

Fundamentals of Deterministic Adaptive Signal Processing and Portfolio Selection

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The field of adaptive signal processing experienced dramatic growth due to the proliferation of new and exciting applications ranging from Internet, wireless communications to multimedia and quantitative finance. Adaptive systems have become an integral part of information and telecommunications industries as a result of advances in device technology. As the range of environments that these signal processing applications are expected to work are increasing, there is now a greater need for adaptive algorithms that can operate efficiently in the presence of a wide range of environmental uncertainties and volatility with relatively low computational complexity. In this context, there exist significant practical and theoretical difficulties to adaptive signal processing, since there is usually no or little knowledge about the statistical properties of the underlying signals or systems involved. Furthermore, the classical robust methods that are resilient to such challenges are overly conservative and usually static such that they provide profoundly inferior results on the average, deeming them practically useless.

In order to provide robust adaptive methods that also perform satisfactorily in real life applications, we introduce a completely radical approach to adaptive signal processing. Here, we aim to design adaptive methods that are mathematically “guaranteed” to “work” uniformly for all possible signals without any explicit or implicit statistical assumptions on the underlying signals or systems. In this sense, to the best of our knowledge, this is the first approach to build adaptive systems that can operate effectively in the presence of large degrees of environmental variability and uncertainty without sacrificing performance. In that, we seek to construct adaptive algorithms that sequentially perform as well as the best “batch” adaptive algorithm, for any signal, that had the ability to observe all of the data in advance, and select the best model, best adaptation method and the best model parameters before even beginning to process the data. This approach is completely different than the classical adaptive and robust signal processing methods since we avoid any statistical assumptions and unlike these methods our results are guaranteed to hold, not on the average, but in an individual sequence manner. These results could both dramatically improve performance of adaptive signal processing methods and significantly expand the range of possible environments that these algorithms can operate. This radical approach would provide the required tools in data prediction, pattern estimation, attribute derivation and adaptive data modeling to deal with the open-ended and frequently changing conditions of real life applications. Towards this end, as an example real life application, we investigate portfolio selection problem from a deterministic adaptive signal processing perspective and introduce algorithms that are guaranteed to work with exact performance bounds.

Short Bio:

Suleyman Serdar Kozat received the B.S. degree with full scholarship and high honors from Bilkent University, Turkey. He received the M.S. and Ph.D. degrees in electrical and computer engineering from University of Illinois at Urbana Champaign, Urbana, IL, in 2001 and 2004, respectively. He is a graduate of Ankara Fen Lisesi.

After graduation, Dr. Kozat joined IBM Research, T. J. Watson Research Center, Yorktown, NY as a Research Staff Member in Pervasive Speech Technologies Group, where he focused on problems related to statistical signal processing and machine learning. While doing his Ph.D., he was also working as a Research Associate at Microsoft Research, Redmond, WA, in Cryptography and Anti-Piracy Group. He holds several patent applications for his works performed in IBM Research and Microsoft Research. Currently, Dr. Kozat is an Assistant Professor at the electrical and electronics engineering department, Koc University, Turkey. Dr. Kozat coauthored more than 50 papers in refereed high impact journals and conference proceedings and has several patent applications. Overall, his research interests include intelligent systems, adaptive filtering for smart data analytics, online learning and machine learning algorithms for signal processing.

Dr. Kozat has been serving as an Associate Editor for the IEEE Transactions on Signal Processing and he is a Senior Member of the IEEE. He has been awarded IBM Faculty Award by IBM Research in 2011, Outstanding Faculty Award by Koc University in 2011, Outstanding Young Researcher Award by the Turkish National Academy of Sciences in 2010, and holds Career Award by the Scientific Research Council of Turkey, 2009. Dr. Kozat has won several scholarships and medals in international and national science and math competitions.