NATIONAL SPACE CONFERENCE 2024

Harnessing Space Science and Innovation for Sustainability

DATE: 28 – 30 August 2024

VENUE: CSIR ICC, Pretoria, South Africa

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REPUBLIC OF SOUTH AFRICA

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Touching lives through innovation

Dynamism and Challenges of Space Position and the need to Improve Communication Navigation and Surveillance

By

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3RD Space Science & CNS symposium

31th of October 2024

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AIR TRAFFIC & NAVIGATION SERVICES
ATNS

Pan African University Institute for Space Sciences

CPUT will work in collaboration with a consortium of six other South African universities working in the **following areas of space sciences:**

- **Space Engineering –** CPUT & Stellenbosch University
  - Satellite Engineering
  - Ground Segments
- **Space Sciences –** University of Cape Town, North-West University, Durban University of Technology & University of KwaZulu-Natal
  - Space Physics
  - Satellite Communications
  - Navigation and Positioning
- **Space Applications –** University of Fort Hare (UFH) & University of Pretoria
  - Astronomy
  - Earth Observations

Some Research Areas

Fundamentals in Space Communications, Navigation and Surveillance (CNS)

Management of Space Projects, Financing, Insurance of Launches and Satellites

Spacecraft and Payloads for Fixed and Mobile CNS Application

Alternative Energy from the Sun, Wind and Sea

Satellite Solar Cells, Electrical Power and Long-life Batteries

Satellite Systems for Space Solar Power (SSP)

Satellite Systems for Meteorological and Hydrological Observation

Main Research Area

Research in Space Communications, Navigation and Surveillance (CNS)

The concept of Communication Navigation and Surveillance (CNS) entails:

- **Aviation communication** which refers to communication between two or more aircraft, the exchange of data or verbal information between aircraft and air traffic control and the ground based communication infrastructure of the air traffic management network
- **Air navigation** which refers to the process of planning, recording, and controlling the movement of an aircraft from one place to another by providing accurate, reliable and seamless position determination capability.
- **Surveillance systems** are used by air traffic control to determine the position of aircraft.

Communication, navigation and surveillance (**CNS**) are the main functions that form the infrastructure for **air traffic management** **(ATM)** to ensure that air traffic is safe and efficient.

For South Africa, this is the responsibility of the **Air Traffic Navigation Services** (**ATNS)** and it is regulated according to guidelines set by the International Civil Aviation Organization (ICAO).

Dynamism in Aviation Airspace

- As air traffic continually increases over time, the need for security among aviation space assets is becoming increasingly important
- The rapid growth of space use and deployment of air space vehicle brings with it many potential threats.
- In recent years, the number of radio frequency (RF) and Global Navigation Satellite Systems (GNSS) signal failures and attacks have taken place, both on-ground and in-space, has increased.
- It is hard to find a perfect navigation system based on the geological aspects due to the constant changes in the surrounding environment as well as the number of human errors

These tend to ruin the navigation system inputs and the fewer capabilities of the equipment, thus, it cannot define a particular object at a certain zoom level

Hence, It is necessary to use more advanced object identification and recognition system that can make the geolocation more accurate and in real-time

Challenges in Space Positioning

The evolution in the uses of space and rapid advances in space technology have created new opportunities, but also new risks, vulnerabilities and potential threats:

- Satellites can be hacked, jammed or weaponized, and anti-satellite weapons could cripple communications and affect the GNSS operations.
- Planes operations, as they are operated and controlled by ground-based facilities are at risk for cybercriminal access i.e. cyber attack
- IoT devices that are used for satellite communications to connect, can be especially vulnerable to cybersecurity threats.
- Targeted signal attacks against GPS and other GNSS signals have been reported across all regions of the globe, even being detected, and characterised as a daily occurrence

Need for Improvements in CNS

- As our dependence on space-based technologies grows, so does system malfunction, human errors, the risk of cyber threats, therefore, securing space assets from these activities is very important.
- We are now in an era where the strategic importance of space cannot be overstated, technological advancements are crucial for space security.
- The need to design and develop a resilient space systems that are able to, can recover from a cybersecurity attack or technical issue is of paramount importance.

Improvements hold the key to:

- Achieving a new standard of **consistent, integrated security**.
- Significantly enhancing **operational efficiency**.
- Elevating **user experiences** to new levels.
- Seamlessly bridging the divide between **current and future network architecture in aviation**.

Expected Benefits

The continuous improvements in CNS will bring about:

- Increased and future proof technical performance for airspace users and the operational environment needs while ensuring resilience and contingency.
- Improved spectrum efficiency, knowing that spectrum is an extremely scarce and expensive resource
- Support innovation in terms of performance, positioning and security aspects
- Reduced annual operating costs and investment budgets

These will help to achieve the global interoperability, as outlined in the ICAO Global Air Navigation Plan (GANP).

Thus, this can help to enhance our ability to operate effectively in space and cyberspace to prevent, detect, counter and respond to the full spectrum of threats.

THANK YOU !!

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