ABSTRACT

Title: Novel Optimal Continuous-Time Cramér-Rao Bound for Signal Parameter Estimation

Digital signal processing, statistical learning, biometric data analysis, and sensor networks all employ electronic signals to model/estimate/predict the behavior of humans, machines and inanimate systems. Information, be it video, audio or data is communicated using telecommunication and wireless networks, satellite links, optical transmission, and mobile communications after converting the information into electronic signals with different parameters which represent the information to be conveyed. The transmission medium, channel, or link also impinges its own characteristics onto the information-bearing signals. Recovery of the information at the user destination requires both estimation of the channel characteristics to allow for removal or compensation of the channel's influences on the information signal, and estimation of the parameters of the signal in order to reconstruct the source information. The measure of goodness of the estimate of the parameters of the signal or the channels is often the variance of the estimate. It may be difficult or impossible to find the exact variance of the estimation and the Cramér-Rao lower bound on the variance of an unbiased estimator has found widespread usage in studying the variance of estimation in a plethora of diverse fields. The bound is always formulated as a discrete-time bound and is usually based on a number of independent samples.

In this talk we present a novel, optimal continuous-time Cramér-Rao bound which is always better or at least as good as any discrete-time Cramér-Rao bound. The study reveals that the fundamental quantity upon which the Cramér-Rao bound depends is not the energy of the signal as is universally believed, but the energy in the derivative function of the signal. An example demonstrates that the application of the novel continuous-time Cramér-Rao bound is simplified compared to the known discrete-time versions of the bound. The new continuous-time bound will benefit non-statisticians as well as theorists.

BIOGRAPHY

Norman C. Beaulieu is an Especially Recruited (Ministerial) Thousand Talents Plan Research Professor at Beijing University of Posts and Telecommunications BUPT in Beijing, China. Educated at the University of British Columbia UBC, McGill University and the Technical University of Denmark, he is a Medalist of the Royal Society of Canada, a Fellow of the Royal Society of Canada, an IEEE Fellow, a Fellow of the Engineering Institute of Canada, a Fellow of the Canadian Academy of Engineering, an NSERC E.W.R. Steacie Memorial Fellow, a Fellow of the Institution of Engineering and Technology IET, and a Copernicus 哥白尼 Visiting Fellow (Italy). He is the only person in the world who holds both the IEEE Edwin Howard Armstrong Technical Achievement Award, named for the inventor of frequency modulation FM, and the IEEE Reginald Aubrey Fessenden Medal named for the inventor of amplitude modulation AM. His research interests centre on the fundamental theory of wireless communications, including 5G, interference systems, channel and signal parameter estimation, cognitive radio, the modelling of wireless channels, applied probability theory, and simulation techniques. Dr. Beaulieu was the Editor-in-Chief of the world's leading research journal in telecommunications, the *IEEE Transactions on Communications* for two terms.