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The role of reproducing densities in a joint likelihood approach to multi-sensor detection and estimation

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In this work, a Bayesian, joint estimation-detection approach is used for computation of sufficient statistics and development of a general multi-sensor information fusion architecture. An approach borrowed from sequential Bayesian processing is used to compute prior densities for joint Bayesian estimation-detection. In this approach, a posteriori densities calculated at one sensor become priors at the next sensor after a coordinate transformation that transforms the outputs of each sensor to a common reference frame for all sensors. Reproducing prior densities are used to simplify the Bayesian iteration scheme and reduce communications requirements. The framework that is developed is equally applicable to networks where all sensors communicate with a centralized detection and estimation processor as well as those networks where sensors relay information from point to point. We anticipate using Bayesian iteration to convert posterior information into prior information on the next data gather cycle, iterate on estimates by exchanging information between sensors, i.e., "turbo likelihood fusion," and having the central decision maker decide when sensors should or should not communicate, depending on a cost criterion which combines information gain versus communication energy expenditure. Simulation are used to show detection and estimation performance under various conditions of sensor position and orientation uncertainty.