Augmented Lagrangian Visualizer

James Anderson, August 2024

This app can be run by double-clicking the file "AL_Visualizer_App.mlapp"

The objective function can be changed by editing the box labeled "f =" and the constraints can be changed by editing the x and y values of the control points under the labels "X:" and "Y:" or by adding and removing control points. To begin the optimization, press the "NEXT STEP" button.

The top center plot displays the objective function with inequality constraints indicated by colored lines and shaded regions. At each step of the AL method, the app displays a plot of the unconstrained AL subproblem at that step and the current estimates of the Lagrange multipliers. Each AL subproblem is solved using fminunc, which means MATLAB Optimization Toolbox is required.

Algorithm 1 Augmented Lagrangian method used in AL Visualizer App

$\mu \leftarrow$ Initial penalty parameter=10
$\mu_{\max} \leftarrow$ Maximum penalty parameter=1e6
$\alpha \leftarrow$ Penalty parameter increase rate=10
$\boldsymbol{\lambda} \leftarrow$ Initial Lagrange multipliers=vector of 0's
$\mathbf{x}, \mathbf{y} \leftarrow$ Initial design variables
$f \leftarrow$ Objective function
$g \leftarrow$ Constraint function
$h \leftarrow \max(-\frac{\boldsymbol{\lambda}}{\mu}, \mathbf{g}\left(x, y\right))$
Iter $\leftarrow 0$
for Advance to next step **do**
    $\mathbf{x}, \mathbf{y} \leftarrow$ fminunc minimization of: $\left(f + \boldsymbol{\lambda}^T \mathbf{h} + \frac{\mu}{2} \sum_{i=1}^{n_{\text{constraints}}} (h_i)^2\right)$
    $\boldsymbol{\lambda} \leftarrow \max(\boldsymbol{\lambda} + \mu \mathbf{h}, \mathbf{0})$
    $\mu \leftarrow \min(\alpha * \mu, \mu_{\max})$
    Iter $\leftarrow$ Iter + 1
end for