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A CODE-BASED DISTRIBUTED GRADIENT DESCENT SCHEME FOR DECENTRALIZED CONVEX OPTIMIZATION

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Abstract. In this paper, we consider a large network containing many regions such that each region is equipped with a worker with some data processing and communication capability. For such a network, some workers may become stragglers due to the failure or heavy delay on computing or communicating. To resolve the above straggling problem, a coded scheme that introduces certain redundancy for every worker was recently proposed, and a gradient coding paradigm was developed to solve convex optimization problems when the network has a centralized fusion center. In this paper, we propose an iterative distributed algorithm, referred as Code-Based Distributed Gradient Descent algorithm (CoDGraD), to solve convex optimization problems over distributed networks. In each iteration of the proposed algorithm, an active worker shares the coded local gradient and approximated solution of the convex optimization problem with non-straggling workers at the adjacent regions only. In this paper, we provide the consensus and convergence analysis for the CoDGraD algorithm and we demonstrate its performance via numerical simulations.

1. Introduction

Convex optimization on a network of large size has played a significant role for solving various problems, such as big-data processing in machine learning, distributed parameter estimation in wireless sensor networks, distributed sampling and signal reconstruction, distributed design of filter banks, distributed spectrum sensing in cognitive radio networks, source localization in cellular networks [7, 8, 10, 12, 18, 19, 23, 24]. The objective functions f in such optimization problems,

$$f(\mathbf{x}) = \sum_{l=1}^{m} f_l(\mathbf{x}),\ \mathbf{x} \in \mathbb{R}^N, \tag{1.1}$$

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