

研究论文

一种简单的分布式无线传感器网络时间同步方案

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摘要:

无线传感器网络缺乏基本架构, 具有分布式、能量受限、存储及计算能力受限的特点. 这些特点决定了在设计无线传感器网络时间同步方案时, 不能有太复杂的计算和路由选择. 为了实现快速时间同步和较低的能量消耗, 提出一种简单的无线传感器网络时间同步方案. 各个节点广播自己当前的时钟信息, 相应的邻居节点接收到这些信息后, 对接收到的信息进行简单的算术平均, 将平均值作为下一个时刻的时钟刻度再进行广播. 此过程反复进行, 最终会使网络所有节点的时钟达到一个相同的平均值, 实现无线传感器网络的分布式同步. 由于网络节点只接收来自邻居节点的广播信息, 故该方案无复杂的路由选择, 并且计算简单, 收敛快速, 能耗较低. 用随机矩阵理论对该同步算法的收敛性进行了理论证明, 对收敛速度和能耗以及同步误差进行了分析. 最后用计算机仿真对本方案进行了仿真实验, 实验结果符合预期分析.

关键词: 同步 时间同步 无线传感器网络

Simple distributed time synchronization scheme for wireless sensor networks

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Abstract:

The wireless sensor network(WSN) is featured by no infrastructure, distribution, resource constraints and limited processing and memory. Accordingly, in designing the time synchronization protocols for wireless sensor networks, intensive computation and complex route selecting are undesirable. For accelerating the time synchronization and lowering energy consumption in the WSN, this paper presents a simple time synchronization scheme for wireless sensor networks. In this scheme, each node broadcasts its clock information and as a result its neighbors will receive the clock information. After averaging the received clock information, the neighbor nodes take the averaged clock information as its next clock tick. This process is carried out repeatedly until all the net nodes meet the same clock tick, which means the whole network achieves distributed synchronization. As each node in the network only receives its neighbor's information, so this scheme does not need specific routing and too complex processing and it has a fast convergence rate and low energy consumption. The proof for the convergence of the proposed synchronization algorithm is carried out using the random matrix theory. The analysis of the convergence rate and the energy consumption and synchronization error are also carried out. The results of theoretical analysis are verified by computer simulation.

Keywords: synchronization time synchronization wireless sensor networks

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