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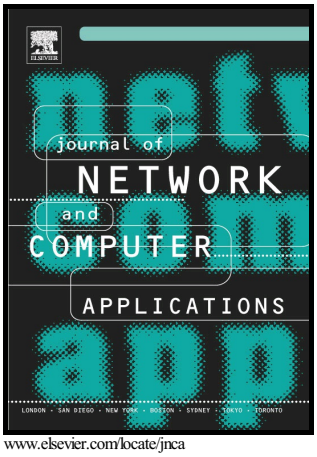

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Improving Time Synchronization in Wireless Sensor Networks using Bayesian Inference

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Abstract

Wireless Sensor Networks are composed of small autonomous devices known as motes. Usually these motes are power-limited and most energy is wasted through the communication process, thus the synchronization is critical. In this paper we improve the accuracy of time synchronization with Bayesian Inference over the Linear Regression model, used in synchronization protocols. Synchronization is generally accomplished using packet exchanges, so the goal is to reduce the number of packets while maintaining perfect synchronization. The constraints are the low-cost hardware components of the motes, in particular their clocks and the power consumption. Long-term synchronization is achieved using Adaptive Time Window Linear Regression algorithms using Least Squares. The method of Least Squares is distribution free, but we can make some feasible assumptions (experimentally validated) to improve these protocols using Bayesian Inference, to achieve an improvement of 12% compared with the related work. In particular, using 80 MHz clock frequency in the motes the mean synchronization error is 147 ns. We propose an algorithm to improve the synchronization under these constraints and we test our method in real deployments.

Keywords:
Time Synchronization, Bayesian Inference, Linear Regression, Wireless Sensor Networks

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