

Editor-in-Chief's Introduction

TOWARDS STRUCTURAL DEVELOPMENT IN AFRICA VIA COMPUTING AND ICT

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ABSTRACT

Computing and ICT no doubt form important pillars in the present day global modern technological processes and development. Although Africa can be said to have improved substantially in the quest for knowledge in this age, much structural advancement and progress in the larger part of the continent have not been noticed. This can be partly ascribed to the relatively meager investment and financial commitment to providing infrastructure for sustainable research. The effect of this is that the technological state and needs of the general African continent are not the same as those of the developed world. As such, research output which may be important for the present socio-econo-technological state of the continent may not quite appear useful in the developed world, and are thus usually not considered fit for their journals. Apart from this, there are relatively few journals based in the African continent that are devoted exclusively to papers on computing and ICT. It is in the light of the above that the *African Journal of*

Computing & ICT is born for the purpose of publishing nontrivial relevant research results in the fields of computer science/engineering, information technology(IT) and allied fields. The journal welcomes papers from African scholars and also from non-africans whose papers address important issues that are relevant to Africa. Every submitted paper is reviewed by at least two appropriate referees for quality and accuracy. Two editions are to be published every year. Further information about the journal is available in the *Instructions to Authors, Subscribers and Advertizers* in the inside back cover. A case is made, in the present paper, for the exploration of the potentials of coding theory for African development.

Keywords: Structural Development in Africa, Computing, ICT, Coding Theory

I. INTRODUCTION

Computing and ICT no doubt form important pillars in the present day global modern technological processes and development. Although Africa can be said to have improved substantially in the quest for knowledge in this age, much structural advancement and progress in the larger part of the continent have not been noticed. This can be partly ascribed to the relatively meager investment and financial commitment to providing infrastructure for sustainable research. The effect of this is that the technological state and needs of the general African continent are not the same as those of the developed world. As such, research output which may be important for the present socio-econo-technological state of the continent may not quite appear useful in the developed world, and are thus usually not considered fit for their journals. Apart from this, there are relatively few journals based in the African continent that are devoted exclusively to papers on computing and ICT. With proper harnessing of her human and material resources, Nigeria has a great potential in achieving the United Nations Millennium Development Goals (UN MDGs) and the targets of the National Economic Empowerment and Development Strategies (NEEDS) programme. For instance, the robotics-like automobile (named Autonov) which the late Professor Ayodele Awojobi (1937 – 1984), of the Department of Mechanical Engineering, University of Lagos, Nigeria, was credited with could have been productively channeled towards the development of a truly development-oriented

country. It is in the light of the above that the *African Journal of Computing & ICT* is born for the purpose of publishing nontrivial relevant research results in the fields of computer science/engineering, information technology (IT) and allied fields. The journal welcomes papers from African scholars and also from non-africans whose papers address important issues that are relevant to Africa. Every submitted paper is reviewed by at least two appropriate referees for quality and accuracy. For the purpose of quality control, the name of the editorial board member who arranged a paper for review (i.e the communicating editor) is included on the front page of every published paper. A peculiar characteristic/policy of the journal is that all the editors are Africans by root or birth, though they are not necessarily based in Africa. A reviewer however need not be an African. Two editions are to be published every year. Efforts shall be made to publish the names of reviewers for every journal volume, consisting of two editions, in the second edition of every year. Further information about the journal is available in the *Instructions to Authors, Subscribers and Advertizers* in the inside back cover.

In an earlier paper, five key areas of practice with respect to ICT were identified namely [3] consulting, research and development (R&D), manufacturing, marketing of ICT equipment and capacity building. The major area of contribution of this journal is basically on R&D which, as has been rightly noted, ‘is the perennial source of technology’ [12]. The focus is on the promotion of indigenous computer and ICT development. This is expected to contribute in the long run to a reduction in the heavy dependence on importation of ICT-related products e.g. a

drastic reduction in the over 95% of mobile telephony and telecom equipment currently believed to be imported in Nigeria. This brings a great drain to the nation's foreign exchange. A preceding paper [11] examined the relevance of ICT to construction technology, with particular reference to software development.

II. PAPERS IN THIS MAIDEN JOURNAL ISSUE

There are altogether five papers in this maiden edition of the *African Journal of Computing & ICT*. The present introductory paper by Dr. 'Dele Oluwade provides a background for other papers. The paper emphasizes the relevance and potential contribution of coding theory towards structural development in Nigeria, in particular, and Africa in general. Four key relevant areas were addressed, namely GSM and general telecommunications industry, space and satellite communication system, film and entertainment industry, as well as computer manufacturing industry. The paper entitled 'Expanding Nigerian Electronics Technology' was contributed by Dr. John McKee, a physicist and electrical engineer, who taught at the University of California Los Angeles Medical School for about 50 years before formal retirement, though he is still active as a researcher. This paper provides useful technical advice and guidelines for the Nigerian technocrats and scientists/engineers on the way forward in achieving technological breakthrough. The author provides clear analogies based on the experiences of his home country- the United States of America. Adeyemi Ajibesin's contribution from South Africa is also on

coding theory in wireless communication system, specifically performance evaluation of turbo codes in wireless communication channels. As explained in Section III of Dr Oluwade's paper, turbo codes which are able to provide virtually error-free communications at unusually high data rates and transmitting power efficiencies. The paper contributed by Olufade Onifade et al provides a review of the mode of operations and characteristics of digital satellite television with a view to highlighting how it can alleviate the problem of limited broadcast reach. Finally, the paper by N. Onwuchekwa and Dr. Gloria Chukwudebe dwells on digital signal processing, which is a popular technique in such areas as communications, medical imaging, radar, hifi music reproduction and oil prospecting. It discusses the use of a combination of noble identities and polyphase decomposition of linear filters for achieving computationally efficient algorithms in multirate digital processing systems.

III. SOME APPLICATION AREAS OF CODING THEORY

Coding theory influences all forms of modern digital electronic systems due to the fact that data are transmitted as sequences of binary digits (bits) or codes. The term coding theory as used in this paper includes both coded character sets (CCSs) as well as error control codes (i.e error detection and correction codes). Coding theory came into being as an active specialized area of study in 1948 through the pioneering works of an American electrical engineer and mathematician Claude Elwood Shannon (1916-2001) [2]. He is appropriately regarded as the father of (information and) coding theory. Coding theory has over the years benefited from

activities in electrical engineering, mathematics, mathematical statistics and computing. Generally, coding theory arises from a model of a data transmission system as a general communication system consisting of six basic parameters, namely Data Source, Channel Encoder (or Transmitter), Digital Channel, Noise, Channel Decoder (or Receiver) and Data Destination [6,9]. In particular, the digital channel is often subject to natural or man-made disturbances and unwanted signals called noise (or crosstalk or distortion) [8]. Due to channel noise disturbance, some of the bits of the received sequence at the Destination often change thus leading to transmission errors [7]. CCSs, such as the ASCII code, provide a means of transmitting data.

A major issue in the development of coding theory was the invention of a new coding scheme, known as turbo codes, in the early 1990s. This scheme is able to provide virtually error free communications at data rates and transmitting power efficiencies which are well beyond the predicted maximum possible rate [4]. Turbo codes can be advantageously and optimally used to improve speeds over land and GSM phone lines by almost two orders of magnitude. The codes have the potential of allowing cellphones and other portable devices to handle multimedia data (e.g video and graphics-rich imagery) over the noisy channels which is typical of cellular communications. They also hold great promise for digital audio, video broadcasting and for increasing data speeds in enhanced versions of Wi-Fi networks.

With respect to space and satellite communication (SSC), coding theory enables

information to be transmitted reliably from outer space, several hundred million of kilometers from the earth, without being completely distorted by noise. This relates in particular to Nigeria SAT-1 and NIGCOMSAT-1 (the first Nigerian and African communication satellite (COMSAT)) which have been launched, the former in Russia. An agreement to design, build, launch and insure NIGCOMSAT-1 was signed in December 2004 with China Great Wall Industry Corporation. The aim of these missions is to gather and relate information to earth for the purpose of assisting in national planning in such areas as census, agriculture etc. Mathematically, the use of error correcting codes in SSC systems can be justified by considering the equation [13]

$$(C/N_0)_{dB} = 10 \log(E_b/N_0) + 10 \log R_b \quad (1)$$

which expresses the carrier power to noise ratio (expression on the left hand side) in terms of the information energy per bit before error coding E_b , the noise density N_0 and the bit rate R_b . By taking into consideration all the losses due to channel impairment and assuming that all the link components and transmission rate can no longer be improved, then the only way to maintain the required carrier to noise ratio is to improve the ratio E_b/N_0 through channel encoding.

In the film, entertainment and related industry, turbo codes and R-S codes can be used to prevent damages (e.g scratches, cracks) in optical compact disks (CDs), magnetic disks and audio disk players. These codes are able to correct up to 4,000 consecutive errors which are up to 2.5mm of track.

A few indigenous Nigerian computer assembly and manufacturing firms (eg ZINOX, OMATEK) can be classified as 'big'. These companies can in their bid to mature to the standard of their peers in industrialized nations, benefit a lot from research activities in both pure and applied coding theory. The design and construction of specialized keyboard encoders or keyboard encoding chips present an interesting venture for indigenous engineering development. When a key is depressed on the keyboard, electric signals are generated that enable a digital computer or a similar machine to determine which of the keys is depressed [5]. Keyboard encoding schemes are useful in secured message transmission in a communication system. The design and construction of modems is another challenging area for indigenous engineering development particularly with respect to the telephone industry.

IV. CONCLUSION

This introductory paper in the maiden edition of *African Journal of Computing and ICT* has attempted to showcase samples on the wide array of intellectual ideas which can aid structural development of Africa in general and Nigeria in particular, with special emphasis on data transmission and storage via coding and related theory. In line with the UN MDGS and the NEEDS initiative, efforts should be made to tap from the abundant opportunities provided by coding (and information) theory. The theory is important because it helps to solve the problem of

distortion of signals arising from noise interference in a communications system.

Governmental agencies, research institutes and private organizations should exploit the potentials of the theory for indigenous development. Such bodies include National Space Research and Development Agency (NASRDA), Projects Development Agency (PRODA) and the National Information and Technology Development Agency (NITDA). That is to say, it is high time 'we looked inwards and try to eliminate the researchless giantism mentality and embrace appropriate technology' [1]. Even though the investment in R&D may seem to be relatively high in the short run, the gains accruable from it in the long run far surpass any disadvantage. There should be a genuine legislative policy requiring all large scale engineering business concerns to maintain a fully functional and adequately-staffed R&D departments.

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REFERENCES

- [1] C.O. Adegoke, and John Ade Ajayi, 'Manufacturing and Industrial Capacity Building in Nigeria: Imperative of Appropriate Technology', *Proceedings of the National Engineering Conference and Annual General Meeting* ('Lagelu 2003'), Nigerian Society of Engineers, pp 67-71, 2003
- [2] Elwyn Berlekamp, 'The Performance of Block Codes', *Notices of the American Mathematical Society*, vol 49, no. 1, pp 17-22, 2002
- [3] Gloria Chukwudebe, and Ifeyinwa E Chika(2003), 'Entrepreneurship Opportunities in ICT in Nigeria', *Proceedings of the National Engineering Conference and Annual General Meeting* ('Lagelu 2003'), Ibid., pp 223-231, 2003
- [4] Erico Guizzo, 'Closing in on the Perfect Code', *IEEE Spectrum INT*, vol 41, no 3, pp 28-34, 2004
- [5] Meshach Osatohanmwun Odaro, *Keyboard Encoding for Message Transmission*, unpublished M.Sc Thesis, Department of Electronics and Electrical Engineering, University of Ife, Ile-Ife, Nigeria, 1983
- [6] Dele Oluwade, 'Applications of 2-Code Error Detection Techniques', *Proceedings of the 14th National Conference of COAN*, vol 9, pp 245-251, 1998
- [7] Dele Oluwade, C.O. Uwadia, and J.O.A. Ayeni, 'Asymptotic Time Complexity of an Algorithm for Finding the Error Pattern of a Uniform Digital Code', *Journal of Scientific Research and Development*, vol. 6, pp 127-134, 2001
- [8] Dele Oluwade, Seyitan Osunade and Sesan Adeyemo, 'On the Superposition and Interdependence of Continuous Signals', *Proceedings of International Workshop and Conference on Information and Communication Technology Applied to Economic Intelligence*, Universite Nancy 2 & University of Ibadan, pp 139 – 141, 2002
- [9] Dele Oluwade, *An Introductory Course on Computer Science (with exercises)*, PG Publishing, Ibadan, 2003
- [10] Dele Oluwade, *Design and Analysis of Computer-Coded Character Sets*, unpublished PhD Thesis, University of Ibadan, Nigeria, 2004
- [11] Dele Oluwade, 'Emergent Benefits of Information Technology to the Nigerian Built Environment', *Globalization, Culture and the Nigerian Built Environment* (Proceedings of the 2nd Faculty Conference, Faculty of Environmental Design and Management) vol. II, Obafemi Awolowo University, pp 160-162, 2005
- [12] C.O. Orangun, 'Coping with Nigeria's Demands on the Engineering Profession', in Adelabu, M.A.K. Adelabu and J.O. Akanmu, (ed), *Kasim Memorial Lectures* (The Nigerian Society of Engineers Lagos Branch: Compilation of Lectures on Topical Issues of Engineering Practice 1985-2003), Foundation Publishers, Lagos, pp 88-107, 2003
- [13] W.W Wu, 'Coding for Satellite and Space Channels', *International Journal of Electronics*, vol. 55, no. 1, pp 183-212, 1983