Computational of iterative algorithms to solving signal processing

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ABSTRACT

Nowadays, there is growing interest for modelling various important problems in science and engineering. This is mostly due to the increasing availability of experimental data and/or computing power. The abstract structure for one of such models has a composite structure, where the objective function is a sum of smooth components and non-smooth parts. This modelling formulation is prevalent in signal processing, machine learning, and deep learning. Thus, it is a vital problem to study. On the other hand, another critical segment is the strategies for solving such problems that leverage the problem's inherent structure. The classic algorithms include proximal gradient descent(ProxGD), fast iterative shrinkage thresholding algorithm(FISTA) and their variants, including stochastic ones). Although these algorithms do well in some instances, one of the challenges associated with some existing methods is that their performance is sub-optimal and often limited to some class of problems.

The presentation will be about some algorithmic formulations that are efficient, robust and easy to implement for solving a non-smooth composite objective function. In particular, a novel stochastic conjugate gradient-based algorithm has been developed. This approach is unlike the existing approaches; it possesses significant characteristics such as variance-reduced property, mini-batching and so on, with an aim at improving the convergence property of the original stochastic gradient descent (SGD) and its improved variations, which rely only on computing randomized gradients. In addition to the proposed stochastic conjugate gradient direction, an additive learning-rate scheme is coined, which is easy to compute. Thus, unlike the existing algorithms, this established algorithm has minimal computational overhead. Furthermore, a thorough theoretical convergence analysis is carried out under some minimal assumptions, and computational complexity is also discussed. Finally, extensive numerical experiments on various paradigms of the non-smooth objective function modelled as signal progressing supervised empirical risk minimization on some real-world datasets. This empirical study is done to verify the proposed algorithm's efficacy as compared to other state-of-art stochastic variants.

Dr. Poom KUMAM (Senior IEEE) is a full Professor in mathematics (at age 37 No.13 in Thailand) the Department of Mathematics, Faculty of Science, King Mongkut's University of Technology Thonburi (KMUTT), Thailand since 2015. He is the head of the Center of Excellence in Theoretical and Computational (TaCS-CoE) and KMUTT Fixed Point Theory and Applications Research Group (KMUTT-FPTARG). Head of CaRe NETWORK Global Research Network Center under Global Leader Project of PMU-B since 2023. His research targeted fixed-point theory, variational analysis, random operator theory, optimization theory, and approximation theory. Also, Fractional differential equations, Differential game, Entropy and Quantum operators, Fuzzy soft set, Mathematical modelling for fluid dynamics and areas of interest Inverse problems, Dynamic games in economics, Image restoration, Signal and image processing, Game Theory and Cryptology. He has provided and developed many mathematical tools in his fields productively over the past years. Dr.Poom has over 1,000 scientific papers (updated June. 2022) and projects either presented or

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He has been Thomson Reuters Highly Cited Researcher (HCR) for the periods: 2015, 2016, 2017 and 2022 (published multiple highly cited papers, ranking in the top 1% by citations for field and year over the last decade. Of all the world's researchers, they are one in 1,000). He has also been listed and ranked in the 25th Place in General Mathematics among the Top 2% Scientists in the World 2020-2022 (Published by Stanford University in USA). In 2021, he was one of the leading professors of applied mathematics in Thailand who work at KMUTT, has been ranked as the Mathematics Best Scientist in Thailand (Number 1 Mathematician in Thailand) according to the 2021 Alper-Doger Scientific Index (also known as AD Scientific Index).

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