We study distributed estimation (DES) problem in power constrained wireless sensor networks (WSNs), where several sensors make noisy observations of an unknown, and transmit locally processed versions of their observations to a fusion center (FC) over wireless channels. The FC reconstructs the unknown via fusing the collective received signals from sensors. We explore the following problems: (i) we derive Bayesian Fisher information matrix (FIM) for bandwidth-constrained DES of a Gaussian vector with linear observation model, where sensors transmit their digitally modulated quantized observations to the FC over power-constrained fading channels. We develop two transmit power allocation schemes from solving the maximization of trace and log determinant of Bayesian FIM, subject to network transmit power constraint, and study the system performance using these schemes. (ii) we consider the DES of a Gaussian source in a hierarchical power-constrained WSN. Sensors within each cluster send their noisy measurements to a cluster head (CH). CHs fuse the received signals and transmit to the FC over orthogonal fading channels. To enable estimation of these fading channels at the FC, CHs send pilots to the FC, prior to data transmission. We derive the MSE corresponding to the LMMSE estimator at the FC, and explore the best power scheduling scheme among sensors and CHs, to minimize the MSE subject to network transmit power constraint. (iii) assuming the DES of a Gaussian source with additive and multiplicative Gaussian observation noises, we derive different estimators including minimum mean square error (MMSE), and maximum posteriori (MAP), and lower bounds on MSE, including Bayesian Cramér-Rao bound (BCRB), and Weiss-Weinstein bound (WWB). We characterize the scenarios that multiplicative noise improves the DES performance (we call the phenomena as enhancement mode (EM) of multiplicative noise), when the variance of multiplicative noise is known/unknown, and also when the observations are quantized/unquantized.

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The public is welcome to attend.