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Summary: A maximum likelihood time delay estimation algorithm using Monte Carlo method (MCML) is proposed to solve the problems that the maximum likelihood delay algorithm has high computational complexity due to peak searching and is easy to fall into local convergence. A likelihood function is constructed by using the channel response estimation vector in a frequency domain. Then the MCML translates the time delay estimation into the expectation of a random variable, and a standardization probability density function is built from the index likelihood function to approximate an impulse function, and to make the variance of the random variable approach zero. Finally, the random variable is sampled using the Monte Carlo method, and the time delay is estimated from sampling mean. Compared with the traditional methods, the MCML avoids the grid search, reduces the computational complexity, and ensures the global convergence and estimation accuracy. Simulation results show that the MCML is always close to Cramer-Rao bound, and the time delay estimation range of the MCML is 34% of the MCMC’s range when the signal to noise ratio is from 0dB to 25dB.

**MSC:**

- 94A12 Signal theory (characterization, reconstruction, filtering, etc.)
- 93E10 Estimation and detection in stochastic control theory
- 65C05 Monte Carlo methods

**Keywords:**

maximum likelihood; Monte Carlo method; time delay estimation; Cramer-Rao bound

**Full Text:** DOI