Pioneer Journal of Theoretical and Applied Statistics
Volume 7, Issues 1-2, Pages 15-25 (January & April 2014)

ISSN: 2230-9837

A ROBUST BAYESIAN FORMULATION OF THE OPTIMAL PHASE MEASUREMENT PROBLEM

K. R. W. Jones

Received March 2, 2014; Revised April 28, 2014

Abstract

Optical phase measurement is a simple example of a quantum-limited measurement problem with important applications in metrology such as gravitational wave detection. The formulation of optimal strategies for such measurements is an important test-bed for the development of robust statistical methods for instrument evaluation. However, the class of possible distributions exhibits extreme pathologies not commonly encountered in conventional statistical analysis. To overcome these difficulties we reformulate the basic variational problem of optimal phase measurement within a Bayesian paradigm and employ the Shannon information as a robust figure of merit. Single-mode performance bounds are discussed, and we invoke a general theorem that reduces the problem of finding the multi–mode performance bounds to the bounding of a single integral, without need of the central limit theorem.

Keywords and phrases: Robust Bayesian formulation, optimal phase measurement.