function [vectorsx vectorsy calcs] = fourstepsKK(anchor, reference, blocksize)  
reference0 = reference;  
anchor0 = anchor;  
reference = imresize(reference, 2, 'bilinear');  
anchor = imresize(anchor, 2, 'bilinear');  
%gnostopoio tis grammes kai tis sthles tou reference frame  
[grammes stiles] = size(reference);  
[grammes1 stiles1] = size(reference0);  
%arxikopoio ton pinaka ton motion vectors  
vectorsx = zeros( ceil(grammes/blocksize), ceil(stiles/blocksize));  
vectorsy = zeros( ceil(grammes/blocksize), ceil(stiles/blocksize));  
halfx = zeros( ceil(grammes/blocksize), ceil(stiles/blocksize));  
halfy = zeros( ceil(grammes/blocksize), ceil(stiles/blocksize));  
temp = 1;  
count = 0;  
errors= ones(3,3)\*256;  
br=0;  
tic;  
%ksekiname apo pano aristera opos ston ebma  
for i = 1 : blocksize : grammes-blocksize+1;  
% for i=12\*blocksize+1:12\*blocksize+1  
    br=br+1;  
    bc=0;  
   for j = 1 : blocksize : stiles-blocksize+1 ;  
% for j=0\*blocksize+1:0\*blocksize+1  
        bc=bc+1;  
        min\_MAD = 256\*grammes\*stiles;   
        x = j; %kratao tis sintetagmenes gia to block pou eimai tora  
        y = i; %gia na mporo na oriso to neo kentro an xreiastei  
        %ypologizoyme to sfalma gia to block sto kentro tis perioxis  
        %anazitisis  
        currentblock = anchor(i:i+blocksize-1, j:j+blocksize-1);  
        referenceblock = reference(i:i+blocksize-1, j:j+blocksize-1);  
        thiserror=MAD(double(currentblock), double(referenceblock), blocksize);   
        errors(2,2) = thiserror; %apothikevoume to sfalma tou kentrou  
        count = count + 1;   
        % edo ypologizoyme to sfalma apo ta 8 geitonika simeia tou kentrou  
        % sto proto stadio toy algorithmou ta eksetazoyme kai ta 8  
        % orizontas ena parathiro 5x5  
        for m = -2:2:2   
            for n = -2:2:2  
                if ( y+m < 1 ) %y+m: h katheti sintetagmeni mas gia to reference block  
                    continue;  
                end  
                if ( y+m > grammes - blocksize + 1 )  
                    continue;  
                end  
                if ( x+n < 1 ) %x+m: h orizontia sintetagmeni mas gia to reference block   
                    continue;   
                end  
                if ( x+n > stiles - blocksize +1 )  
                   continue;  
                end  
                if (m == 0 && n == 0) %an eimai sto kentro min ypologiseis to sfalma  
                    continue %giati to exo idi ypologismeno apo prin  
                end  
                currentblock = anchor(i:i+blocksize-1, j:j+blocksize-1);  
                referenceblock = reference(y+m:y+m+blocksize-1, x+n:x+n+blocksize-1);  
                thiserror=MAD(double(currentblock), double(referenceblock), blocksize);  
                %edo gia ton pinaka 3x3 pou exo me to sfalma ton 9 simeion  
                %kathe fora apothikevo tin sintetagmeni tou simeiou pou  
                %eimai  
                errors(m/2+2,n/2+2)=thiserror;  
                count = count + 1 ;  
            end  
        end  
        errors;  
        %apo ton pinaka me ta sfalmata ton simeion  
        %tha vroume to simeio me to mikrotero sfalma  
        %kai tha to apothikeusoume  
        [indy, indx] = size(errors);  
        mymin = 256\*indy\*indx;  
        for loopi = 1:indy  
            for loopj = 1:indx  
                if (errors(loopi,loopj) < mymin)  
                    mymin = errors(loopi,loopj);  
                    dy=loopi;  
                    dx=loopj;  
                end  
            end  
        end   
        [dx dy];  
% anchor(i:i+blocksize-1, j:j+blocksize-1)  
% reference(y:y+2+blocksize-1, x:x+2+blocksize-1)  
        %an to simeio auto einai to kentro tote tha psaksoume  
        %sta 8 geitonika simeia tou kai to parathyro ginetai 3x3  
        if (dx==2 && dy==2)   
            for m = -1:1:1   
                for n = -1:1:1  
                    if ( y+m < 1 )  
                        continue;  
                    end  
                    if ( y+m > grammes - blocksize + 1 )  
                        continue;  
                    end  
                    if ( x+n < 1 )   
                        continue;   
                    end  
                    if ( x+n > stiles - blocksize +1 )  
                       continue;  
                    end  
                    if (m == 0 && n == 0)  
                       continue;  
                    end  
                currentblock = anchor(i:i+blocksize-1, j:j+blocksize-1);  
                referenceblock = reference(y+m:y+m+blocksize-1, x+n:x+n+blocksize-1);  
                thiserror=MAD(double(currentblock), double(referenceblock), blocksize);   
                errors(m+2,n+2)=thiserror;   
                  
                if (thiserror<min\_MAD)  
                    min\_MAD=thiserror;  
                    dy=m;  
                    dx=n;  
                end  
                count = count + 1;  
                end  
            end  
            %pali vrisko to simeio me to mikrotero sfalma  
            [indy, indx] = size(errors);  
            mymin = 256\*indy\*indx;  
            for loopi = 1:indy  
                for loopj = 1:indx  
                    if (errors(loopi,loopj) < mymin)  
                       mymin = errors(loopi,loopj);  
                       dx=loopi;  
                       dy=loopj;  
                    end  
                end  
            end   
            [dx dy];  
            errors;  
            %orise to best match pou tha einai auto me to minimum sfalma  
            %kai i anazitisi teleionei  
            x = x + dx - 2;  
            y = y + dy - 2;   
            %apothikevoume kai ta motion vectors  
            indexi=floor((i-1)/blocksize)+1;  
            indexj=floor((j-1)/blocksize)+1;  
            vectorsx(indexi,indexj)=y - i ;  
            vectorsy(indexi,indexj)=x - j ;  
            temp = temp + 1;  
            %arxikopoioume ton pinaka me ta sfalmata  
            errors= ones(3,3)\*256\*grammes\*stiles;  
%----- edo tha ertho an to best match den einai to kentro -----  
        else  
            oldX = x; %apothikevo tis sintetagmenes tou block pou eimai tora  
            oldY = y; %gia na kano elenxo sta boundaries  
            x = x + (dx-2)\*2; %edo pera orizo tis sintetagmenes tou neou kentrou  
            y = y + (dy-2)\*2;  
            %arxikopoio kai pali ton pinaka pou periexei ta sfalmata  
            errors = ones(3,3)\*256;  
            %ta 4 vimata tou algorithmou einai autes oi 4 epanalipseis pou   
            %orizetai kai pali ena parathyro 5x5 se kathe epanalipsi  
            %kai epanalamvanetai i idia diadikasia opos prin  
            for steps = 1:1  
                tobreak=0;  
                for m = -2:2:2   
                    if tobreak==1;  
                       break;  
                    end  
                    tobreak=0;   
                    for n = -2:2:2  
                        %elenxos orion  
                        if ( y+m < 1 )   
                           continue;  
                        end  
                        if ( y+m > grammes - blocksize + 1 )  
                           continue;  
                        end  
                        if ( x+n < 1 )   
                           continue;   
                        end  
                        if ( x+n > stiles - blocksize +1 )  
                           continue;  
                        end  
                        if (y+m >= oldX - 2 && y+m <= oldX + 2 && x+n >= oldY - 2 && x+n <= oldY + 2 )  
                           continue;  
                        end  
                        if (m == 0 && n == 0)  
                           continue  
                        end  
                        currentblock = anchor(i:i+blocksize-1, j:j+blocksize-1);  
                        referenceblock = reference(y+m:y+m+blocksize-1, x+n:x+n+blocksize-1);  
                        thiserror=MAD(double(currentblock), double(referenceblock), blocksize);  
                        errors(m/2+2,n/2+2)=thiserror;   
                        count = count + 1;   
                    end  
                end   
                [indy, indx] = size(errors);  
                mymin = 256\*indy\*indx;  
                for loopi = 1:indy  
                    for loopj = 1:indx  
                        if (errors(loopi,loopj) < mymin)  
                            mymin = errors(loopi,loopj);  
                            dy=loopi;  
                            dx=loopj;  
                        end  
                    end  
                end   
                [dx dy]  
                errors  
                %an to simeio me to mikrotero sfalma den einai to kentro  
                %tote edo orizo to neo kentro   
                if (dx~=2||dy~=2)   
                oldX = x;   
                oldY = y;   
                x = x + (dx-2)\*2;   
                y = y + (dy-2)\*2;   
                errors = ones(3,3)\*256;  
                errors(2,2)=mymin;  
                %edo simainei oti eimaste sto kentro kai i metavliti  
                %tobreak ginetai isi me 1 gia na vgoyme apo ti loopa  
                else   
                    tobreak=1;  
                    break;  
                end   
            end   
            %edo tha erthoume otan to best match einai to kentro se kapoia  
            %apo tis 4 epanalipseis   
            %ellatonetai to vima sto miso simfona me auta pou orizei  
            %i theoria tou 4 step kai psaxnoume ta 9 simeia kai pali   
            %mazi me to kentro exontas ena parathyro anazitisis 3x3  
            min\_MAD = 256\*grammes\*stiles;  
            for m = -1:1:1   
                for n = -1:1:1  
                    %elenxos orion  
                    if ( y+m < 1 )  
                        continue;  
                    end  
                    if ( y+m > grammes - blocksize + 1 )  
                        continue;  
                    end  
                    if ( x+n < 1 )   
                        continue;   
                    end  
                    if ( x+n > stiles - blocksize +1 )  
                        continue;  
                    end  
                    if (m == 0 && n == 0)  
                        continue;  
                    end  
                    currentblock = anchor(i:i+blocksize-1, j:j+blocksize-1);  
                    referenceblock = reference(y+m:y+m+blocksize-1, x+n:x+n+blocksize-1);  
                    thiserror=MAD(double(currentblock), double(referenceblock), blocksize);   
                    errors(m+2,n+2)=thiserror;  
                    if (thiserror<min\_MAD)  
                        min\_MAD=thiserror;  
                        dy=m;  
                        dx=n;  
                    end  
                    count = count + 1;  
                end  
            end  
            %evresi opos prin tou simeiou me to mikrotero sfalma  
            [indy, indx] = size(errors);  
            mymin = 256\*indy\*indx;  
            for loopi = 1:indy  
                for loopj = 1:indx  
                    if (errors(loopi,loopj) < mymin)  
                        mymin = errors(loopi,loopj);  
                        dy=loopi;  
                        dx=loopj;  
                    end  
                end  
            end  
            [dx dy];  
            errors;  
            %apothikevoume ta telika mvs  
            %--> sintetagmenes tou block pou eimaste tora + tin metatopisi  
            %afairontas ti metatopisi tou kentrou  
            x = x + dx - 2;  
            y = y + dy - 2;   
            indexi=floor((i-1)/blocksize)+1  
            indexj=floor((j-1)/blocksize)+1;  
            vectorsx(indexi,indexj)=x - j ;  
            vectorsy(indexi,indexj)=y - i ;  
%----------------------half pixel motion estimation --------------------------  
%---------------------this is the part that needs your attention ---------------  
            min\_MAD = 256\*grammes\*stiles;  
            for m = vectorsy(indexi,indexj)-0.5:0.5:vectorsy(indexi,indexj)+0.5  
                for n = vectorsx(indexi,indexj)-0.5:0.5:vectorsx(indexi,indexj)+0.5   
                    if ( y+m < 1 )  
                        continue;  
                    end  
                    if ( y+m > grammes - blocksize + 1 )  
                        continue;  
                    end  
                    if ( x+n < 1 )   
                        continue;   
                    end  
                    if ( x+n > stiles - blocksize +1 )  
                        continue;  
                    end  
                    currentblock = .5\*anchor(i:i+blocksize-1, j:j+blocksize-1);  
                    referenceblock = .5\*reference(y+m:y+m+blocksize-1, x+n:x+n+blocksize-1);  
                    thiserror=MAD(double(currentblock), double(referenceblock), blocksize);   
                    if (thiserror<min\_MAD)  
                        min\_MAD=thiserror;  
                        dy=m;  
                        dx=n;  
                    end  
                    count = count + 1;  
                end  
            end  
            vectorsx(indexi,indexj)=dx ;  
            vectorsy(indexi,indexj)=dy ;  
            temp = temp + 1;  
            %arxikopoioume ton pinaka me ta sfalmata kai   
            %epanalamvanetai i idia diadikasia  
            errors= ones(3,3)\*256\*grammes\*stiles;  
%----oti kai na ginei panta kataligo na psaxno ta 8 geitonika----  
%----simeia tou kentrou. to thema einai posa vimata tha kano ----  
%----me megisto arithmo vimaton ta 4  
        end   
    end  
    %disp([i,j,br,bc,dx,dy,min\_MAD,thiserror]);  
end  
  
for i = 1 : blocksize : grammes-blocksize+1  
    for j = 1 : blocksize : stiles-blocksize+1  
                indexi=floor((i-1)/blocksize)+1;  
                indexj=floor((j-1)/blocksize)+1;  
                dx = vectorsx(indexi,indexj);  
                dy = vectorsy(indexi,indexj);  
                pframe(i:i+blocksize-1, j:j+blocksize-1)=reference(i+dy:i+dy+blocksize-1, j+dx:j+dx+blocksize-1);   
    end  
end   
  
telapsed=toc;  
vectorsx  
calcs = count/(temp - 1);  
calcs  
pframe = imresize(pframe, 0.5, 'bilinear');  
anchor = anchor0 ;  
reference = reference0 ;  
%ypologismos tou PSNR metaksi tou anchor frame kai tou reference frame kai  
%metaksi tou anchor frame kai tou predicted frame  
[PSNR\_ph] = calc\_PSNR(anchor,reference,pframe,blocksize,stiles,grammes)  
  
figure(1)  
imshow(anchor)  
title('anchor frame');  
%subplot(2,1,2);  
imagesc(pframe);  
axis image;  
  
str=sprintf('Prediction from Prev Frame and ME\n4 Step Search Method, PSNR=%5.2fdB',PSNR\_ph);  
title(str);  
  
figure(2)  
imshow(reference);  
title('reference frame');  
figure(3)  
imshow(pframe)  
title('predicted frame');  
figure(4);  
quiver(vectorsx,vectorsy);  
set(gca, 'YDir', 'reverse')  
title('Motion Vectors');  
axis image  
telapsed  
count  
temp  
end