

MATLAB R2023a - academic use

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FILE NAVIGATE CODE ANALYZE SECTION RUN

Current Folder: C:\S_Local\ME 570\Assignment 3\Matlab\homework3(16)

Editor - C:\S_Local\ME 570\Assignment 3\Matlab\homework3(16)\qp_supervisor.m

```
1 %function [uOpt,deltaOpt]=qp_minEffort(AAttr,bAttr,ABarrier,bBarrier,m,varargin)
2 %Solves the optimization problem
3 % min_u 0.5*||u-u_ref||^2
4 % subject to
5 % AAttr*u+bAttr<=0
6 %Optional arguments
7 % 'method',name Select the method to use to formulate and solve the QP
8 % 'cvx' Use CVX. Easier to write, but slower
9 % 'quadprog' Use Matlab's quadprog. Requires explicit matrices and
10 % vectors for the cost, but faster.
11 function [uOpt]=qp_supervisor(ABarrier,bBarrier,uRef,varargin)
12
13 ABarrier = [-1,0;0,1];
14 bBarrier = [0;0];
15 uRef = [1;1];
16 method = 'cvx';
17 %optional parameters
18 ivarargin=1;
19 while(ivarargin<=length(varargin))
20     switch(lower(varargin{ivarargin}))
21         case 'method'
22             ivarargin=ivarargin+1;
23             method=lower(varargin{ivarargin});
24         otherwise
25             disp(varargin{ivarargin})
26             error('Argument not valid!')
27         end
28     end
29     ivarargin=ivarargin+1;
30 end
31
32 switch method
33     case 'cvx'
34         cvx_begin quiet
35             variables u(2,1)
36             uDiff=u-uRef;
37             minimize(uDiff'*uDiff)
38             %Octave version: minimize pow_pos(norm(u-uRef,2),2)
39             subject to
40                 ABarrier*u+bBarrier<=0
41             cvx_end
42             if ~strcmp(cvx_status,'Solved')
43                 %The problem is infeasible
44                 error('The QP problem was not solved because CVX found it %s',cvx_status)
45             end
46         case 'quadprog'
```

qp_supervisor.asv (Editor Autosave)

Workspace

Name	Value
ABarrier	[-1,0;0,1]
bBarrier	[0;0]
f	@(x1,x2)0.5*([x1;x2]-...
F	61x61 double
uOpt	[1.0000;-1.0443e-09]
uRef	[1;1]
X1	61x61 double
X2	61x61 double

Command Window

11:21 PM 10/25/2023

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qp_supervisor.m

```

36 minimize(uDiff*uDiff)
37 %Octave version: minimize pow_pos(norm(u-uRef,2),2)
38 subject to
39 A*Barrier*u+b*Barrier<=0
40 cvx_end
41 if ~strcmp(cvx_status,'Solved')
42 %The problem is infeasible
43 error('The QP problem was not solved because CVX found it %s',cvx_status)
44 end
45 case 'quadprog'
46 H=eye(size(uRef,1));
47 f=-uRef;
48 A=A*Barrier;
49 b=-b*Barrier; %quadprog uses the constraint Ax<=b instead of Ax+b<=0
50 opts=optimset('Display','None');
51 [u,~,exitFlag]=quadprog(H,f,A,b,[],[],[],uRef,opts);
52 if exitFlag<=0
53 %There was a problem in the optimization
54 error('The QP problem was not solved (exitFlag = %d)', exitFlag)
55 end
56 flagFeasible=all(A*Barrier*u<=b+1e-9);
57 if ~flagFeasible
58 %The problem is infeasible
59 error('quadprog did not find a feasible solution (exitFlag = %d)',exitFlag)
60 end
61 % Create the contour plot
62 f = @(x1, x2) 0.5 * ([x1; x2] - uRef)' * ([x1; x2] - uRef);
63 [X1, X2] = meshgrid(-3:0.1:3, -3:0.1:3);
64 F = arrayfun(f, X1, X2);
65
66 % Display the contour plot
67 figure;
68 contour(X1, X2, F, 35);
69 hold on;
70 fill([0, 3, 3, 0], [0, 0, -3, -3], 'c', 'FaceAlpha', 0.3);
71 plot(uOpt(1), uOpt(2), 'ro', 'MarkerSize', 5, 'LineWidth', 5);
72 title('Image');
73 xlabel('x1');
74 ylabel('x2');
75 legend('Level sets for f(x)', 'Feasible Set', 'u_opt');
76 grid on;
77 axis equal;
78
79 end
80 uOpt=u;

```

Workspace

Name	Value
ABarrier	[-1,0,0,1]
bBarrier	[0;0]
f	@(x1,x2)0.5*([x1;x2]-...)
F	61x61 double
uOpt	[1.0000;-1.0443e-09]
uRef	[1;1]
X1	61x61 double
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Image

