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AIR TRAFFIC & NAVIGATION SERVICES
ATNS

1ST SPACE SCIENCE AND CNS SYMPOSIUM

BOOK OF ABSTRACT

Special Key Note: Prof Sibusiso Moyo, DVC-RIE

Host: Prof Innocent E Davidson, DUT Program Leader

Date: 25 October 2021

Venue: Ritson Hotel School, Durban University of Technology

1st Space Science and CNS Symposium

25 October 2021 @ Ritson Hotel School

ORDER OF PROGRAMME

Time	Item	Anchor
Programme director	**Dr Elutunji Buraimoh**	
7:45 - 8:00 am	**Registration**	Secretariat
8:00 - 8:15	**Welcoming**	Prof I E Davidson (Host)
8:15 - 8:30	**Address**	Prof Sibusiso Moyo, DVC-RIE
8:30 – 8:40	**PHOTO SESSION**	
8:40 - 9:10	**1st Presentation – Mr Bhekinkosi P Madoonsela (DUT)** **Research Title:** The estimation of the channel parameters and linear combination of the frequencies to mitigate the carrier GNSS Multipath errors	
9:10 - 9:40	**2nd Presentation – Ms Nompumelelo Chili (DUT)** **Research Title:** Performance Analysis of precoding schemes for massive MIMO	
9:40 - 10:10	**3rd Presentation - Mr Radoje Džankić (Prof Sanja Bauk) (DUT)** **Research Title:** Apparatus for tracking containers in land and sea transportation	
10:10 – 10:25	**TEA BREAK**	
10:25 - 10:55	**4th Presentation – Mr Phillip Gyasi-Agyei (UKZN)** **Presentation:** Overview of the UKZN Aerospace Systems Research Group's Phoenix Hybrid Rocket Programme	
11:00 - 11:30	**5th Presentation - Mr Bonginkosi Gumede (DUT)** **Research Title:** The performance of LDPC Codes for satellite communication in ka band	
11:30 -12:00	**6th Presentation – Mr Jonas Dakora (DUT)** **Research Title:** Performance analysis of low-density parity check code for satellite communication in ka-band	
12:00 – 12:30	**LUNCH BREAK**	
12:30 – 1:00 pm	**7th Presentation - Mr Moses Thabo Nkhoma (DUT)** **Research Title:** Public-private partnerships for enhancing border security through space technology in South Africa	

13:00 – 13:30	**8th Presentation –** **Ms Ntombezinhle Kweyama (DUT)** **Research Title:** Converging for human and social wealth in the fourth industrial revolution (4IR) realm	
13:30 – 14:00	**9th Presentation – Ms Sindisiwe Malanda (DUT)** **Research Title:** Transient Fault Analysis of a VSC-Based Multi-Terminal HVDC Scheme	
14:00 – 14:300 PM	**Closing Remark**	Prof I E Davidson

Programme Planning Committee: L-R Dr E Buraimoh, Mrs R Naidoo, Ms N Zakuza, Prof I E Davidson, Mr V V Nemudzivhadi

1st Space Science and CNS Symposium

1st Presentation

By

Mr Bhekinkosi P Madoonsela and Prof Innocent Davidson

Department of Electrical Power Engineering, Durban University of Technology

Research Title:

The estimation of the channel parameters and linear combination of the frequencies to mitigate the carrier GNSS Multipath errors

Abstract:

The Global Navigation Satellite Systems (GNSS) are the key systems that provide the position, time and navigation worldwide. Numerous applications depend on the GNSS, such as agriculture, oil & gas, military, electricity sector, banking and transportation. Hence, the number of these applications requires a specific accuracy of about a centimetre level. The biggest challenge here is the error that affects the GNSS measurements. These errors include the errors from the transmitting satellite, propagation channel and receiver. A large number of these GNSS errors can be mitigated by modelling and correlation characteristics, excluding the multipath error. The multipath error is the combination of the direct signal and replica signal that is reflected near the antenna of the GNSS receiver, and this type of error is difficult to mitigate using the modelling and differential approaches. The accuracy of the GNSS application relies on the linear combination of the different frequencies. The multipath error is strongly dependent on the environment and low frequencies for single frequency measurements. Hence, the modelling of such errors is difficult. In this research, we attempt to estimate the changes in signal parameters in the presence of the multipath, the amplitude, the code delay and the Doppler shift. We further study the multipath error at the linear combination level. Therefore, the objectives of this research are to: Estimate the changes in the parameters of the incoming signals in the presence of the multipath error through the realistic analysis of the signal and noise models; Evaluate the statistical distribution of the multipath error component in urban areas with long buildings using real-time data measurements and analysis; and Adopt and analysis the effectiveness of the Doppler frequency shifted copies to mitigate the carrier multipath errors. This is inclusive of the linear combination of the GNSS signal

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2nd Presentation

By

Ms Nompumelelo Chili and Dr S Reddy

Department of Electronics and Computer Engineering, Durban University of Technology

Presenter: Ms Nompumelelo Chili

Research Title:

Performance Analysis of precoding schemes for massive MIMO

Abstract:

Performance Analysis of precoding schemes for massive MIMO is the research topic. This research aims to compare and analyze the precoding schemes for both linear and non-linear. Suitable precoding schemes will be chosen to compare the bit-error rate and spectral efficiency. Model perfect and imperfect CSI channels using Rayleigh fading model at time division duplex. Then combine the model to carry out the analysis based on chosen precoding

schemes for both the perfect and imperfect CSI using MATLAB simulation. This memo will present accomplishments, work in progress and the remaining research.

Mr Joe Dlamini and Ms Nompumelelo Chili

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3rd Presentation

By

Mr Radoje Džankić and Prof Sanja Bauk

Department of Maritime Studies, Durban University of Technology

Presenter: Prof Sanja Bauk

Research Title:

Apparatus for tracking containers in land and sea transportation

Abstract:

The apparatus for tracking and tracing the cargo container in both land and sea transportation will be presented. This instrument consists of a Raspberry Pi computer, power supply (battery and USB device), GSM and GPS modems, server, desktop work station, mobile (portable) device like a smartphone, and four types of sensors: motion, temperature, humidity and light. Data acquisition and calibration of alarms will be attained through a Python software

environment, while the application will be web-accessible. We found inspiration to construct this instrument and use it in field studies since we found out that there is no well-established system of tracking and tracing every container on board a ship. In some cases, there is no need to track and trace each container, but if one transports containers, so-called casks, with radioactive waste, e.g., in this case, there is a need to track and trace every single container on board in near real-time from shore, for safety and security purposes.

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4th Presentation

By

Mr Phillip Gyasi-Agyei

Discipline of Mechanical Engineering, University of KwaZulu-Natal

Presentation:

Overview of the UKZN Aerospace Systems Research Group's Phoenix Hybrid Rocket Programme

Abstract:

The University of KwaZulu-Natal's Aerospace Systems Research Group (ASReG), based in the Discipline of Mechanical Engineering, has been conducting wide-ranging applied research in the disciplines of aerospace propulsion and vehicle systems design for over a decade. One of ASReG's major endeavours has been the Phoenix Hybrid Rocket Programme, which pursues the development of suborbital rockets propelled by hybrid propellant rocket motors to facilitate human capital and technology development. This presentation will provide an overview of the Phoenix programme, touching on technological fundamentals, outlining the programme's prior ground and flight test activities, and introducing the next Phoenix flight test campaign - provisionally scheduled to occur towards the end of 2022.

Mr Mthobisi Tshomela, and Mr Phillip Gyasi-Agyei

Dr Jean Pitot

Dr Jean Pitot, Mr Mthobisi Tshomela, and Mr Phillip Gyasi-Agyei

Dr Jean Pitot, Mr Mthobisi Tshomela, Prof Innocent Davidson and Mr Phillip Gyasi-Agyei

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5th Presentation

By

Mr Bonginkosi Gumede, Dr C Mulangu and Dr E Mukubwa

Department of Electronics and Computer Engineering, Durban University of Technology

Research Title:

The performance of LDPC Codes for satellite communication in ka band

Abstract:

This research presents the performance analysis of Low-Density Parity Check (LDPC) codes in Ka-band satellite communication. Rain attenuation is a measure problem in satellite communication operating in Ka-band. Weather impairments cause major signal degradation. In this research, we use LDPC codes and adaptive modulation to mitigate the problem of rain fade. Preliminary results have shown that LDPC codes are effective in error correction at Low Signal to Noise Ratio (SNR). The system has been simulated using MATLAB software; we only simulated LDPC codes with Addictive White Gaussian Noise. The next simulation will include Ka-band multiplicative noise vector. Preliminary results achieved are good.

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6th Presentation

By

Mr Jonas Dakora and Prof Innocent Davidson

Department of Electrical Power Engineering, Durban University of Technology

Presenter: Mr Jonas Don-yelee Dakora

Research Title:

Performance analysis of low-density parity-check code for satellite communication in ka-band

Abstract:

This paper presents the analysis of LDPC code for a Satellite communication system. The need for proficient and reliable digital data transmission has increased. Low-density parity-check codes are coding techniques introduced by Gallager for error control which needs modification. This research focuses on analysing the BER performance of low-density parity-

check codes compared with other coding schemes using the BPSK modulation technique in Ka band. The low density parity check coding techniques are used to minimize the effect of weather conditions and fading that is caused by distance in the Ka-band. High frequency in the range of Ka-band communication system is affected by weather attenuation conditions. These factors cause signal attenuation, which is a function of frequency. Furthermore, the frequency of Ka-band satellite channel is affected by other external forces which influence the system performance. This can decay the performance and reliability of the satellite links.

Mr Jonas Dakora and Prof Innocent Davidson

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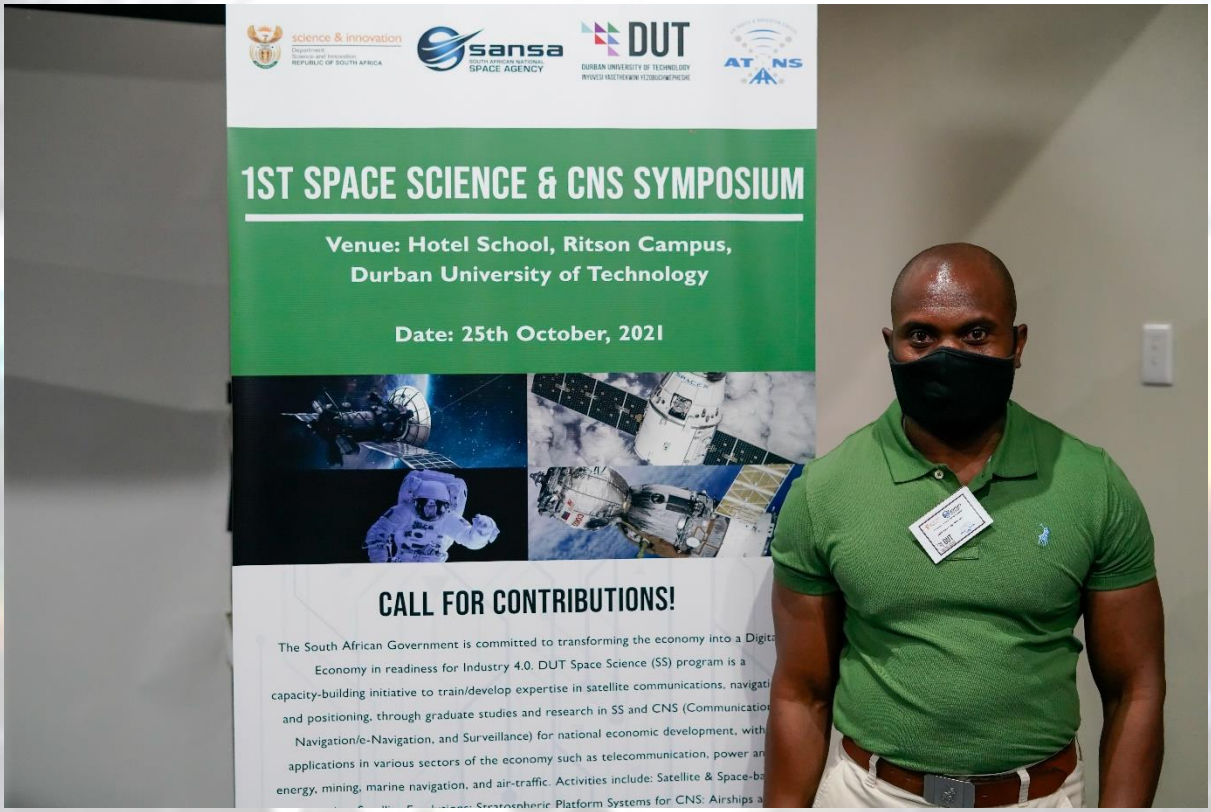
7th Presentation

By

Mr Moses Thabo Nkhoma and Dr Albert Agbenyegah

Department of Applied Management, Durban University of Technology



Presenter: Mr Moses Thabo Nkhoma

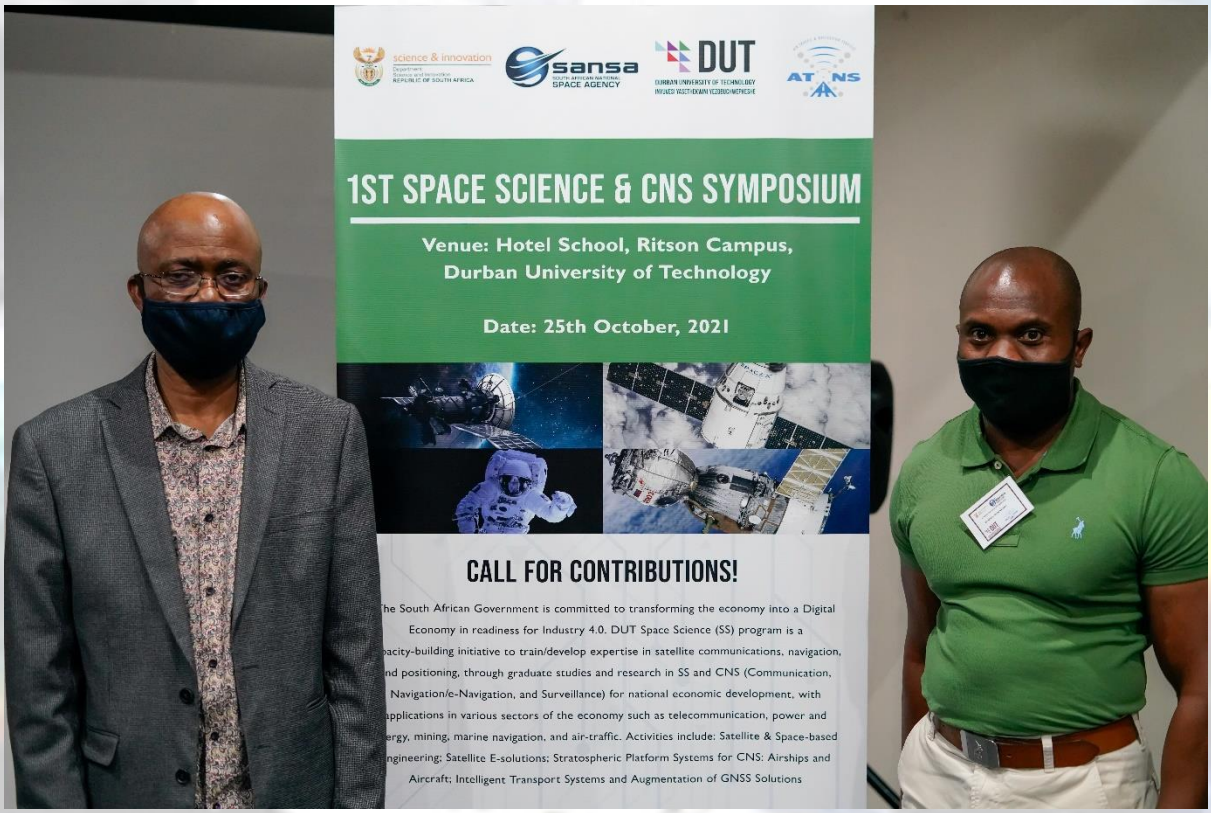
Research Title:

Public-private partnerships for enhancing border security through space technology in South Africa

Abstract:

This study sought to examine the value of employing space technology through effective Public-Private Partnerships to address border security limitations in South Africa. A qualitative research methodology was applied to achieve these objectives consisting of documentary analysis and semi-structured interviews. Research participants were drawn

from the border security environment, satellites technology sector, and Unmanned Aerial Systems sector. The researcher approached this study from an Applied Management perspective. Evidence in this study suggested a need to integrate various technologies, including space-based technologies, to enhance border security in South Africa. It also highlighted opportunities for the South African border security authorities to collaborate with the private space technology sector to provide space technologies for border security in the country. This type of partnership would look at aspects of research and development, innovation; skills transfer; and sharing of expertise. The study also highlighted that partnerships would provide technological solutions faster than traditional public procurement methods and allow for the development of specific and suitable space technologies based on the needs of the border security authorities.



Dr Albert Agbenyegah and Mr Moses Thabo Nkhoma

Dr Albert Agbenyegah

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8th Presentation

By

Ms Ntombezinhle Kweyama and Prof Sanja Bauk

Department of Maritime Studies, Durban University of Technology

Presenter: Ms Ntombezinhle Kweyama

Research Title:

Converging for human and social wealth in the fourth industrial revolution (4IR) realm

Abstract:

Technology has become an unavoidable part of our everyday lives. We have passed through three industrial revolutions during the past two hundred years as humans. The first one has been anchored by the steam engine, the second by mass electrification, the third by computerization, and the actual fourth one - by virtual or artificial intelligence. Today, scientists face the challenge either to develop further virtual intelligence or to upgrade by

converging technologies human body and, in particular human brain and intelligence, which is considerably different from virtual-artificial one. The ultimate goal while deciding about the preferences in this regard should be human dignity, wellness, and social wealth. Therefore, the thesis focuses on the converging technologies for enhancing human sensory, motorial and cognitive abilities, social welfare, and economic progress.

The most significant advantage of wearable chips or chip implantation into the human body is convenience. It has the potential to replace some communication and sensing abilities, and its applications can help humanity. However, at this point, the technology must be refined, which will take a long time. In addition, the method of implanting chips must take into account the physiological nature of the human body. Various types of physical discomfort may occur once the chip is installed. This necessitates research into appropriate new medications to be utilized in conjunction with the implantation. As a result, chip insertion technology still confronts numerous challenges.

Technologically based predictions of the future are already threatening humanity, so this research is important. It is potentially driven to highlight further developments of virtual intelligence and converging technologies. It stands to protect human wealth and dignity, while it is not "per se" against technological development for the betterment of both societies and individuals since there is no happy society without happy individuals.

This research aims to find direction on (1) Can biological and virtual intelligence be developed simultaneously to enhance each other, and in which ways? (2) Do convergent technologies serve only for the betterment of society? (3) Does enthusiasm about convergent technologies guarantee ethics and human and societal wealth?

As a research approach, structured, both face-to-face and computer-assisted or videoconferencing interviews will be conducted. The interviewees will be professors and well-established researchers in informatics, HCI, UX, accessibility design, biotechnology, computer science, electrical engineering, artificial intelligence, participatory democracy, and communications from South Africa and abroad.

To make the presentation more engaging for the audience, we included some examples of advanced artificial intelligence and convergent technologies inventions, like Deep Blue IBM computer that won world chess champion, Garry Kasparov, in 1997; transcranial helmets used for curing degenerative brain diseases (Alzheimer's and Parkinsons), and also for controlling military mind; tactile Internet with haptic feedback experience; cyborg Sophia; smart dust, and Internet of brains (Brainternet), which is used for medical treatment, while turns the brain into the Internet of Things and WWW. We believe the presentation will inspire the audience and open constructive discussion, which can enhance our further endeavours in exploring the impact of these disruptive and emerging advanced technologies.

Prof Sanja Bauk and Ms Ntombezinhle Kweyama

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9th Presentation

By

Ms Sindisiwe Malanda and Prof Innocent Davidson

Department of Electrical Power Engineering, Durban University of Technology

Research Title:

Transient Fault Analysis of a VSC-Based Multi-Terminal HVDC Scheme

Abstract:

A multiterminal HVDC system includes the connection of different HVDC terminals to a common grid. Most of the MTDC networks are realized in voltage source converter (VSC) high voltage direct current (HVDC). Over long distances, HVDC transmission is preferred to high voltage direct current (HVAC). Furthermore, HVDC is subjected to minimal harmonics oscillation problems due to the absence of frequency. HVDC enables the interconnection of systems at different frequencies, and the system becomes free of angular stability problems. VSCs employ insulated gate bipolar transistors (IGBTs) switches. High-frequency pulse width modulation is used to operate the IGBTs to achieve high-speed control of active and reactive power. The growth of MTDC networks may require a new type of VSCs topology, which is resilient and efficient to dc and ac network faults. This research investigation focuses on the transient dc-side fault analysis in a two-level Monopolar VSC-Based Multi-Terminal HVDC Scheme consisting of four asynchronous terminals sharing a rated 400kV DC-grid was carried out in PSCAD software. During dc-side fault analysis, a pole-to-ground fault was considered as it's more likely to occur, although it is less severe than pole-to-pole. The converters are interconnected through 100 km dc cables placed 0.5 m apart and at a depth of 1.5 m underground. It was observed that during the steady-state analysis, the dc voltage in the grid was maintained at the rated value of 400 kV, the currents measured at the converters bus was 0.5 kA, and the current flowing through the cables was 0.25 kA. Under the fault condition, the dc voltage drop needs to be maintained to a closed range to avoid the grid from collapsing. The dc voltage controller incorporated the voltage droop technique to keep the dc voltage at the narrow range. Depending on the value and nature of ground fault resistance, the fault current magnitude varies, and distance variation along the cable significantly contributes to the fault current. It is observed that fault close to the converter (5 km's measured nine kA) results in high fault currents compared to fault away from the converter (50 km's measured

7.8 kA). The protection design of the VSC needs to be able to detect whether it's a ground fault or a short circuit since the location of the fault needs to be identified and repaired. Another observation made when the fault is inserted 50 km away from the converter, meaning the fault is at the center of the two converters, resulting in high currents in both converters. The isolation of the fault should be fast and selective as the critical time is very short. The dc circuit breakers are mostly recommended as primary protection; however, different protection techniques need to be incorporated with dc circuit breakers to quickly identify, select, and reliably isolate the faulted line. Moreover, the protection should be able to isolate the line before the fault reaches the maximum fault current to avoid damage to the converter components.

Dr Elutunji Buraimoh, Ms Sindisiwe Malanda and Prof Innocent Davidson


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From the first row bottom left: Mr Bonginkosi Gumede, Mr Mthobisi Tshomela, Mr Phillip Gyasi-Agyei, Mr Thabo Nkhoma. From second row left: Ms Sindi Malanda, Ms Nompumelelo Chili, Ms Nomihla Ndlela, Ms Ntombenhle Mazibuko, Prof Sibusiso Moyo (DVC-RIE), Prof Inno Davidson (Program Leader), Prof Sanja Bauk, Dr Albert Agbenyegah, Ms Ntombezinhle Kweyama, Ms Nomusa Zakuza, Ms Namhla Mtukushe. Last row from left: Mr Joe Dlamini, Dr Elutunji Buraimoh, Dr Jean Pitot, Mr Vusani Nemudzivhadi and Mr Sipho Lafleni.

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