Paper Review: On Unbounded Delays in Asynchronous Parallel Fixed-Point Algorithms

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As Moore′s law is coming to inevitably end, CPUs will only become faster through the addition of more cores rather than more powerful cores. The increasing demands for solving large-scale optimization problems motivate the development of algorithm parallelization. Nevertheless, most of the existing parallel algorithms are synchronous algorithms, which may become impractical on busy networks. Specifically, the issues such as the network latency and the packet loss, make synchronous-parallel algorithm extremely expensive and inefficient. On the contrary, asynchronous algorithms are resilient to the above problems and many other common problems on large congested networks, where nodes simply computes their next updates using the most recent information they has received, instead of waiting to receive all the results at the current iteration.

Therefore, this paper focuses on the convergence of ARock which allows a set of nodes randomly choose solution coordinates to update in an asynchronous parallel fashion, under possibly unbounded delays. Note that ARock, a general asynchronous algorithm, takes many popular algorithms as its special cases, including asynchronous block gradient descent, proximal point, forward backward, and so on. Compared with the existing literatures of ARock with the assumption of bounded delays or strict conditions on the underlying fixed-point operator, the authors show that the iterates of ARock converge weakly to a solution with probability 1 under unbounded delays, which can be either stochastic or deterministic. Moreover, they also propose more practical and larger step sizes than those in the existing works. Due to ARock covering a range of algorithms, these results also have broad implications and applications.