WiOpt 2016 – Invited Talk

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Title:
Fundamental limits of remote estimation under communication constraints

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Abstract:
In many applications such as networked control systems, sensor and surveillance networks, and transportation networks, etc., data must be transmitted sequentially from one node to another under a strict delay deadline. In many of such real-time communication systems, the transmitter is a battery powered device that transmits over a wireless packet-switched network; the cost of switching on the radio and transmitting a packet is significantly more important than the size of the data packet. Therefore, the transmitter does not transmit all the time; but when it does transmit, the transmitted packet is as big as needed to communicate the current source realization. In this paper, we characterize fundamental trade-offs between the estimation error (or distortion) and the cost or average number of transmissions in such systems.

Two fundamental limits of this trade-off are characterized for infinite horizon discounted cost and average cost setups. First, when each transmission is costly, we characterize the minimum achievable cost of communication plus estimation error. Second, when there is a constraint on the average number of transmissions, we characterize the minimum achievable estimation error. Transmission and estimation strategies that achieve these fundamental limits are also identified.