ネットワーク情報理論とモバイルワイヤレス通信

Network Information Theory and Mobile Wireless Communications

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Abstract

Network Information Theory is an extension of Shannon's Information Theory to Networks. We believe that the key to the successful development of *generation-less* mobile wireless communication systems concepts should be to best-utilize the latest results of Network Information Theory in the most suitable forms, so as to satisfy network objectives and requirements in efficient way. As such, identifying the theoretical performance limits of such systems is of most crucial importance.

It has been well known that the theoretical basis for analyzing the performance of End-to-End Lossless wireless cooperative communication networks is Lossless Distributed Multiterminal Source Coding in Network Information Theory; The distributed multi-terminal assumption is required because cooperative networks are assumed to have massive wireless devices.

The primary objectives of this Seminar Talk are (1) to provide participants with the concept for the elimination of the *End-to-End* (E2E) *Lossless* requirement being reasonable, and (2) to provide mathematical framework for deriving outage probability of the *E2E Lossy* wireless network in fading mobile communication environments accommodating distributed multiple sources.

Especially, this talk focuses on how the Lossy Distributed Multi-terminal Source Coding Theory and its theoretical framework should be modified so that the wireless communications community can get the maximum benefit from this theoretical framework. The use cases of this framework include wireless cooperative communications networks having massive wireless devices, such as wireless mesh networks, relay communications, sensor networks, Internet-of-Things (IoT) and Vehicle-to-Things (V2X) networks. This talk includes theoretical limit analysis, algorithm design, and verification by simulations.

The reason for the pursuance towards the goals described above is that in IoT, V2X, and Edge computing, the *lossless recovery of information observed by the sensing devices should not necessarily be End-to-End Lossless*. In other words, the purpose of IoT network is NOT the full recovery of observations, but to make correct decisions based on the observations made by massive sensing devices which are assumed to be distributed around the target, and hence the corrected information is correlated. By utilizing the source correlation knowledge at the receiver, Ultra Reliable Low Latency Communication (URLLC) is possible,

even though packet-wise transmission is Lossy. Recent results on this topic are introduced, which covers performance analysis of Lossy Multi-source transmission over fading Multiple Access Channels (MACs), such as Wyner Ziv systems over fading MAC. At the final stage of this Tutorial, how the decision-making process based on the Loss observation and transmission are connected to the *distributed hypothesis testing* (*DHT*) is introduced.