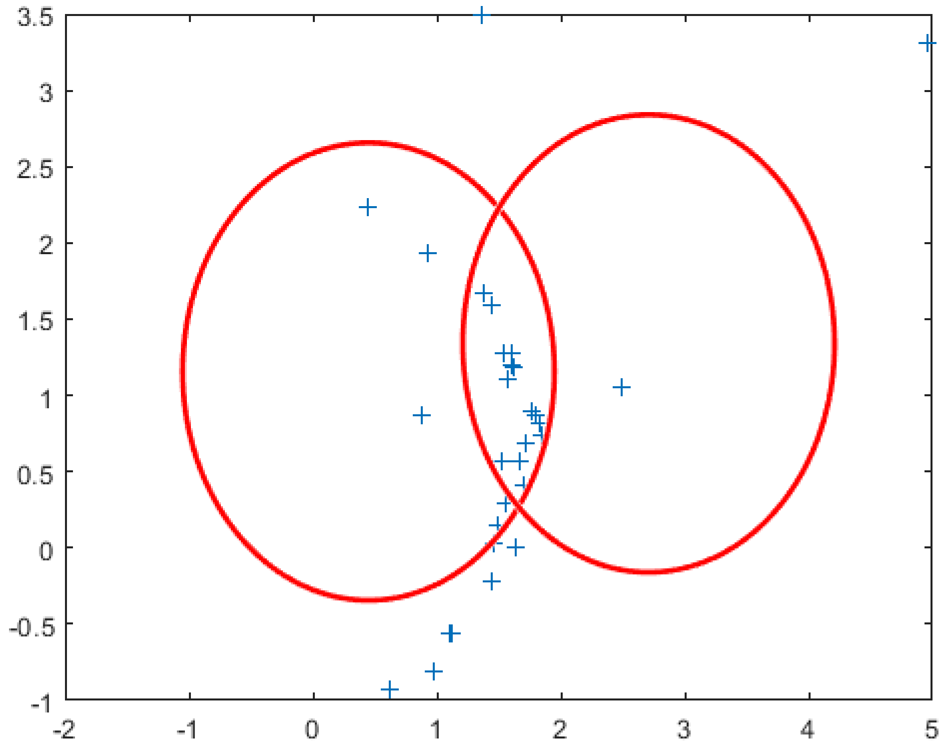
```
function[d]=grad_ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = [0;0] ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:length(xi)

        d(1) = d(1) + 2*(xi(k)-cx)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );
        d(2) = d(2) + 2*(yi(k)-cy)*(R/(sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)) - 1 );

    end
end
```

```
function[d]=ctls(cx,cy,xi,yi)
    n = length(xi) ;
    d = 0 ;
    R = 1.5 ;

    %syms k ;
    %d = symsum( ( sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2   ,k,0,29 ) ;

    for k = 1:30
        d = d + (sqrt((xi(k)-cx)^2 + (yi(k) - cy)^2)-R )^2  ;
    end
end
```

```
counter =

   202


ans =

  Group with properties:

    Children: [2×1 Line]
     Visible: on
     HitTest: on

  Use GET to show all properties


ans =

  Group with properties:
```

```
   Children: [2×1 Line]
    Visible: on
    HitTest: on

  Use GET to show all properties
```





Question 9

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