Incremental Weak Subgradient Method for Large Scale Machine Learning Problems

Gulcin Dinc Yalcin
Eskisehir Technical University
Iki Eylul Campus
Engineering Faculty
Department of Industrial Engineering
Eskisehir, Türkiye
gdinc@eskisehir.edu.tr

Abstract

In optimization problems, when the problem is differentiable, gradient search methods are developed using the gradient concept. When it is nonsmooth, the solution methods are based on the subdifferential concept which is valid under the convexity condition. Subgradients defined for convex functions are the general mapping of gradients. If the problem is not convex, the weak subgradient can be used. The weak subgradient is defined with a more analytical approach to nonconvex and nonsmooth optimization problems and it is provided to generalize the concept of subgradient for nonconvex. In the problem of optimizing the sum of a finite number (m) of functions, incremental methods that use the gradient (or subgradient) of each function one by one work faster than non-incremental methods, especially when the number of m is larger.

Machine learning problems are optimization problems based on "minimizing the sum of the finite number of functions", which is the minimization of the loss function that shows the difference between the real data label and the estimated data label. The semidefinite machine learning problem (SML) contains nonlabelled data and contains nonsmooth nonconvex functions. The aim of this study is to develop an incremental weak subgradient method for SML problems. We work on the incremental weak subgradient method, which starts with an initial solution and calculates a new solution by using the weak subgradient values of one of the functions with random order at the current solution in each subsequent iteration. The convergence properties of the method are investigated and SML problems are solved.

Keywords
Nonsmooth optimization, nonconvex optimization, weak subgradient, semidefinite machine learning

Acknowledgements
This study is supported by Eskisehir Technical University Scientific Research Projects Commission under grant no: 22ADP279.

Biography
Gulcin Dinc Yalcin is an Assistant Professor of Industrial Engineering at Eskisehir Technical University, Department of Industrial Engineering, Türkiye She obtained her doctorate degree at Anadolu University, Türkiye and she was a post-doctoral researcher at Lehigh University, Department of Industrial and System Engineering, Bethlehem, PA, USA. Her research interest includes nonsmooth optimization, multi-objective optimization and their applications into various problems, logistics problems especially in vehicle routing problems, location problems, and multi-criteria decision making. She is a member of SIAM, Operations Research Society in Türkiye and Mathematical Optimization Society.