MVCE problem

Minimum volume covering ellipsoid problem

Ellipsoid definition

The problem definition

For the sake of simplicity let us write this as

The expression is not convex. But there are some manipulations that we can take advantage of.

The change of variables

It is “extremely easy to see” that this is equal to

Let us state the problem once again

Let us look at the objective term , this can be simplified to

And

Therefore

And the problem can be stated as

Which is equivalent to the problem given as

Which is a convex problem. To obtain the original variables

And can be recovered.

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| Matlab code |
| %% add MOSEK  %% add YALMIP  clear all,close all,clc;yalmip('clear');  %%  rng(12345);  center\_x = randi([-10, 10], 1);  center\_y = randi([-10, 10], 1);  %  x\_vec = randn(1, 1000) + center\_x;  y\_vec = randn(1, 1000) + center\_y;  plot(x\_vec,y\_vec,'k.');  %%  b=sdpvar(2,1);  A=sdpvar(2,2);  F=[];  for ii=1:1:length(x\_vec)  F=[F;norm(A\*[x\_vec(ii);y\_vec(ii)]+b)<=1];  % F=[F;[[x\_vec(ii);y\_vec(ii)]-b]'\*A\*[[x\_vec(ii);y\_vec(ii)]-b]<=1];  end  options = sdpsettings('solver','mosek');  diagnostics=optimize(F,[-logdet(A)],options)  A=value(A);  b=value(b);  %%  Q=A'\*A;  c=[-b'\*A\*inv(Q)]';  P=inv(Q);  %%  fimplicit(@(x,y) Q(1,1)\*x.^2+Q(2,2)\*y.^2+2\*Q(1,2).\*x.\*y-1); |

Minimum enclosing circle problem

By using

This is a convex problem.

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| Matlab code |
| %% add MOSEK  %% add YALMIP  clear all,close all,clc;yalmip('clear');  %%  rng(12345);  center\_x = randi([-10, 10], 1);  center\_y = randi([-10, 10], 1);  %  x\_vec = randn(1, 1000) + center\_x;  y\_vec = randn(1, 1000) + center\_y;  plot(x\_vec,y\_vec,'k.');  %%  c=sdpvar(2,1);  r2=sdpvar(1,1);  F=[];  for ii=1:1:length(x\_vec)  F=[F;norm([x\_vec(ii);y\_vec(ii)]-c,2)^2<=r2];  end  options = sdpsettings('solver','mosek');  diagnostics=optimize(F,[r2],options)  r2=value(r2);  c=value(c);  %%  r=sqrt(r2);  plot(x\_vec,y\_vec,'ro'); hold on;  plot\_2D\_circle(c,r);  %% functions  function plot\_2D\_circle(c,r)  hold on;  for theta=-pi:0.01:pi  plot(r\*cos(theta)+c(1),r\*sin(theta)+c(2),'b.'); hold on;  end  end |