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Energy efficient indoor localisation for narrowband internet of things

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Abstract

There are an increasing number of Narrow Band IoT devices being manufactured as the technology behind them develops quickly. The high co-channel interference and signal attenuation seen in edge Narrow Band IoT devices make it challenging to guarantee the service quality of these devices. To maximise the data rate fairness of Narrow Band IoT devices, a multi-dimensional indoor localisation model is devised, consisting of transmission power, data scheduling, and time slot scheduling, based on a network model that employs non-orthogonal multiple access via a relay. Based on this network model, the optimisation goal of Narrow Band IoT device data rate ratio fairness is first established by the authors, while taking into account the Narrow Band IoT network: The multi-dimensional indoor localisation optimisation model of equipment tendstominimize data rate, energy constraints and EH relay energy and data buffer constraints, data scheduling and time slot scheduling. As a result, each Narrow Band IoT device's data rate needs are met while the network's overall performance is optimised. We investigate the model's potential for convex optimisation and offer an algorithm for optimising the distribution of multiple resources using the KKT criterion. The current work primarily considers the NOMA Narrow Band IoT network under a single EH relay. However, the growth of Narrow Band IoT devices also leads to a rise in co-channel interference, which impacts NOMA's performance enhancement. Through simulation, the proposed approach is successfully shown. These improvements have boosted the network's energy efficiency by 44.1%, data rate proportional fairness by 11.9%, and spectrum efficiency by 55.4%. © 2023 The Authors. CAAI Transactions on Intelligence Technology published by John Wiley & Sons Ltd on behalf of The Institution of Engineering and Technology and Chongqing University of Technology.

Author keywords

artificial inteligence; detection of moving objects; internet of things

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1	Efficient Connectivity in Smart Homes: Enhancing Living Comfort through IoT Infrastructure *Open Access*	Youssef, H.M., Osman, R.A., El-Bary, A.A.	2024	Sensors 24(9),2761	0

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Modern homes are experiencing unprecedented levels of convenience because of the proliferation of smart devices. In order to improve communication between smart home devices, this paper presents a novel approach that particularly addresses interference caused by different transmission systems. The core of the suggested framework is an intelligent Internet of Things (IoT) system designed to reduce interference. By using adaptive communication protocols and sophisticated interference management algorithms, the framework minimizes interference caused by overlapping transmissions and guarantees effective data sharing. This can be accomplished by creating an optimization model that takes into account the dynamic nature of the smart home environment and intelligently allocates resources. By maximizing the signal quality at the destination and optimizing the distribution of frequency channels and transmission power levels, the model seeks to minimize interference. A deep learning technique is used to augment the optimization model by adaptively learning and predicting interference patterns from real-time observations and historical data. The experimental results show how effective the suggested hybrid strategy is. While the deep learning model adjusts to shifting interference dynamics, the optimization model efficiently controls resource allocation, leading to better data reception performance at the destination. The system's robustness is assessed in various kinds of situations to demonstrate its flexibility in responding to changing smart home settings. This work not only offers a thorough framework for interference reduction but also clarifies how deep learning and mathematical optimization can work together to improve the dependability of data reception in smart homes.

2	A Power-Aware Method for IoT Networks with Mobile Stations and Dynamic Power Management Strategy *Open Access*	Shamsan Saleh, A.M.	2023	Engineering, Technology and Applied Science Research 13(6), pp. 12108-12114	2

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The Internet of Things (IoT) plays a critical role in the digitalization of numerous industries, enabling increased automation, connectivity, and data collection in areas such as manufacturing, healthcare, transportation, and smart cities. This paper introduces a power-aware method for IoT networks using mobile stations and a dynamic power management strategy. The proposed method aims to improve power consumption and total packets received compared to the static-station balanced data traffic method. The proposed method uses a mobile station to dynamically adapt its transmission power based on the network conditions and the strength of the received signal. Furthermore, a dynamic power management strategy is employed to further decrease the power usage of the network by adjusting the power state of each station and IoT node according to its level of activity, data traffic, and communication requirements. Simulation results showed that the proposed method reduced power consumption by up to 64%, increased total packets received by 72%, and, as a result, increased network coverage and lifetime compared to the balanced data traffic method with static stations. This method can be employed in various IoT applications to improve power efficiency and increase network reliability.

3	Lightweight Security for IoT	Saurabh, Sharma, C., Khan, S., (...), Alabduallah, B.I., Ansari, A.A.	2023	Journal of Intelligent and Fuzzy Systems 45(4), pp. 5423-5439	0

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With the ever-increasing demand for IoT Devices which enable all objects to connect and exchange information in applications such as healthcare applications, Industry 4.0, smart cities and smart homes, etc. IoT devices play a crucial role in our day-to-day life like homes, offices, healthcare, wearable, and agriculture. With the development of IoT devices, securing device-to-device communication has attracted more and more attention and we need to ensure the privacy and security of data amongst these IoT devices. User authentication has emerged as a major security concern while connecting IoT devices and the cloud. Many authentication schemes like mutual authentication, group authentication have been proposed to ensure only authenticated users and with very high confidence we can rely on the decision-

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making process. Symmetric key based as well as Asymmetric key-based solutions have been proposed but due to the resource constraint nature of the IoT devices designing lightweight, robust, provably secure authentication schemes is a big challenge. This paper discusses the various authentication techniques designed for low-powered IoT devices and proposes a lightweight authentication scheme for IoT.

4 Blockwise Joint Detection of Physical Cell Identity and Carrier Frequency Offset for Narrowband IoT Applications
Open Access
You, Y.-H., Jung, Y.-A., Lee, S.-H., Hwang, I.
2023 Mathematics 11(18),3812 0

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This paper presents a novel formulation for detecting the secondary synchronization signal in a narrowband Internet of Things communication system. The proposed approach is supported by a noncoherent algorithm that eliminates the need for channel information. A robust joint synchronization scheme is developed by decoupling the estimations of the physical cell identity and the carrier frequency offset. We derive the detection probability of the proposed physical cell identity detector and the mean squared error of the carrier frequency offset estimator, demonstrating their accuracy through simulation results. The performance of the proposed detection scheme is compared with that of existing detection schemes in terms of both estimation accuracy and computational complexity. Experimental results confirm that the proposed synchronization method exhibits superior performance while maintaining relatively lower complexity compared with benchmark methods.

5 Experimental Validation of State Estimation of Non-Linear Twin Rotor System using Extended Kalman Filter
Haider, S., Ali, S., Rasool, A., Huda, A.B.
2023 Pakistan Journal of Engineering and Applied Sciences 32, pp. 1-9 0

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In this paper, theoretical and experimental validation of state estimation capability of Extended Kalman Filter (EKF) is done on MIMO twin rotor system. Different immeasurable states are estimated. For theoretical validation, states with different behaviors (e.g. random, exponential, sinusoidal and abruptly changed) are generated and outputs are calculated. These outputs are invoked in EKF algorithm that provides an estimate of above generated states. Comparison between self-generated and estimated states is made. In practical, information of immeasurable process states is needed. Therefore experimental readings of inputs and outputs of the system are inserted in the EKF algorithm that provides the close estimate of desired immeasurable states. This experimental validation is carried out for open loop and closed loop twin rotor system data. The results show that EKF estimates are precise and fast convergent to the actual twin rotor states.

Sensors . *Open Access* . Volume 24, Issue 9 . May 2024 . Article number 2761

Efficient Connectivity in Smart Homes: Enhancing Living Comfort through IoT Infrastructure

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Abstract

Modern homes are experiencing unprecedented levels of convenience because of the proliferation of smart devices. In order to improve communication between smart home devices, this paper presents a novel approach that particularly addresses interference caused by different transmission systems. The core of the suggested framework is an intelligent Internet of Things (IoT) system designed to reduce interference. By using adaptive communication protocols and sophisticated interference management algorithms, the framework minimizes interference caused by overlapping transmissions and guarantees effective data sharing. This can be accomplished by creating an optimization model that takes into account the dynamic nature of the smart home environment and intelligently allocates resources. By maximizing the signal quality at the destination and optimizing the distribution of frequency channels and transmission power levels, the model seeks to minimize interference. A deep learning technique is used to augment the optimization model by adaptively learning and predicting interference patterns from real-time observations and historical data. The experimental results show how effective the suggested hybrid strategy is. While the deep learning model adjusts to shifting interference dynamics, the optimization model efficiently controls resource allocation, leading to better data reception performance at the destination. The system's robustness is assessed in various kinds of situations to demonstrate its flexibility in responding to changing smart home settings. This work not only offers a thorough framework for interference reduction but also clarifies how deep learning and mathematical optimization can work together to improve the dependability of data reception in smart homes. © 2024 by the authors.

Author keywords

1-DCNN; achievable data rate; energy efficiency; Lagrange optimization; smart home

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Engineering, Technology and Applied Science Research • *Open Access* • Volume 13, Issue 6, Pages 12108 - 12114 • December 2023

A Power-Aware Method for IoT Networks with Mobile Stations and Dynamic Power Management Strategy

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Abstract

The Internet of Things (IoT) plays a critical role in the digitalization of numerous industries, enabling increased automation, connectivity, and data collection in areas such as manufacturing, healthcare, transportation, and smart cities. This paper introduces a power-aware method for IoT networks using mobile stations and a dynamic power management strategy. The proposed method aims to improve power consumption and total packets received compared to the static-station balanced data traffic method. The proposed method uses a mobile station to dynamically adapt its transmission power based on the network conditions and the strength of the received signal. Furthermore, a dynamic power management strategy is employed to further decrease the power usage of the network by adjusting the power state of each station and IoT node according to its level of activity, data traffic, and communication requirements. Simulation results showed that the proposed method reduced power consumption by up to 64%, increased total packets received by 72%, and, as a result, increased network coverage and lifetime compared to the balanced data traffic method with static stations. This method can be employed in various IoT applications to improve power efficiency and increase network reliability. © 2023, Dr D. Pylarinos. All rights reserved.

Author keywords

dynamic power management; internet of things; mobile stations; power consumption

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Blockwise Joint Detection of Physical Cell Identity and Carrier Frequency Offset for Narrowband IoT Applications

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Abstract

This paper presents a novel formulation for detecting the secondary synchronization signal in a narrowband Internet of Things communication system. The proposed approach is supported by a noncoherent algorithm that eliminates the need for channel information. A robust joint synchronization scheme is developed by decoupling the estimations of the physical cell identity and the carrier frequency offset. We derive the detection probability of the proposed physical cell identity detector and the mean squared error of the carrier frequency offset estimator, demonstrating their accuracy through simulation results. The performance of the proposed detection scheme is compared with that of existing detection schemes in terms of both estimation accuracy and computational complexity. Experimental results confirm that the proposed synchronization method exhibits superior performance while maintaining relatively lower complexity compared with benchmark methods. © 2023 by the authors.

Author keywords

carrier frequency offset; narrowband Internet of Things; physical cell identity; secondary synchronization signal

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Experimental Validation of State Estimation of Non-Linear Twin Rotor System using Extended Kalman Filter

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Abstract

In this paper, theoretical and experimental validation of state estimation capability of Extended Kalman Filter (EKF) is done on MIMO twin rotor system. Different immeasurable states are estimated. For theoretical validation, states with different behaviors (e.g. random, exponential, sinusoidal and abruptly changed) are generated and outputs are calculated. These outputs are invoked in EKF algorithm that provides an estimate of above generated states. Comparison between self-generated and estimated states is made. In practical, information of immeasurable process states is needed. Therefore experimental readings of inputs and outputs of the system are inserted in the EKF algorithm that provides the close estimate of desired immeasurable states. This experimental validation is carried out for open loop and closed loop twin rotor system data. The results show that EKF estimates are precise and fast convergent to the actual twin rotor states. © (2023), (University of Engineering and Technology). All Rights Reserved.

Author keywords

experimental validation; extended Kalman filter; nonlinear model; state estimation; Twin rotor system

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