ISSN 2229-5518

Mathematical Modelling & Wireless Communication Network - A Review

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Abstract- Introduction Of the several kinds of creative activity being promoted in contemporary developments ,arguably the most empowering for students is mathematical modelling. A good deal has been written about modelling as a classroom teaching and learning strategy. In the last few decades, there have been abundant discussions among mathematicians and mathematics educators on promoting mathematical modelling (a process of using mathematics to tackle real world problems) as a classroom practice. Despite the consensus on its importance and relevance, mathematical modelling remains a difficult activity for both teachers and learners to fully engage in. In this paper, we examine some of these difficulties and discuss how technology can play a pivotal role in providing the essential support to make mathematical modelling a more accessible mathematical activity amongst students. Through a series of examples drawn from different fields and topics .The paper is devoted to study and evaluation of the erroneous packets flow on the physical layer of a wireless communication network. A mathematical model of the erroneous packets passed to the communication channel has been structured and analysed. The statistical estimation of the erroneous packets number is presented and discussed in the paper. In wireless sensor networks, sensor nodes are randomly distributed of high-density. This paper formulates a mathematical model in which only if some parameters are known, the number of nodes in order to reach certain coverage fraction can be calculated. Simulation results show that the simulation results can be able to calculate the number of nodes in little error compared with the analytical results.

Index Terms—:Modelling, wireless network, Wireless Sensor Networks, Wireless communication channel, erroneous packets, error bursts.

1. Introduction

A concern voiced by business, related to the need for mathematical modelling, is the perceived lack of transfer of school mathematical knowledge by students to the workplace. School provides students with an extensive mathematical "toolkit" but may not prepare them adequately in its use. Business and economic interests are demanding that students be prepared as flexible problem solvers in order to be ready to meet the challenges and uncertainties of their fast-changing workplaces. In short, they are demanding a smarter, more adaptable and better educated worker. Mathematical modelling may be loosely defined as a process of representing real world problems in mathematical terms in an attempt to understand and find solutions to the problems. The mathematical problem can then be solved using familiar mathematical techniques. The solution obtained is then interpreted and translated into real terms. Although there may be several interpretations of mathematical modelling, the process of mathematical modelling may be represented in figure. Due to their simplicity of use and configuration, the WLAN is to become one of the main solutions of connection for companies. The market of wireless networks grows quickly since the companies notice the works which have been done on the security and in the growth of the throughput. Meanwhile, other applications have been developed which used a lot of bandwidth, like multimedia applications. The next step for the companies is to used these applications on their WIRELESS LAN.

Most communication systems are sensitive to random errors and synchronization failures. The Physical Layer analysis of any Computer Communication network is very important. This is because many different problems concerning network execution and utilization are caused by errors and failure son the Physical Layer. Wireless communication networks are not the exception. Moreover, the problem of achieving high reliability and error tolerance is urgent in modern communication technologies such as mobile Internet Protocol (IP) or General Packet Radio Service (GPRS) networks.

2. 2. Process of mathematical modelling:

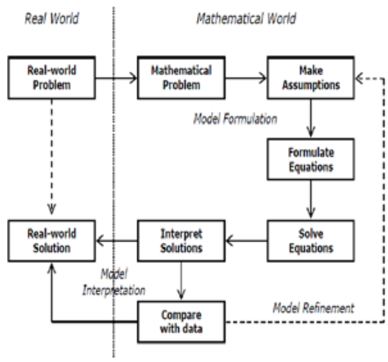


Figure: process of mathematical modelling

Once a model is constructed, the next stage requires various mathematical techniques and tools. Very often, unless a model is particularly simple, some kind of technological or computing tool will be necessary. One also often finds that there can be a variety of ways of solving the same problem, making mathematical modelling a very enriching mathematical experience. We then interpret the results or solutions of the model in the context of the real world problem, and make attempts to compare the model solutions and any collected or known data. Sometimes, wish to refine the model by revisiting and revising our assumption.

3. Technology and Mathematical Modelling:

Despite its importance and relevance to the real world, mathematical modelling is generally not the main approach to teaching and learning of mathematics. Technology may be the bridge for the cognitive gap that hinders a student from carrying out a modelling task. However, it should also be noted that technology should never replace the mathematics, much less the teacher; it should be viewed as a timely, and sometimes temporary means of overcoming a difficulty

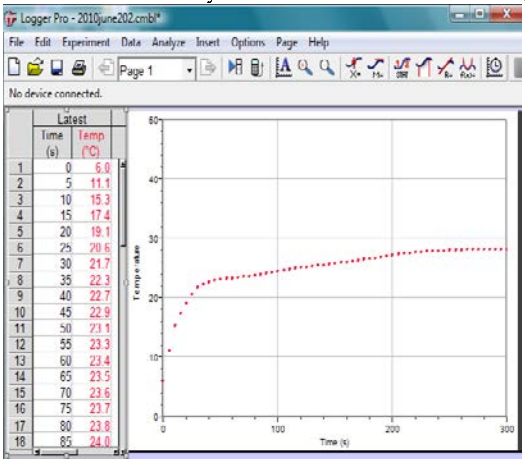
Examples:

1. Warm up:

One simple technological tool that can be used for capturing data for a modelling task is the data logger and the accompanying software, Logger Pro 3.

(a) Data logger

the modeller to find ways to solve the model, using



(b) A screenshot of Logger Pro 3

Figure 3.1: Modelling the warming of ice water using a data logger and Logger Pro 3

The task could be to “develop” or “discover” mathematical model to describe the process of warming, this case, of ice water. However, the point of the task is to take the student through the process of modelling.

4. Related Work:

The high-density of sensor nodes deployed in detected region could lead to high energy costs. In guaranteed certain coverage fraction at the same time, the strategy of making part of nodes into low-power sleep state is commonly used currently. Achieving coverage as well as connectivity in wireless sensor networks also attracted wide attention from researchers.

In 2003, Singapore had to grapple with the outbreak of deadly disease known as Severe Acute Respiratory Syndrome, or SARS in short. In a short span of 70 days, 206 cases were reported and of these, 31 lives were lost. Data for the SARS outbreak in Singapore are available in the public domain and reproduced below.

5. Simulation and mathematical model:

In this section, we introduce a mathematical model of the maximum throughput of a connection in the standard 802.11b wireless network as a function of the packets size variation, of the transmissions rate and of the number of stations which want to transmit data to a server which is behind the access point. Indeed, we simulate a WLAN in infrastructure mode by using TCP and UDP over

DCF. The WLAN is composed of an access point and several wireless stations. All station generate TCP packets traffic for TCP or UDP packets traffic for UDP to a server station located behind the access point. The transmission rate of a Wi-Fi communication is dependent upon the distance between the transmitter and the receptor, and can only be chosen among these four different bandwidths.During simulations, RTS/CTS access mechanism wasturned off and hidden terminal was not considered.

DIFS	50 µs
SIFS	10 µs
SLOT	20 µs
CWmin	31
CWmax	1023

Figure: MAC parameter for 802.11b PHY

Initially, we set the packet size and the transmission rate at a constant and we varied the number of stations. All the stations generate the same packet to a server station behind the access point. For each given number of stations, simulations were carried out in order to find the maximum throughput observed for each station. For both TCP and UDP, the data results for the throughput expressed as a function of the number of stations and plotted in **loglog** scale was shown to be roughly linear.

6. General Principles for Determining the Probabilistic Model of the Wireless Channels:

A various range of BER within a given Virtual Connection characterizes wireless communication channels. Therefore, it is reasonable to create an appropriate probabilistic model of the wireless channel. The purpose of this paper is to analyse the general number of erroneous packets during a specific time interval. It should be mentioned that BER and Packet Error Rate (PER) do not change during a packettransmission in the presented model. The PER change is expected after the ending of a given packet transmission. Mention that PER is a BER function in a network model.

7. Conclusion:

It has been suggested that mathematical modelling can provide a “unifying framework” for teaching applied mathematics (Smith, 1996), without necessarily adding content to the curriculum. We have introduced a mathematical model expressing the maximum throughput in infrastructure based wireless network using TCP and UDP. Based on the real data, the modified decoding algorithm that appropriates to the non-reliable noisy wireless environment should be chosen and applied in the modern mobile IP or GPRS technologies. Thus, the PER in the wireless network should be decreased. Consequently, the network reliability should be significantly improved in comparison with the existing models. We are working to use neural network to model the same maximum throughput. After that we will compare the two results to find out the best method between mathematical and the neural network models. By mathematical analysis and simulation, the issue of coverage problem in random deployment circumstance has been studied. A mathematical model is proposed, which is known the proportion of the sensing range of nodes to the range of the deployment area independent of geographic information. The mathematical model has the capability to calculate the minimum number of nodes to reach a certain coverage fraction. Although there exists little error, the mathematical model can be applied to any application and its error margin is less than six percent. At the same time, in the field of deployment and topology control in wireless sensor networks, the model can also be widely used.

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