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Fast and efficient lossless adaptive compression scheme for wireless sensor networks ☆

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ABSTRACT

The number of wireless sensor network deployments for real-life applications has rapidly increased in recent years. However, power consumption is a critical problem affecting the lifetime of wireless sensor networks (WSNs). A number of techniques have been proposed to solve this power problem. Among the proposed techniques, data compression scheme is one that can be used to reduce the volume of data to be transmitted. This paper therefore proposes a fast and efficient lossless adaptive compression scheme (FELACS) for WSNs. FELACS was proposed to enable a fast and low memory compression algorithm for WSNs. FELACS generates its coding tables on the fly and compresses data very fast. FELACS is light-weight, robust to packet losses and has very low complexity. FELACS achieved compression rates of 4.11 bits per sample. In addition, it achieved power savings up to 70.61% using the real-world test datasets.

1. Introduction

Wireless sensor networks (WSNs) are very large scale deployments of tiny smart wireless sensor devices working together to monitor a region and to collect data about the environment. Sensor nodes are generally self-organized and they communicate with each other wirelessly to perform a common task. The nodes are deployed in large quantities (from tens to thousands) and scattered randomly in an ad-hoc manner in the sensor field (a large geographic area). Through advanced mesh networking protocols, these sensor nodes form a wide area of connectivity that extends the reach of cyberspace out into the physical world. Data collected by each sensor node is transferred wirelessly to the sink either directly or through multi-hop communication. WSNs have unlimited applicability. They find application in areas such as environmental monitoring, industrial monitoring, health and wellness monitoring, seismic and structural monitoring, inventory location monitoring, surveillance, power monitoring, factory and process automation, object tracking, precision agriculture, disaster management, and equipment diagnostics [1–6]. These monitoring applications involve the collection of large volumes of raw data over time. Thus, collecting high-fidelity data for these monitoring applications considering the limitations of WSNs presents a key challenge.

WSNs operate under tight energy budgets and have other limitations that include limited radio bandwidth, limited memory, limited computational capability, limited packet size and high packet loss rates. Data compression is one tool that can be

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