國 立 陽 明 交 通 大 學 電 信 工 程 研 究 所
系 統 組 論 文 研 討

THE EXPONENTIAL RELIABILITY ADVANTAGE OF SEQUENTIALITY IN UNIVERSAL CLASSIFICATION

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Abstract

In sequential hypothesis testing, the decision maker sequentially collects samples from the environment and opportunistically stops to make the decision. Such sequentiality is known to exponentially improve the error probabilities of decision making, that is, the error exponents. Nevertheless, implementing the optimal test requires the knowledge of the underlying distributions. In the scenario where the knowledge of distributions is replaced by empirically observed statistics from the respective distributions, the gain of sequentiality is less understood when subject to universality constraints over all possible distributions. In this work, the gap is mended by a unified study on the exponential reliability advantage of sequentiality in the universal binary classification problem. Under the proposed framework, different sequential setups are investigated so that fair comparisons can be made with the fixed-length counterpart. The optimal error exponents are characterized, and the exponential reliability advantage of sequentiality is shown both analytically and numerically by comparing the sequential and the fixed-length cases. The impact due to the imperfect knowledge of the underlying distributions is demonstrated. We also design universal tests that achieve the optimum for all distributions simultaneously. To prove the results, we develop a unified proof by investigating a more general composite hypothesis testing problem with sequential components, which is interesting in its own right.

Biography

I-Hsiang Wang received the B.Sc. degree in electrical engineering from National Taiwan University, Taiwan, in 2006. He received a Ph.D. degree in electrical engineering and computer sciences from the University of California at Berkeley, USA, in 2011. From 2011 to 2013, he was a postdoctoral researcher at École Polytechnique Fédérale de Lausanne, Switzerland. Since 2013, he has been at the Department of Electrical Engineering in National Taiwan University, where he is now a full professor. His research interests include network information theory, networked data analysis, and statistical learning.