Abstract We consider the problem of making statistical inferences using measurements of distributed sensors. Sensors transmit their local data over a noisy multi-access communication channel to a fusion center. The number of sensors involved in data fusion may be random, and their transmissions are subject to random fading. We propose the use of a Type-Based Multiple Access (TBMA) in which sensors with the same data type share a common transmission waveform, and the multi-access channel delivers a distorted sensor empirical distribution. We present algorithms and analysis of distributed detection and estimation using TBMA in asymptotic regimes where the (average) number of transmissions is large. In the absence of random fading or when channel state information is available at the transmitter, we show that TBMA coupled with an asymptotic maximum likelihood method is optimal. Effects of channel fading are quantified. For channels with zero mean random fading, the single-transmission TBMA does not lead to consistent inference, and multi-slot TBMA is necessary. For sensors with statistical duty-cycle schemes, insights into optimal wake-up strategies are obtained.

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