



Geodesy Education at DUT: Experiences, Challenges and Future Directions



Preparing the Next Generation of Geomatics Professionals in South Africa

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2 . Why Geodesy Still Matters

- Geodesy education at DUT is aligned with **ENVISION2030** and the **DUT Philosophy of Education**, which seek to develop socially responsive, innovative and future-ready graduates.
- Geodesy provides the foundation for accurate positioning and measurement.
- It underpins:
 - GNSS and positioning
 - Mapping and surveying
 - Engineering projects
 - Cadastral applications
 - Remote sensing and photogrammetry
 - Geospatial data infrastructure
- Modern Geomatics increasingly depends on accurate spatial reference.

3. My Experience Teaching Geodesy at DUT

What students encounter:

- Mathematical and physical concepts
- Reference systems and reference frames
- Coordinate systems and transformations
- Geodetic observations
- Error and uncertainty
- Adjustment and interpretation of measurements
- Practical applications

My experience:

Students generally engage more strongly when theory is connected to a practical spatial problem.

4 — The Changing Geomatics Landscape

Traditional

- Total stations
- Conventional surveying
- Classical geodetic observations

Modern

- GNSS
- Digital photogrammetry
- Remote sensing
- GIS
- UAV mapping

Emerging

- Multi-sensor integration
- Mobile mapping
- LiDAR
- Artificial intelligence and machine learning
- Automated data processing
- Real-time positioning

5 — Challenges in Geodesy Education

Key challenges

1. Mathematics and abstract concepts

Students can struggle to connect mathematical theory with spatial applications.

2. Rapid technological change

Technology and software develop faster than curricula can sometimes change.

3. Balancing theory and practice

Students need both conceptual understanding and practical competence.

4. Computational skills

Modern Geodesy increasingly requires programming, numerical methods and data processing.

5. Student diversity

Students enter programmes with different levels of mathematical, computing and spatial knowledge.

6 — What Should the Graduate Look Like?

The future Geomatics professional should be:

1. Technically competent

Understands geodetic principles and measurement technologies.

2. Computationally capable

Can work with data, numerical methods and programming.

3. Analytical

Can assess uncertainty, errors and the quality of spatial information.

4. Adaptable

Can learn and adopt new technologies.

5. Problem-oriented

Can apply Geomatics to real societal and environmental problems.

6. Ethically responsible

Understands the consequences of inaccurate or poorly managed spatial information.

7 — Future Directions for Geodesy Education at DUT

Possible directions:

1. Strengthen practical learning : More real-world surveying and positioning problems.

2. Integrate Geodesy with other Geomatics disciplines

Geodesy + GNSS + Photogrammetry + Remote Sensing + GIS.

3. Increase computational learning

- MATLAB, Python, Numerical methods and Data analysis

4. Introduce modern technologies

- UAVs, LiDAR, Multi-sensor systems, Modern GNSS

5. Strengthen project-based learning

Students solve authentic spatial problems rather than only completing isolated exercises.

8 — From Knowledge to Problem Solving

A possible
educational model:

Fundamentals



Measurement



Computation



Analysis



Innovation



Societal Impact

Examples

- **Monitoring infrastructure**
- **Mapping coastal environments**
- **Water-resource assessment**
- **Disaster response**
- **Urban development**
- **Environmental monitoring**
- **Climate-related applications**
- **Smart cities**
- **Sustainable infrastructure**
- **SDG-related spatial applications**
- **Community mapping initiatives**

9 — Conclusion: Preparing the Next Generation

Key message:

The future of Geodesy education is not about choosing between fundamentals and technology. It is about combining them.

We should develop graduates who can:

Understand → Measure → Compute → Analyse → Adapt → Innovate → Solve → Societal Impact



By combining strong geodetic fundamentals with technology, problem-based learning and social responsibility, we can prepare the next generation of geomatics professionals to contribute meaningfully to South Africa and beyond.

Thank you



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