

Digital Communication over Generalized Fading Channels: A Unified Approach to Performance Analysis

Dr. Marvin K. Simon

Signal fading has been an enduring problem since the advent of modern communication systems and most recently has received considerable attention relative to the wireless communication channel. Literally hundreds of authors over the past forty years have contributed to the literature dealing with this problem in one form or another. A large number of these contributions fall into the category of performance evaluation of systems impaired by this phenomenon. Traditional analytical solutions to this problem have, in many instances, taken the form of complicated expressions that provide little or no insight into the dependency of the system behavior on the various system parameters that characterize it. In other cases, closed-form solutions were not possible at all.

Using alternative representations of such classic mathematical functions as the Gaussian probability integral (Q -function), Marcum Q -function, and incomplete gamma function, a unified approach to evaluating the performance of digital communication systems in the presence of fading has been recently proposed. Aside from allowing all previous results to be placed within a common framework, this approach has the additional advantages of: 1) simplifying the analysis and computation of existing results and 2) allowing one to obtain closed-form results for special cases that until now resisted solution. The approach applies to a broad class of signaling/detection types and fading channel models typical of practical communication systems and in all cases the resulting performance expressions obtained can be readily evaluated numerically.

Since the introduction of the above approach, other unifying-type methods have been proposed based on Parseval's theorem and numerical approximation of the inverse Laplace transform. The talk will review and discuss these various performance analysis approaches in the context of their application to the wireless communication channel.