

Duke University
Department of Civil and Environmental Engineering
CE 130L. Uncertainty, Design, and Optimization
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Example of Running Constrained Minimization Codes
Optimized Step-Size Random Search (ossrs)
Nelder-Mead with inequality constraints (fminc)
Sequential Quadratic Programming (oldSQP)

Cost function

minimize: $J = f(x_1, x_2) = (x_1 - c_1)^2 + (x_2 - c_2)^2$, where c_1 and c_2 are constants,

Constraints

such that: $g_1(x_1, x_2) = ((x_1 - 0.2)^2 + (x_2 - 0.5)^2) - 0.3 \leq 0$,
 $g_2(x_1, x_2) = -((x_1 + 0.5)^2 + (x_2 - 0.5)^2)2.0 + 1.5 \leq 0$,

and $0 \leq x_i \leq 1$

Code

```
1 function [ cost, constraints ] = optim_example_analysis( x, c )
2 % test problem 0 from
3 % K.Deb,
4 % 'An efficient constraint handling method for genetic algorithms,'
5 % Comput. Methods Appl. Mech. Engrg. 186 (2000) 311-338.
6
7 % H.P. Gavin, Dept. Civil & Environ. Eng'g, Duke Univ., 2011-1-25
8
9 cost = ( x(1) - c(1) )^2 + ( x(2) - c(2) )^2;
10
11 constraints = [ (( x(1)-0.2)^2 + (x(2)-0.5)^2 ) * 1 - 0.3 ;
12               -(( x(1)+0.5)^2 + (x(2)-0.5)^2 ) * 2.0 + 1.5 ];

1 % optim_example_opt.m
2 % H.P. Gavin, Dept. Civil & Environ. Eng'g, Duke Univ., 2011-1-25
3
4 p_min = [ 0 , 0 ];           % minimum allowable parameter values
5 p_max = [ 1 , 1 ];           % maximum allowable parameter values
6
7 p_init = x_min + rand(1,2).*(x_max - x_min); % random initial guess, or ...
8 % p_init = [ 0.8 ; 0.8 ];     % a specified initial guess
9
10 c      = [ 0.8 , 0.2 ];      % other constants used in the cost function
11
12
13 % algorithmic parameters ...
14 %      display tolX tolF tolG MaxEvals Penalty
15 opts = [      3      1e-2 1e-2 1e-2 5e2 1.0 ];
16
17 [p_opt,f_opt,g_opt,cvg_hst] = ossrs('optim_example_analysis', p_init, p_min, p_max, opts, c );
18
19 [p_opt,f_opt,g_opt,cvg_hst] = fminc('optim_example_analysis', p_init, p_min, p_max, opts, c );
20
21 [p_opt,f_opt,g_opt,cvg_hst] = oldSQP('optim_example_analysis', p_init, p_min, p_max, opts, c );
```

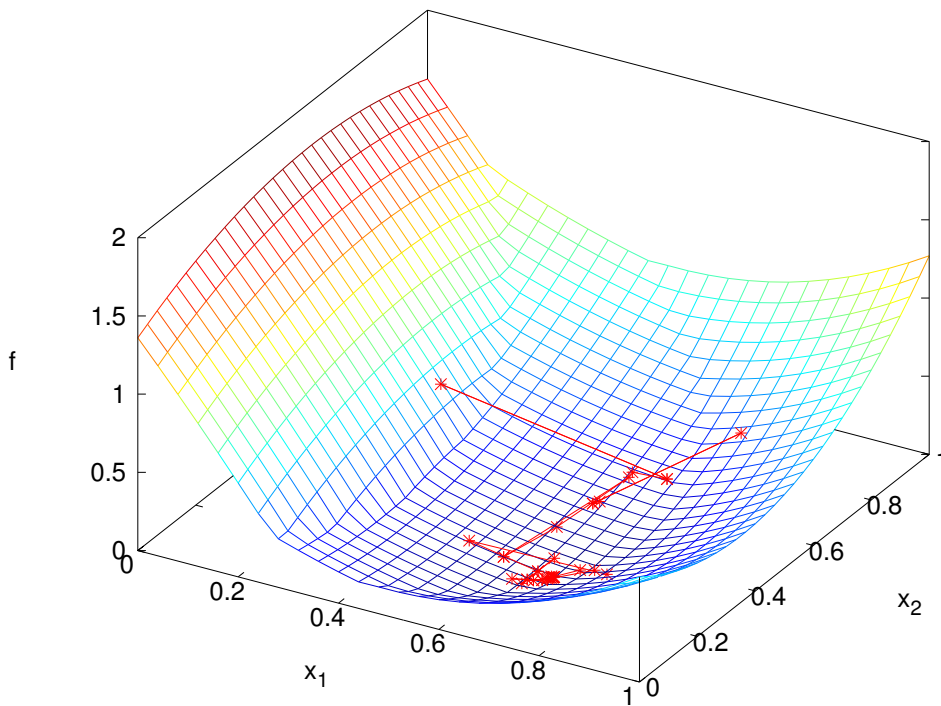


Figure 1. OSSRS convergence on penalized objective function surface.

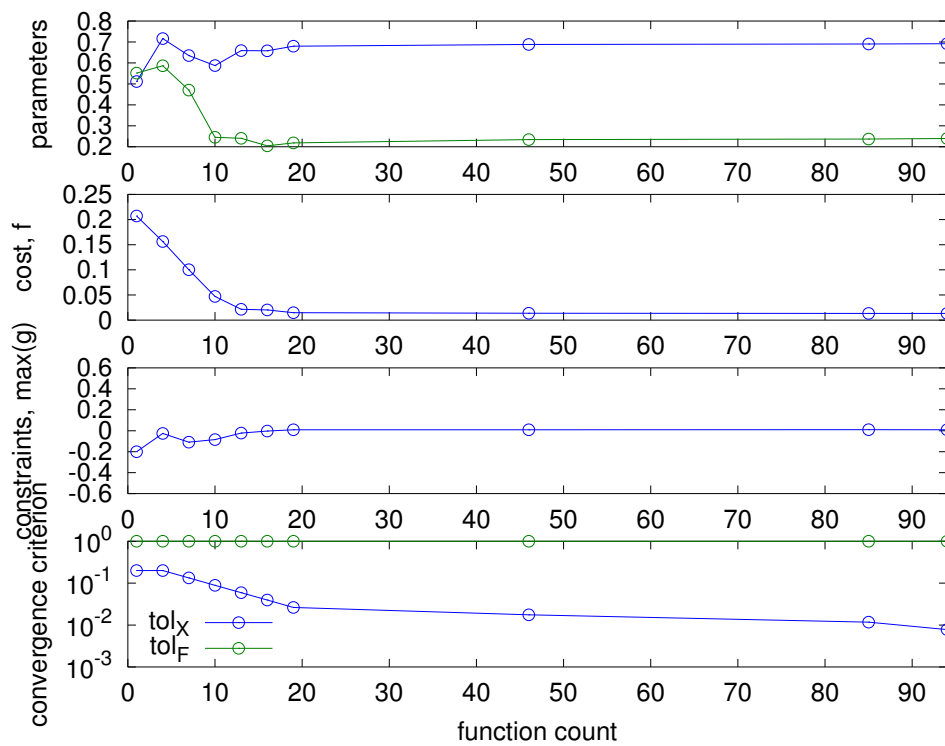


Figure 2. OSSRS convergence histories.

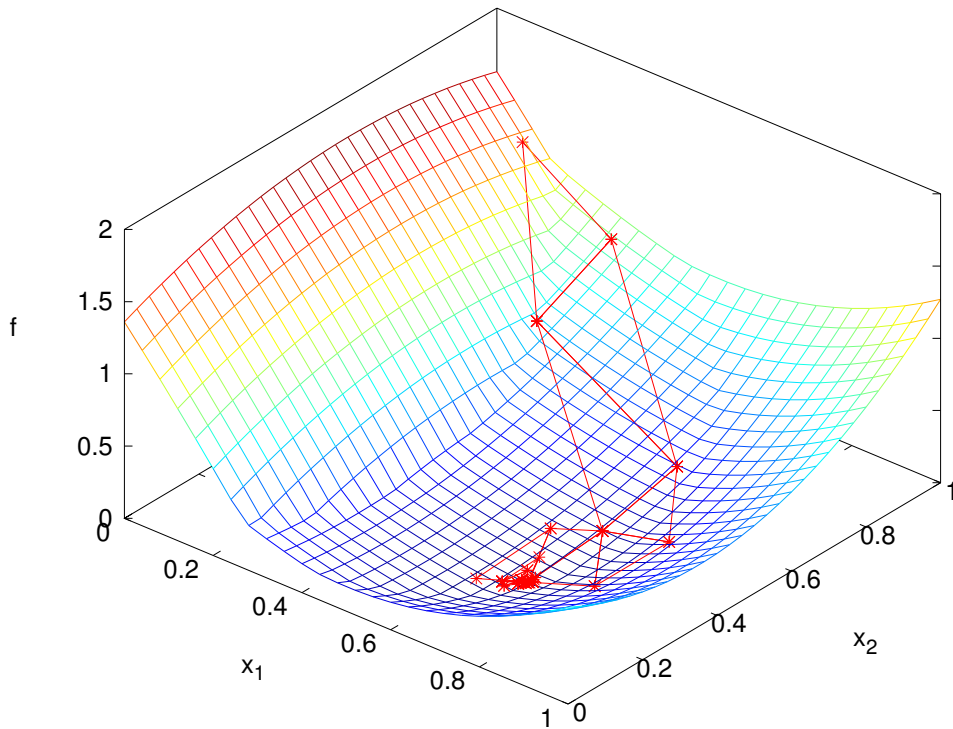


Figure 3. FMINC convergence on penalized objective function surface.

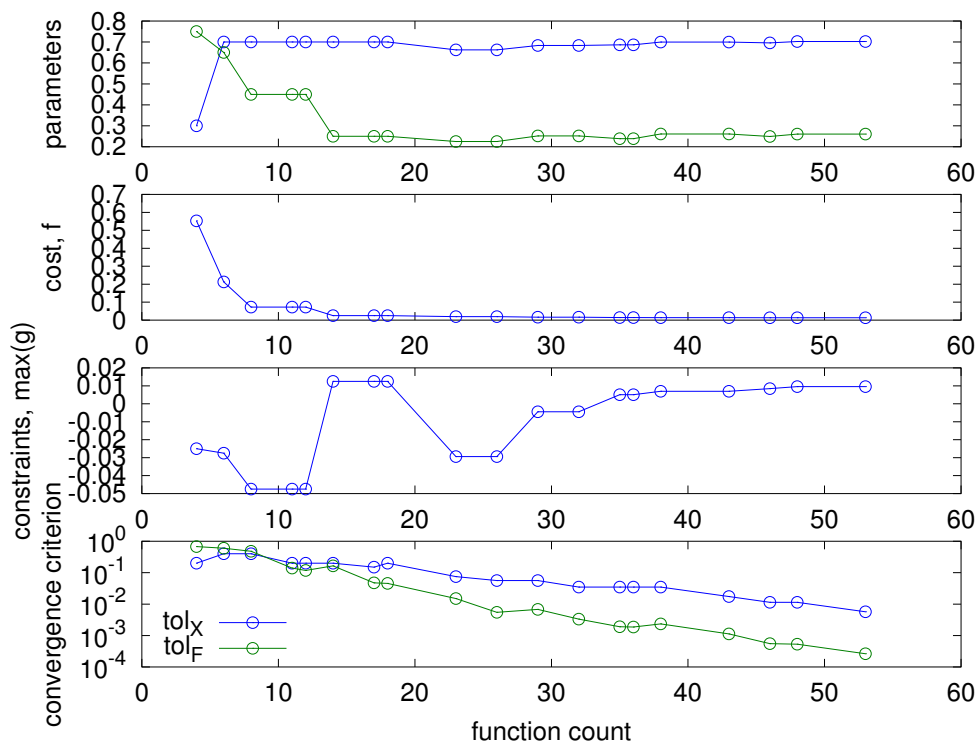


Figure 4. FMINC convergence histories.

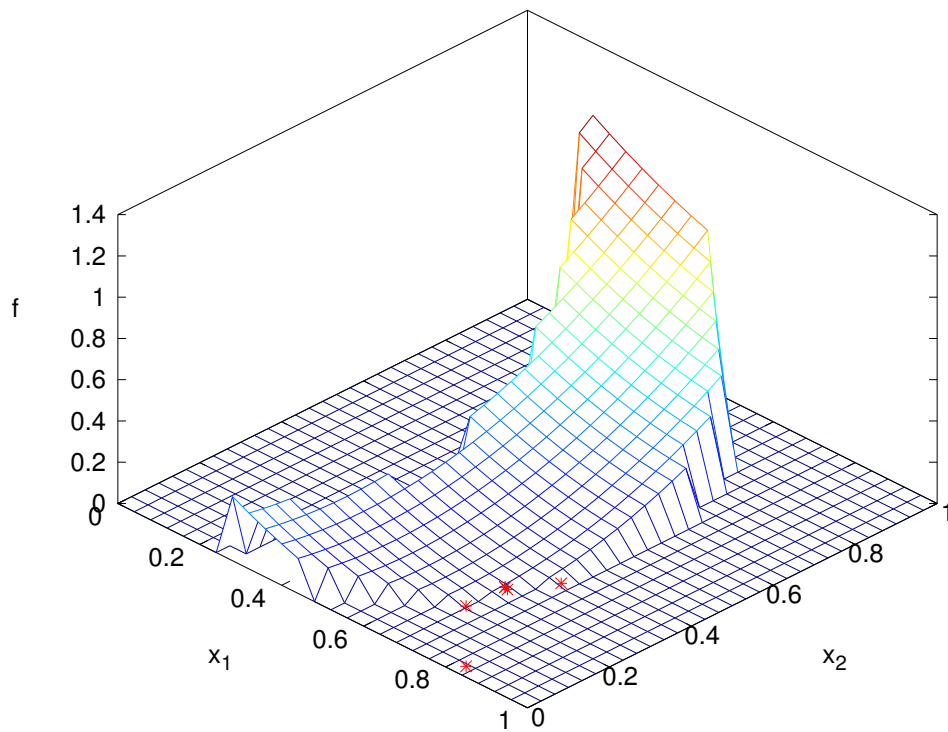


Figure 5. oldSQP convergence on penalized objective function surface.

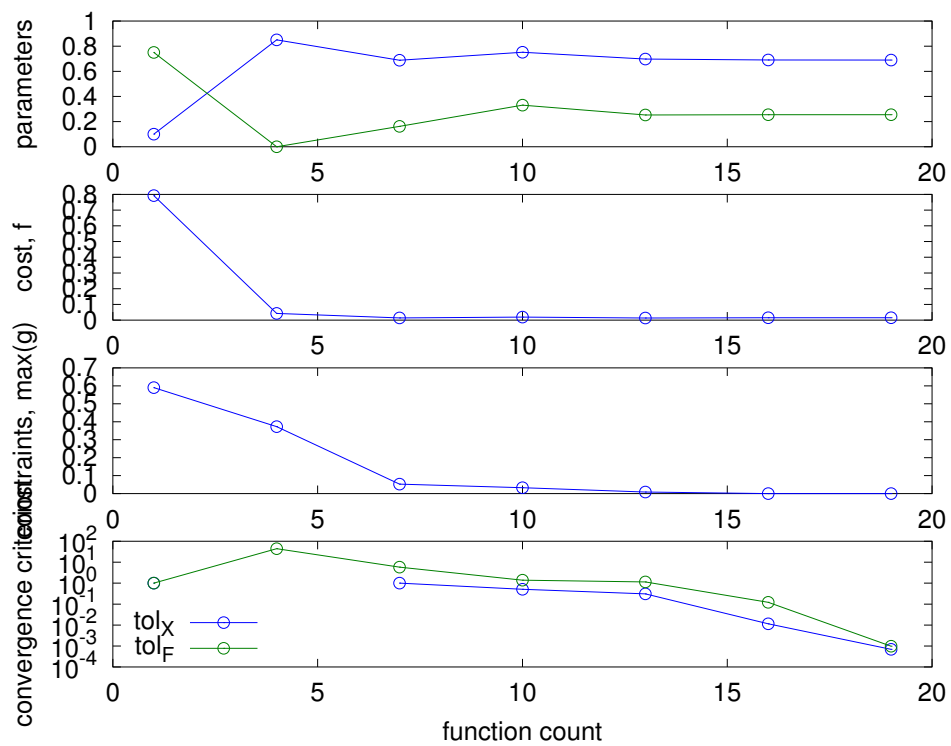


Figure 6. oldSQP convergence histories.