Homework #4: Constrained Optimization — ME 575

due 3/4/2015 before class via Learning Suite — **50 possible points**

This assignment will give you a chance to make more headway on your project, and learn more about constrained optimization.

4.1 Come up with a simplified version of your project as a "rapid prototype" or "proof of concept". The problem must have multiple design variables and multiple constraints, and should be solvable using a gradient-based method. Describe your problem in detail, and discuss any reformulation, scaling, spline parameterization, or other techniques you used to translate your engineering problem into a problem suitable for optimization.

4.2 Solve your problem using an existing optimizer (e.g., fmincon, SNOPT, etc.).

4.3 Write a constrained gradient-based optimizer to solve your problem using two different approaches (e.g., penalty method, SQP, interior point, etc.). Your two approaches do not need to be two completely different methods, although they can be, but can be two variations of a single method. It would be nice to use the code you wrote in HW2 for unconstrained optimization to solve any unconstrained subproblems, but if you cannot make it work you are welcome to use an existing optimizer for those subproblems. During development, I would suggest first testing your optimizer on a simple analytic problem rather than your more complicated problem, but that is up to you.

4.4 Compare the solution accuracy and convergence efficiency of the optimizers, discuss the results and findings of your problem, and discuss plans for expanding towards the final project.

Notes:

- Task 4.1 can be done with your project team, but does not have to be. In other words you may want to define and create your simplified simulation together, or you may choose to explore different simplified simulations as a way to test out different ideas and approaches. Whichever you choose, the remaining tasks (4.2–4.4) should be done individually. I would like each of you to gain experience with the solvers and develop understanding of how they work.
- I realize that some of you have problems that contain integer variables or are discontinuous. If that describes your project, come up with a smooth version of your problem that is differentiable. We will have an opportunity to explore non-gradient based methods in the next module.