Consolidator Researcher Talk Mini Symposium 2025

Analytical Bit Error Rate Bounds via Marcum-Type Functions in Signal Processing

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Abstract:

The generalized Marcum Q-function is a special function that arises in several areas of engineering and applied mathematics, particularly in radar signal processing, communications theory, and statistical detection theory. For example, in detection theory the generalized Marcum Q-function gives the probability of detection in radar systems when a signal is present (non-central chi-squared distribution). Bounds on the generalized Marcum Q-function are an active area of research due to the function's complexity and its importance in communication theory, radar detection, and statistical signal processing. Accurate and computationally efficient bounds are valuable when numerical evaluation is difficult or when closed-form analysis is needed. In this talk we will review the main properties of the generalized Marcum Q-function, like monotonicity and log-concavity properties, as well as Turán type inequalities and present some tight bounds for this functions. Moreover, as an application an interesting approximation is given for the bit error rate for the differential quaternary phase shift keying transmission with Gray coding over an additive white Gaussian noise channel.

Short CV:

Árpád Baricz received his Bachelor of Science [B.Sc.], Master of Science [M.Sc.], and Doctor of Philosophy [Ph.D.] degrees in mathematics from Faculty of Mathematics and Informatics, Babeş-Bolyai University of Cluj-Napoca, Romania, in 2003, 2004, and 2008, respectively. In 2008 he also received a Ph.D. degree in mathematics from the Institute of Mathematics, University of Debrecen, Hungary. Currently, he is a full professor at Department of Business Administration, Extension Sfântu Gheorghe, Faculty of Economics and Business Administration, Babeş-Bolyai University, Cluj-Napoca, Romania and at Institute of Applied Mathematics, John von Neumann Faculty of Informatics, Óbuda University, Budapest, Hungary. Since 2006 he teaches in Hungarian and Romanian probability theory and statistics for economics students at Department of Business Administration, Extension Sfântu Gheorghe, Faculty of Economics and Business Administration, Babeş-Bolyai University. Since 2017 he also teaches in English the asymptotic analysis of special functions for applied mathematics master students at Institute of Applied Mathematics, Óbuda University. Moreover, recently Árpád Baricz also teaches in

Hungarian a course on special functions for mathematics students at Faculty of Mathematics and Informatics, Babeș-Bolyai University.

His research interests include orthogonal polynomials and special functions, complex function theory, analytic inequalities, probability theory and recently he is also interested in Riemann-Hilbert problems and asymptotic analysis, especially in the steepest descent method for Riemann-Hilbert problems. The webpage https://sites.google.com/site/bariczocsi/ contains more details about the publications, projects, scientific talks and special courses of Árpád Baricz.