

# Curriculum Vitae

**1. Name:** Willem Hermanus Steyn (ID: 551119 5002 085)

**2. Date of birth:** 19/11/1955

**3. Marital status:** Married, 2 children (aged 24 & 28)

## **4. Academic Qualifications:**

1. B.Eng (Hons) {Cum Laude}  
- 1980, University of Stellenbosch, South Africa
2. M.Eng {Cum Laude}  
- 1985, University of Stellenbosch, South Africa
3. M.Sc (Satellite Engineering) {Distinction}  
- 1990, University of Surrey, UK
4. Ph.D Engineering  
- 1995, University of Stellenbosch, South Africa

## Awards:

1. Phillips Award (1978) for the best third year student in Electronic Engineering.
2. Associated Electronics Award (1985) for the best M.Eng thesis.
3. NOK Cullinan Industrial Design Award with J.J. du Plessis (1989).
4. Best paper at the IEEE/SAIEE Symposium on Small Satellites and Control (Oct.1994).
5. Evaluated as a NRF C2 researcher in 2003.
6. Evaluated as a NRF C1 researcher in 2010.
7. Evaluated as a NRF B3 researcher in 2015.
7. SABS Design Excellence Award (as SU Systems Engineer on behalf of SU & SunSpace) in 2011.

## **5. Membership of professional societies:**

Registered Pr Eng (SAIEE)

Senior Member AIAA

Member IAF (institutional)

Elected Member of the International Academy of Astronautics (IAA)

Elected Member of South African Academy of Engineering (SAAE)

## **6. Editorial, Reviewing and Refereeing:**

- a) Proceedings Editor, IEEE Symposium on Small Satellites and Control Systems. SS&C-94 in Stellenbosch South Africa
- b) Associate Editor, Control Engineering Practice Journal, 2007-2013
- c) Regular Reviewer (Total > 20 per year): AIAA Journal of Guidance, Control and Dynamics, Aerospace Science and Technology Journal, Control Engineering Practice Journal, Acta Astronautica, ASCE Journal of Aerospace Engineering

- d) Invited Reviewer for International Nanosatellite Mission Idea Contest in Japan (MIC1 in 2011, MIC2 in 2012, MIC3 in 2014). Chair for pre-MIC3 contest in 2013.

## 7. Work history:

1981 : Assistant Area Engineer (Instrumentation) SASOL 2  
1982 - 1987 : Lecturer in Electronic Engineering US  
1987 - 1996 : Senior Lecturer in Electronic Engineering US  
1997 : Associate Professor in Electronic Engineering US  
1998 - 2001 : Principal Engineer (Team leader) Surrey Satellite Technology Ltd in the UK.  
2002 - 2004: Head Product Development, SunSpace & Information Systems, Part-time Professor in Electronic Engineering US  
2004 – Current: Professor in Electronic Engineering US, Head of Department (2011,2012), Head of Computer and Control Group (2006-2010)  
Head of Satellite Research Group (2013-current)

## 8. Area of specialisation:

### 7.1 Teaching:

Undergraduate - Classical and Modern Control Systems Theory, Computer Systems.  
Postgraduate - Adaptive and Multivariable Robust Control Systems, Satellite Engineering.

Study leader for the following completed Master theses (most 2 year research degrees):

1. “*Token Passing Optical Ring Network*”, U. Böhlke, December 1984.
2. “*Inter Connection of Computer Networks and a Transport Layer for Grafnet*”, H. Carse, December 1985.
3. “*The Design of a High Speed Computer Network up to the Transport Layer and a Special Investigation into Techniques to Implement a Gateway*”, C.M. Visser, December 1986.
4. “*n Predictive Controller for a Stable Platform on a 8-Wheel Vehicle*”, J.F. Marais, December 1991.
5. “*Quantitative PID Controller Design*”, G.A. Cowley, December 1992.
6. “*Optimal Control of a Wood Drying Process*”, J.P.S. Viljoen, March 1993.
7. “*A Redundant Multi-Mode Hard Real-Time System on Heterogeneous Processors*”, F.G. Miedema, December 1993. Co-study leader with the University of Twente, Netherland.
8. “*Extended Kalman Filter Observer for SUNSAT*”, J.H. Tredoux, March 1994.
9. “*A Charge Coupled Device Star Sensor System for a Low Earth Orbit Micro Satellite*”, B.C. Greyling, December 1995.
- 10 “*A New Unified Approach to Power Quality Management*”, A. Van Zyl, Co-study leader, December 1995.
11. “*A Low Cost High Precision Star Sensor*”, M.J. Jacobs, December 1995.
12. “*An Extended Kalman Filter for Autonomous Orbit Navigation*”, L.J. Jordaan, March 1997.
13. “*H-Infinity Control of a Hydraulic Engine-Dynamometer System*”, E. Jansen, December 1998.
14. “*A Reaction Wheel System for Microsatellites*”, L.J. Joubert, December 1999.
15. “*Multivariable Control of Pulp and Froth Levels in a Flotation Plant*”, J.P. van Heerden, December 2001.
16. “*A Magnetic Control System for Nanosatellites*”, A.J. Gryllakis, University of Surrey, August 2001.

17. "*Development of a Practical Control Moment Gyro for a Small Satellite*", R. Berner, April 2005.
18. "*3D Tracking between Satellites using Monocular Computer Vision*", D.F. Malan, December 2004.
19. "*A Safety System for a Patient Robot Positioning System used in Medical Radiation Treatment*", N. von Hoesslin, December 2004.
20. "*A Distributed Control System for an Electrostatic Roll Separator*", P.L. Theron, April 2006.
21. "*An Automatic Heading, Attitude and Position System for an Airship*", J. Bijker, December 2006.
22. "*A 3-Axis Inertially Stabilised Platform for Small Air Vehicles*", A.F.L. Bredenkamp, March 2007.
23. "*An AODC System for Small GEO Satellites*", G. Thopil, December 2006.
24. "*A Bore-sight Motion Detection Algorithm for Satellite Attitude Control*", L. Visagie, December 2007.
25. "*An Attitude Determination and Control System for a Nanosatellite*", J. Schoonwinkel, December 2007.
26. "*A CAN based Distributed Telemetry and Telecommand Network for a Nanosatellite*", S. Khumalo, March 2008.
27. "*Development of a Vacuum Arc Thruster for Nanosatellite Propulsion*", J. Lun, December 2008.
28. "*Autonomous Docking for a Satellite Pair using Monocular Vision*", D. Mienie, March 2009.
29. "*Autonomous Flight Control System for an Airship*", G.C. Avenant, March 2010.
30. "*The Dynamic Modelling and Control System of a Tethered Aerostat for Remote Sensing Applications*", D.A. Fourie, December 2009.
31. "*An investigation into control techniques for cascaded plants with buffering, to minimise the influence of process disturbances and to maximise the process yield*", J. Gryffenberg, December 2010.
32. "*Development of Attitude Controllers and Actuators for a Solar Sail Cubesat*", P.H. Mey, March 2011.
33. "*The development of Sun and Nadir sensors for a solar sail Cubesat*", H. Loubser, March 2011.
34. "*The Design and Development of an ADCS OBC for a Cubesat*", P.J. Botma, December 2011.
35. "*An Aerodynamic Attitude Control System for a Cubesat*", J. Auret, April 2012.
36. "*An Attitude Control System for the Deployment and Stabilisation of a Tethered Dual Cubesat Mission*", M-A. Kearney, March 2013.
37. "*Advanced Process Control for a Spray Dryer and Evaporator*", A. Haasbroek, March 2013.
38. "*Development of CubeStar a CubeSat-Compatible Star Tracker*", A.O. Erlank, December 2013.
39. "*Orbital Lifetime Predictions of Low Earth Orbit Satellites and the effect of a DeOrbitSail*", M. Afful, December 2013.
40. "*Attitude Determination and Control System for Eyassat for Hardware in the Loop Application*", C.J. Groenewald, April 2014.
41. "*An Agile 3-Axis Attitude Control System Design for a Cubesat*", J. Gerber, Dec 2014.
42. "*Design and Implementation of ZA-AeroSat's OBC Real-time operating system for the QB50 constellation*", AE Heunis, Dec 2014.
43. "*Advanced ADCS for an agile small LEO satellite*", GH Janse van Vuuren, April 2015.

44. “*Variable Speed Scissored Pair Dual Gimbal Control Moment Gyro for Nanosatellite*”, DG Steyn, December 2015.
45. “*A GPS Based On-board Orbit Propagator for Low Earth-Orbiting CubeSats*”, NC Rossouw, December 2015.
46. “*The Design and Implementation of a Stellar-Gyro Sensor for Accurate Angular Rate Estimation on CubeSats*”, N Calitz, December 2015.
47. “*The Development of a Hardware-in-the-loop Platform for Attitude Determination and Control Testing of a Small Satellite*”, M Junaid, December 2015.

Study leader for the following uncompleted Master theses:

1. “*An Investigation into the Requirements and Design of an Ultra-fine Pointing ADCS for a Microsatellite with an Astrophysical Application*”, M. Bin Othman started 2014.
2. “*Redesign, Implementation and Evaluation of the final Superheater Stage at a Power Station*”, H-J Gadinger started 2015.
3. “*An Infrared Horizon Sensor for a CubeSat Satellite*”, JH Wessels started 2016.
4. “*Development, Analysis and Simulation of the Subsonic Flight Control System of the AVL Booster during Atmospheric Flight Conditions*”, AJ Buysse started in 2016.
5. “*Augmented Stellar Sensor for Small Spacecraft*”, GJ Roux started 2017.
6. “*Development of a Spinning Solar Sail and its Deployment Mechanism*”, LT Hibbert started 2017. (Co-supervision with Dr HW Jordaan)

External Examiner for the following Master theses:

1. “*H-Infinity Optimal Control of a Counter-Current Process*”, B.J. Olivier, University of Cape Town, September 1991.
2. “*Fuzzy Control and its Application to a Simple Oscillatory System*”, A.P. Ferreira, Rhodes University, December 1995.
3. “*Internal Performance of Iterative Feedback Tuning*”, J. Sikaundi, University of Cape Town, December 2008.
4. “*Multivariable H-inf Control for an Active magnetic Bearing Flywheel System*”, S.J.P. Steyn, North-West University, December 2010.

Study leader for the following PhD theses:

1. “*A Study of Combined Spacecraft Attitude Control Systems*”, X-J. Chen, University of Surrey, December 2000.
2. “*In Orbit Calibration of Satellite Inertia Matrix and Thruster Coefficients*”, R. El-Bordany, University of Surrey, March 2001.
3. “*A Control Moment Gyro based Attitude Control System for Agile Small Satellites*”, V.J. Lappas, University of Surrey, October 2002.
4. “*Onboard Image Quality Assessment for a Satellite*”, I.v.Z. Marais, University of Stellenbosch, March 2009.
5. “*A Spinning Solar Sail Attitude and Orbit Control System for Cubesail*”, H.W. Jordaan, University of Stellenbosch, March 2016.

Study leader for the following uncompleted PhD theses:

1. “*A Radiation Testing Framework for Electronic Components in Low Earth Orbit*”, A. Barnard, started 2007.
2. “*Reliable Communication Link for a Small Satellite Based Wireless Sensor Network*”, Z. Joao started 2012 (co-supervisor with Dr R. Wolhuter)

3. “Control Strategy for a Reusable Launch Vehicle Flyback First Stage”, A.N. Schutte started 2014.

## 7.2 Completed Research Projects:

1. Design and development of hardware and software for the monitor of a distributed irrigation control system - in collaboration with the Department of Civil Engineering for the Water Research Commission.
2. Design and performance analysis of a register insertion high speed ring network - M.Eng degree.
3. Development of attitude control algorithms and simulation software for low orbit microsattellites - M.Sc degree.
4. Multi-mode attitude determination and control techniques for high performance applications on small satellites - Ph.D degree.
5. Study for ESA (European Space Agency) into attitude and orbit control accuracies on small satellites.

## 7.3 Current Research Areas:

1. Attitude determination and control hardware and software subsystems for satellites.
2. Algorithms for the enhancement of the attitude control performance on small earth observation satellites.
3. Solar sailing using Cubesats.
4. Dynamics modelling and autonomous control of small airships.

## 9. Service at the University of Stellenbosch:

### 9.1 Departmental:

Courses - Development of Robust Control 813, Multivariable Systems 813, Advanced Sampled Control 813 and Satellite Systems 813 as post-graduate modules for Masters studies. Several undergraduate courses were also developed and expanded.

Laboratories - Several experimental aids were developed for student labs, i.e. a servo control tutor system (also used by the University of Pretoria), A/D plus D/A and communication PC cards and a few control demonstration units.

Administrative - Member of the faculty timetable committee, responsible for the administration and allocation of student assistants. Responsible for all computer instrumentation in the departmental labs. Project leader for the attitude control system of the SUNSAT microsatellite.

### 9.2 University:

Development of a computer network (NETUS) used for all access control and photocopy card readers on the university campus. Various control and instrumentation developments for research projects in other university departments:

- a) An automatic irrigation and dosing system for the soil sciences group within the Agriculture department.
- b) A kiln control system for automatic wood drying for the Forestry department.
- c) A patented wood moisture sensor, for the Forestry department.
- d) Accurate temperature control for ovens used by the Domestic Sciences department.

### 9.3 External:

Secretary of the “Control System Chapter” of the IEEE in SA from 1994 until 1996.  
Proceedings editor of the “Symposium on Small Satellites and Control Systems - SS&C-94”.  
Associated Editor for the Control Engineering Practice journal since April 2007.  
Member of the successful bid committee for the IAC 2011 World Congress in Cape Town.  
Member of the successful bid committee for the IFAC 2014 World Congress in Cape Town.  
Member of the Board of Directors of SunSpace and Information Systems from 2004 to 2012.

### **10. Industrial Experience:**

Several smaller projects were done in collaboration with industry. Larger projects completed were:

1. Design and implementation of a train brake control system for WABCO (SA) (Westinghouse Air Brake Company). This system received the 1989 Cullinan Design award. A few training courses on the application and service of the system were also given to engineers and technicians of SA Railways.
2. Improvements of the stabilisation algorithms on the elevation and traverse gun control turrets mounted on tanks and armoured cars, for ESD/REUTECH.
3. Redesign and improvements to the servo tracking accuracy of a monopulse radar antenna, for IMT.
4. Automatic control of sheet thickness in a fiber-cement processing plant, for EVERITE.

From 1998, until the end of 2001, I have been the head of spacecraft attitude and orbit control systems (AODCS Team leader) at Surrey Satellite Technology SSTL in the UK. This is a small company of 120 staff (60% graduated engineers) specialising in nano to minisatellite system development. SSTL has already build, launched and operated 20 satellites in low earth orbit. I was personally involved in six new satellite programs during the period from 1998 to 2001. The company is based at the University of Surrey and within the Surrey Space Centre a large academic group (University staff and students) is also accommodated. The AODCS team is a small group of engineers (all with post graduate qualifications) responsible for all the analysis, development and implementation of attitude and orbit control systems on new satellites. The AODCS team is also actively supervising many post graduate students during their research in this specific field.

The following projects were participated in (ADCS budget between brackets):

1. Lead for planning, design and implementation of the attitude and orbit control system for the 3-axis stabilised minisatellite UoSAT-12 (600k BP).
2. Lead for the ADCS hardware and software development of the 3-axis stabilised microsatellite Tsinghua-1 (200k BP).
3. Lead for the ADCS hardware and software development of the first 3-axis stabilised nanosatellite SNAP-1 (30k BP).
4. Technical lead for the development of a momentum wheel for the ESA Rosetta Lander spacecraft (200k BP).
5. Lead for the ADCS design on TOPSAT a high performance platform for an optical payload (500k BP).
6. Technical lead for the in-house development and calibration of various attitude sensors and actuators e.g. sun sensors, reaction wheels and magnetorquer rods.
7. Various studies for NASA, ESA and commercial customers on new satellite missions e.g.
  - a) MMS (Multiscale Magnetospheric System), constellation of spinning satellites with wire booms for NASA.
  - b) GEODEM (Geostationary Demonstration Satellite), bus definition to fly various

payloads into GEO.

- c) RapidEye a constellation of minisatellites with high performance pointing requirements.
8. Participant in FP7 project *DeOrbitSail* to investigate debris mitigation using solar sail technology. (Euro 150k)
9. Participant in QB50 project with the 2U CubeSat *ZA-AeroSat* to model the upper Ionosphere (Euro 250k – full project).
10. Design, development and delivery of 20 ADCS bundles to other QB50 teams (Euro 300k)
11. Participant in FP7 project *RemoveDebris* to investigate technology to remove space debris (Euro 50k)

From 2002 to 2012, I was the Head Product Development of SunSpace and Information Systems a delegate company with roots in the University of Stellenbosch. I was also a director of the company and the team leader of the ADCS group within the company, until 2012 when the company was bought by government and became part of the Denel group. I was responsible for the development of an attitude control system for a 200 kg earth observation satellite at SunSpace. This project was completed early 2004 and the launch (on 17 April 2007) and commissioning successfully took place between April and May 2007. I have also been the designer of the attitude and orbit control system of SumbandilaSat, launched on 17<sup>th</sup> September 2009 and participated in the full commissioning and control of SA's second in-orbit satellite.

During 2009 I was consulting for Zeiss Optronics South Africa on the control stabilisation improvement of various optical platforms and head tracking systems. Since 2010 the satellite research group under my supervision participates with CPUT on several Cubesat missions, we are responsible for the ADCS system design and development. The total sponsorship received for this project is roughly R 250k/year.

From April 2011 I am a participant on an EU FP7 project called "DeorbitSail" for a period of 3 years, the total funding received was in the order of R 2 million.

From November 2011 until July 2012 I was leading the Space Engineering Expert Group (SEEG) of the National Space Program (NSP) of the South African National Space Agency (SANSA). A Space Vision 2030 Plan document was delivered and an Executive Summary was prepared for the SA Government Cabinet for approval.

Since 2012 I am participating in the ESA QB50 project to develop an aerodynamically stabilised 2U CubeSat called ZA-AeroSat. With the Surrey Space Centre we have also developed and delivered more than 20 ADCS bundles to stabilise the QB50 satellites of other participating teams. Since June 2014 two of these ADCS bundles have successfully been commissioned on the QB50 precursor satellites.

## **11. Service since 2002 at the University of Stellenbosch:**

Since 2002, I was appointed as full professor on a 2 day per week basis. Since July 2004, I have been appointed as a full professor in permanent capacity. I am responsible for teaching 2 post graduate semester modules i.e. Satellite Systems 813 and Advanced Control 813. I am also currently study leader for 5 Masters and 3 PhD students and have supervised 15 final year student projects the last three years. During the period Oct 2005 to Sept 2009, I was appointed as Systems Engineer for the government sponsored (DST) Sumbandila satellite

project. Although SunSpace build the satellite, the technical overview and approval of all review meetings was done by me. I was also involved within the Electronic Systems Laboratory (ESL) with the planning, execution and development of the ADCS for the SumbandilaSat microsatellite. I was responsible for the overall academic supervision of all the Engineering Masters students receiving bursaries on the Sumbandila project (2006 to 2011). I was the Head of the Computer and Control Group within the Department of Electrical and Electronic (E&E) Engineering from 2006 to 2010. In 2011 and 2012 I was Head of Department of E&E Engineering. Since 2013 I am Head of the Satellite Engineering Group within the Department E&E Engineering.



## 12. Papers at Conferences/Symposia:

1. “*Communication network for the monitor and management of irrigation systems*”, WH Steyn - Symposium on Automatic Weather Stations and Data Logging Systems, Department of Environment CSIR, 11-12 Nov. 1986: pp.287-299.
2. “*Microsatellite Attitude Control*”, WH Steyn - Satellite Technology Conference, Cape Town City Council, Oct.1991.
3. “*Optimal Drying of Lumber using a Discrete On-line Mathematical Model of Moisture Movement*”, HF Vermaas, WH Steyn & JPS Viljoen - IUFRO All Division 5 Conference on Forest Products, Nancy France 23-28 Aug.1992.
4. “*The Attitude Control Hardware and Algorithms for Fine Pointing of SUNSAT during Imaging*”, WH Steyn - 8th AIAA/USU Conference on Small Satellites, Utah State University, Logan Utah USA, 29 Aug.-1 Sept.1994.
5. “*Full Satellite State Determination from Vector Observations*”, WH Steyn - 13th IFAC Symposium on Automatic Control in Aerospace, Palo Alto California USA, 12-16 Sept. 1994: pp.193-198. (Cited = 9, 2014)
6. “*Optimal Reaction Wheel Desaturation of a Nadir Pointing Satellite using Magneto-Torquers*”, WH Steyn - IEEE/SAIEE Symposium on Small Satellites and Control Systems, University of Stellenbosch, 4 Oct.1994: pp.5-1 to 5-10.
7. “*Automatic Microirrigation and Salt Injection System for Research and Commercial Applications*”, WPJ Wessels, WH Steyn and JH Moolman - 5th ASAE International Microirrigation Congress, Orlando Florida USA, 2-6 April 1995: pp.116-122. (Cited = 4, 2014)
8. “*A New Unified Approach to Power Quality Management*”, A Van Zyl, JHR Enslin, WH Steyn and R Spée - 26th IEEE Power Electronics Specialists Conference (PESC-95), Atlanta Georgia USA, 18-22 June 1995: pp.183-188.
9. “*A Multi-Mode Attitude Determination and Control System for SUNSAT*”, WH Steyn - 3rd International Symposium on Small Satellites Systems and Services, Annecy France, 24-28 June 1996, Proceedings: Session 8/17 pp.1-9. (Cited = 5, 2012)
10. “*Using Atmospheric Drag for Constellation Control of Low Earth Orbit Microsatellites*”, DNJ du Toit, JJ du Plessis and WH Steyn, 10th AIAA/USU Conference on Small Satellites, Utah State University, Logan Utah USA, 16-19 Sept. 1996, Proceedings: Poster Session/3 pp.1-13.
11. “*Pre-Flight Performance of SUNSAT, South Africa’s first Remote Sensing and Packet Communications Microsatellite*”, A Schoonwinkel, GW Milne, S Mostert, WH Steyn and K van der Westhuizen, 10th AIAA/USU Conference on Small Satellites, Utah State University, Logan Utah USA, 16-19 Sept. 1996, Proceedings: Session V/4 pp.1-19. (Cited = 4, 2014)

12. “*A High Performance Low Cost Star Sensor System for Full Attitude Determination of a Microsatellite*”, WH Steyn, PJ Oosthuizen and MJ Jacobs, Workshop on Control of Small Spacecraft at the 1997 Annual AAS Guidance and Control Conference, Breckenridge Colorado USA, 5-9 Feb. 1997.
13. “*Enhanced Low-Cost Attitude Control of Microsatellites*”, MS Hodgart, Y Hashida and WH Steyn, International Workshop on Spacecraft and Orbit Control Systems, ESTEC (ESA-JPAC), 15-17 Sept. 1997.
14. “*Attitude Control recovery of the CERISE Microsatellite Following an In-Orbit Collision*”, Y Hashida, NP Bean, WH Steyn and MS Hodgart, 21st Annual AAS Guidance and Control Conference, 4-8 Feb. 1998, Proceedings: AAS 98-078, pp. 655-663.
15. “*Astrolabe - A Low Cost Autonomous Star Camera*”, NM Gomes, M Fouquet and WH Steyn, 4th International Symposium on Small Satellites Systems and Services, Antibes France, 14-18 September 1998, Proceedings: Session 6/7.
16. “*Optimal Combined Reaction-Wheel Momentum Management for LEO Earth-Pointing Satellites*”, X-J Chen and WH Steyn, 12th Annual AIAA/USU Conference on Small Satellites, Utah State University, Logan Utah USA, 31 Aug.- 3 Sept. 1998, Proceedings: Session IX/2 pp.1-11.
17. “*Robust Combined Eigenaxis Slew Manoeuvre*”, X-J Chen and WH Steyn, AIAA Guidance, Navigation and Control Conference, Portland Oregon USA, 9-11 Aug.1999, Proceedings: Volume 1, Session 17-GNC-11, 99-4048, pp.521-529. (Cited = 5, 2014)
18. “*An Attitude Control System for a Low-Cost Earth Observation Satellite with Orbit Maintenance Capability*”, WH Steyn and Y Hashida, 13th Annual AIAA/USU Conference on Small Satellites, Utah State University, Logan Utah USA, 23-26 Aug.1999, Proceedings: Session XI/4 pp.1-13. (Cited = 25, 2014)
19. “*Sunsat – Launch and First Six Month’s Orbital Performance*”, GW Milne, A Schoonwinkel, JJ du Plessis, S Mostert and WH Steyn, 13th Annual AIAA/USU Conference on Small Satellites, Utah State University, Logan Utah USA, 23-26 Aug.1999, Proceedings: Session I/4 pp.1-16. (Cited = 10, 2014)
20. “*In-orbit Attitude and Orbit Control Commissioning of UoSAT-12*”, WH Steyn and Y Hashida, 4<sup>th</sup> ESA International Conference on Spacecraft Guidance, Navigation and Control Systems, ESTEC Noordwijk, The Netherlands, 18-21 Oct.1999, Proceedings: Session 3/3. (Cited = 15, 2014)
21. “*Dynamic Ground-Track Chasing Constellation Using Atmospheric Drag*”, M Aorpimai, PL Palmer and WH Steyn, 4<sup>th</sup> ESA International Conference on Spacecraft Guidance, Navigation and Control Systems, ESTEC Noordwijk, The Netherlands, 18-21 Oct.1999, Proceedings: Session 7/4.
22. “*An Attitude Control System and Commissioning Results of the SNAP-1 Nanosatellite*”, WH Steyn and Y Hashida, 14th Annual AIAA/USU Conference on Small Satellites, Utah State University, Logan Utah USA, 21-24 Aug.2000, Proceedings: Session VIII/8 pp.1-8.

(Cited = 26, 2014)

23. "*In-orbit Estimation of the Inertia Matrix and Thruster Parameters of UoSAT-12*", RE Bordany, WH Steyn and SF Wu, 14th Annual AIAA/USU Conf on Small Sats, Utah State University, Logan Utah USA, 21-24 Aug.2000, Proceedings: Session I/4 pp.1-8.
24. "*Ground Target Tracking Control of Earth Pointing Satellites*", X-J Chen, WH Steyn and Y Hashida, AIAA Guidance, Navigation and Control Conference, Denver Colorado USA, 14-17 Aug.2000, Proceedings on CD: Session 104-GNC-37, 2000-4547, pp.1-11. (Cited = 7, 2012)
25. "*Advanced Attitude Control Systems for Agile Small Satellites*", VJ Lappas, WH Steyn & CI Underwood, CASI/UTIAS Workshop on Low-Cost Space Systems, University of Toronto, Canada, 4-5 May 2001.
26. "*In-Orbit Attitude Performance of the 3-Axis Stabilised SNAP-1 Nanosatellite*", WH Steyn & Y Hashida, 15th Annual AIAA/USU Conference on Small Satellites, Utah State University, Logan Utah USA, 13-16 Aug.2001, Proceedings: Session V/1. (Cited = 21, 2014)
27. "*In-Orbit Modelling and Calibration of the Sun Sensors on UoSAT-12 and Tsinghua-1 Satellites*", S-F Wu & WH Steyn, 15th Annual AIAA/USU Conference on Small Satellites, Utah State University, Logan Utah USA, 13-16 Aug.2001, Proceedings: Session V/3.
28. "*Control Moment Gyro Gimbal Angle Compensation using Magnetic Control during External Disturbances*", VJ Lappas, WH Steyn & CI Underwood, AIAA Guidance, Navigation, and Control Conference, Montreal, Canada, 6-9 Aug.2001, Proceedings: Session GNC-34, 2001-4339. (Cited = 7, 2012)
29. "*Advanced Micro/Nanosatellite Attitude Control Systems*", VJ Lappas, WH Steyn & CI Underwood, University of Toronto/CASI 1<sup>st</sup> Workshop on Low-cost Spaceflight, May 2001.
30. "*Advanced Micro/Nanosatellite Attitude Control Systems*", VJ Lappas, WH Steyn & CI Underwood, 16<sup>th</sup> ISU Annual Symposium: "Smaller Satellites, Bigger Business ?", May 2001.
31. "*Attitude Control Systems for Agile Small Satellites using Control Moment Gyros*", VJ Lappas, WH Steyn & CI Underwood, International Astronautical Federation Conference, Toulouse France, October 2001.
32. "*Practical Results on the Development of a Control Moment Gyro based Attitude Control System for Agile Small Satellites*", VJ Lappas, WH Steyn & CI Underwood, 16<sup>th</sup> AIAA/USU Small Satellite Conference, Proceedings: Session SSC02-VIII-8, 12-15 Aug.2002. (Cited = 19, 2012)
33. "*Laboratory experiments of a control moment gyroscope cluster for agile small satellites*", VJ Lappas, WH Steyn & CI Underwood, 5<sup>th</sup> International ESA Conference on Guidance Navigation and Control Systems, Session G, Frascati Rome Italy, 22-25

Oct.2002, Proceedings SP-516, pp.109-113.

34. "*In-Orbit Calibration of the Cold-Gas Thrusters Onboard UoSAT-12*", S-F Wu, WH Steyn, PL Palmer & L Guilicci, 5<sup>th</sup> International ESA Conference on Guidance Navigation and Control Systems, Session G, Frascati Rome Italy, 22-25 Oct.2002, Proceedings SP-516, pp.473-480.
35. "*Topsat Imaging Mode ADCS Design*", D Dungeate, WH Steyn et.al., 5<sup>th</sup> International ESA Conference on Guidance Navigation and Control Systems, Session G, Frascati Rome Italy, 22-25 Oct.2002, Proceedings SP-516, pp.493-496.
36. "*Minisatellites for Affordable Space Science*", A Phipps, WH Steyn et.al., 53<sup>rd</sup> International Astronautical Federation Conference, The World Space Congress-2002, Houston Texas, 10-19 Oct.2002.
37. "*Experimental Testing of a CMG Cluster for Agile Microsatellites*", VJ Lappas, CI Underwood & WH Steyn, 54<sup>th</sup> International Astronautical Congress of the IAF, 29<sup>th</sup> Sept-3<sup>rd</sup> Oct. 2003, Proceedings IAF-03-IAA.11.5.05, pp.371-377, Bremen, Germany.
38. "*African Resource and Environmental Management Constellation*", S Mostert, M Jacobs, WH Steyn & GW Milne, 54<sup>th</sup> International Astronautical Congress of the IAF, 29<sup>th</sup> Sept-3<sup>rd</sup> Oct. 2003, Proceedings IAF-03-IAA.11.4.04, Bremen, Germany. (Cited = 6, 2014)
39. "*A Robust Attitude Measuring System for Agile Satellites*", J Treurnicht & WH Steyn, 1<sup>st</sup> African Control Conference AFCON 2003, Cape Town, 3-5 Dec. 2003.
40. "*A View-finder Control System for an Earth Observation Satellite*", WH Steyn, The 4S (Small Satellite Systems and Services) Symposium, ESA Proceedings SP-571, La Rochelle, France, 20-24 September 2004.
41. "*Platform Control for Space-Based Imaging: The Topsat Mission*", D. Dungeate, WH Steyn et.al., The 4S (Small Satellite Systems and Services) Symposium, ESA Proceedings SP-571, La Rochelle, France, 20-24 September 2004.
42. "*In-Orbit Identification of Unmodelled Disturbance Torques Acting on a Spacecraft Body*", JAA Engelbrecht & WH Steyn, IEEE Africon 2004, pp.3-8, Gaborone.
43. "*MSMI – Next Generation Microsatellite Imager for Micro-satellite Earth Observation*", A Schoonwinkel, S Mostert, WH Steyn, B Scholes & H Burger, 55<sup>th</sup> International Astronautical Congress of the IAF, Oct. 2004, Proceedings IAC-04-IAA.4.11.6.08, Vancouver, Canada. (Cited = 3, 2014)
44. "*Remote Satellite Position & Pose Estimation Estimation using Monocular Vision*", DF Malan & WH Steyn, Small Satellite for Earth Observation 5<sup>th</sup> International Symposium for IAA, Berlin 4-8 April 2005.
45. "*An Attitude Control System for ZA-002 South Africa's Second Earth Observation Satellite*", WH Steyn, SACAC '06 Control Conference, UKZN Durban, 7 July 2006.

46. “Attitude Determination and Control System Hardware in the Loop Test on Air Bearing Trolley”, W Soh & WH Steyn, AIAA Guidance, Navigation, and Control Conference, Paper 6448, pp.3186-3196, Keystone Colorado, 21-24 August 2006.
47. “A Control System Analysis for a Potential Geostationary Satellite for South Africa”, G Thopil & WH Steyn, IEEE Africon 2007, Paper 640, Windhoek, 26 to 28 September 2007.
48. “Low cost TID testing of COTS components”, A Barnard & WH Steyn, Proceedings of the 9<sup>th</sup> European Conference on Radiation and its Effects on Components and Systems (RADECS), art.no. 5205562, Deauville France, 10-14 Sept 2007. (Cited = 2, 2014)
49. “An Attitude Control System for SumbandilaSAT an Earth Observation Satellite”, WH Steyn, The 4S (Small Satellite Systems and Services) Symposium, ESA Proceedings SP-660, Rhodes Greece, 26-30 May 2008. (Cited = 4, 2014)
50. “Construction of an Image Quality Assessment Model for use On Board an LEO Satellite”, IvZ Marais, WH Steyn & JA du Preez, IEEE International Geoscience & Remote Sensing Symposium Proceedings (IGARSS), Vol.2, Paper 1023, pp. 1068-1071, Boston USA, 6-11 July 2008. (Cited = 4, 2014)
51. “Noise Estimation Algorithms for Onboard Image Quality Assessment”, IvZ Marais & WH Steyn, Paper 2 in Session T2, International Conference on Space Technology, Thessaloniki Greece, 24-26 Aug 2009.
52. “Onboard Image Quality Assessment for a Small Low Earth Orbit Satellite”, IvZ Marais, WH Steyn & JA du Preez, Paper IAA B7-0602, 7<sup>th</sup> IAA Symposium on Small Satellites for Earth Observation, Berlin Germany, 4-8 May 2009. (Cited = 5, 2014)
53. “In-Orbit AODCS Performance of SumbandilaSAT an Earth Observation Satellite for South Africa”, WH Steyn, Paper IAC-10.B4.6A.4, 61<sup>st</sup> International Astronautical Congress, Prague Czech Republic, 27 Sept – 1 Oct 2010.
54. “Cubesat Solar Sail Attitude Determination and Control System Hardware Design and Orbital Analysis”, V Lappas et.al & WH Steyn, 2010 AIAA Guidance, Navigation, and Control Conference, Toronto Canada, Paper AIAA-2010-8135, 2-5 Aug 2010.
55. “Attitude Control Actuators, Sensors and Algorithms for a Solar Sail Cubesat”, WH Steyn, Paper IAC-11.B4.6B.6, 62<sup>nd</sup> International Astronautical Congress, Cape Town South Africa, 3-7 Oct 2011.
56. “Design of an Aerodynamic Attitude Control System for a CubeSat”, J Auret & WH Steyn, Paper IAC-11.E2.2.3, 62<sup>nd</sup> International Astronautical Congress, Cape Town South Africa, 3-7 Oct 2011.
57. “Modular Simulation and Visualisation Application for Satellite Attitude Control”, L Visagie, WH Steyn & V Lappas, Paper IAC-11-C1.6.1, 62<sup>nd</sup> International Astronautical Congress, Cape Town South Africa, 3-7 Oct 2011.
58. “Implementation and Evaluation of Low Cost Fault Tolerant Techniques for Nano/Pico-Satellite Applications”, PJ Botma, WH Steyn & A Barnard, 5<sup>th</sup> UN/Japan Nanosatellite

Symposium, Nagoya Japan, 10-13 Oct 2012.

59. “*Spinning Solar Sail in an Earth-Centred Orbit*”, HW Jordaan & WH Steyn, 5<sup>th</sup> UN/Japan Nanosatellite Symposium, Nagoya Japan, 10-13 Oct 2012.
60. “*Advanced control with fundamental and data-based modeling for falling film evaporators*”, A Haasbroek, WH Steyn & L Auret, 2013 IEEE International Conference on Industrial Technology, Cape Town, 25-28 Feb 2013, page 46-51.
61. “*Development of a Robust, Low-Cost ‘CubeStar’ Sensor*”, A Erlank & WH Steyn, 5<sup>th</sup> European CubeSat Symposium, Brussels Belgium, 3-5 June 2013.
62. “*The Attitude Control of a Tri-Spin Solar Sail Satellite*”, HW Jordaan & WH Steyn, 3<sup>rd</sup> International Symposium on Solar Sailing, Glasgow Scotland, 11-13 June 2013.
63. “*Current and Future Small Satellite Projects in South Africa*”, WH Steyn, R van Zyl, M Inggs & PJ Cilliers, IEEE International Geoscience and Remote Sensing Symposium, Melbourne Australia, 21-26 July 2013, IEEE Xplore Proceedings: 978-1-4799-1114-1, pp.1294 - 1297.
64. “*Low Cost Fault Tolerant Techniques for Nano/Pico-Satellite Applications*”, PJ Botma, WH Steyn & A Barnard, IEEE Africon 2013 Conference, Mauritius, 9-12 Sept 2013, IEEE Xplore Proceedings ISBN: 978-1-4673-5943-6.
65. “*A comparison of control techniques for dairy falling film evaporators*”, A Haasbroek, L Auret, WH Steyn, 10<sup>th</sup> IFAC International Symposium on Dynamics and Control of Process Systems, DYCOPS 2013, Mumbai India, 18-20 Dec 2013, Proceedings pp 253-258.
66. “*Attitude Manoeuvres of a Tri-Spin Solar Sail Satellite*”, HW Jordaan & WH Steyn, SACAC Control Systems Day, University of Cape Town, 27 Nov 2013.
67. “*A Minituarised Attitude Control and Determination System for the QB50 and SME-SAT Missions*”, L Visagie, J Forshaw, TE Frame, VJ Lappas & WH Steyn, 9<sup>th</sup> International ESA Conference on Guidance, Navigation & Control Systems, Oporto, Portugal, 2-6 Jun 2014.
68. “*An Attitude Control System for the Deployment and Stabilisation of a Tethered Dual CubeSat Mission*”, M-A Kearney & WH Steyn, Paper WeC19.2, 19<sup>th</sup> IFAC World Congress, Cape Town, 24-29 Aug 2014, Proceedings ISBN: 978-3-902823-62-5, pp.7935-7940.
69. “*An Attitude Control System for ZA-AeroSat subject to significant Aerodynamic Disturbances*”, WH Steyn & M-A Kearney, Paper WeC19.1, 19<sup>th</sup> IFAC World Congress, Cape Town, 24-29 Aug 2014, Proceedings ISBN: 978-3-902823-62-5, pp.7929-7934.
70. “*Arcminute Attitude Estimation for CubeSats with a Novel Nano Star Tracker*”, A Erlank & WH Steyn, Paper ThB19.1, 19<sup>th</sup> IFAC World Congress, Cape Town, 24-29 Aug 2014, Proceedings ISBN: 978-3-902823-62-5, pp.9679-9684.

71. “ZA-AeroSat: A QB50 CubeSat Demonstrator for Multidisciplinary Technology and Scientific Research”, M-A Kearney & WH Steyn, 6<sup>th</sup> European CubeSat Symposium, Estavayer-le-Lac, Switzerland, 14-16 Oct 2014.
72. “QB50 Precursor ADCS Flight Results”, LVisagie, V Lappas & WH Steyn, 6<sup>th</sup> European CubeSat Symposium, Estavayer-le-Lac, Switzerland, 14-16 Oct 2014.
73. “Hyperspectral Imaging with Nanosats”, M Jacobs, S Mostert, H Burger, WH Steyn, R Merton, Paper IAC-14-B1.2.4, 65<sup>th</sup> International Astronautical Congress, Toronto Canada, 29 Sept – 3 Oct 2014. Proceedings ISSN 1995-6258.
74. “Space Strategies for Developing Countries (A South African Example)”, Plenary invited presentation by WH Steyn, 7<sup>th</sup> International Conference on Recent Advances in Space Technologies RAST 2015, 16-19 June 2015, Istanbul Turkey. Plenary Session-2.
75. “Hints on how to Design a Robust and Reliable ADCS for QB50 CubeSats”, WH Steyn & L Visagie, 7<sup>th</sup> European CubeSat Symposium, Liege, Belgium 14-16 September 2015.
76. “Development of a Dual Gimbal Control Moment Gyro for Nano-Satellites”, DG Steyn & WH Steyn, Paper IAC-15.B4.6B.6, 66<sup>th</sup> International Astronautical Congress, Jerusalem Israel, 12-16 Oct 2015. Proceedings ISSN 1995-6258
77. “An Active Attitude Control System for a Drag Sail Satellite”, WH Steyn & HW Jordaan, Paper IAC-15.B4.6A.1, 66<sup>th</sup> International Astronautical Congress, Jerusalem Israel, 12-16 Oct 2015. Proceedings ISSN 1995-6258
78. “RemoveDebris: An EU Low Cost Demonstration Mission to Test ADR Technologies”, JL Forshaw, et.al. & WH Steyn, Paper IAC-14.A6.6.3, 66<sup>th</sup> International Astronautical Congress, Jerusalem Israel, 12-16 Oct 2015. Proceedings ISSN 1995-6258 .
79. “Review of Final Payload test Results for the RemoveDebris Active Debris Removal Mission”, JL Forshaw, et.al. & WH Steyn, Paper IAC-16.A6.6.8, 67<sup>th</sup> International Astronautical Congress, Guadalajara, Mexico, 26-30 Sept 2016.
80. “Gyro-Control of a Solar Sailing Satellite”, HW Jordaan & WH Steyn, Paper at 4<sup>th</sup> International Symposium on Solar Sailing, Kyoto Japan, 17 to 20 January 2017.
81. “Flight control system for a reusable rocket booster on the return flight through the atmosphere”, A Buysse, WH Steyn, A Schutte, Paper IAA B11-0606, 11<sup>th</sup> IAA Symposium on Small Satellites for Earth Observation, Berlin Germany, 24-28 April 2017.
82. “The Telematics International Mission TIM for 3D Earth Observation by Pico-Satellites”, Klaus Schilling, Herman Steyn, et.al., GLEX-17-12.1.4x36789, Global Space Exploration Conference, Beijing, China, 6-8 June 2017.
83. “The Development of nSight-1 – Earth Observation and Science in 2U”, DF Malan, K Wiid, H. Burger, L Visagie & WH Steyn, 31<sup>st</sup> AIAA/USU Small Satellite Conference, Proceedings: SSC17-X-10, Logan Utah USA, 5-10 Aug.2017.

84. *“The RemoveDebris ADR Mission: Launch from the ISS, Operations and Experimental Timelines”*, JL Foreshaw et.al. & WH Steyn, Paper IAC-17.A6,6.4,x37324, 68<sup>th</sup> International Astronautical Congress, Adelaide, Australia, 25-29 Sept 2017.
85. *“Flight Results of nSight-1 QB50 CubeSat Mission”*, L Visagie, WH Steyn, H Burger, DF Malan, 4<sup>th</sup> IAA Conference on University Satellite Missions and CubeSat Workshop, Proceedings: IAA-AAS-CU-17-03-14, Rome Italy, 4-7 Dec 2017.
86. *“In Orbit ADCS Commissioning Results of the QB50 CubeSat nSight-1”*, WH Steyn & L Visagie, 9<sup>th</sup> European CubeSat Symposium, Ostend, Belgium 29 Nov 1 Dec 2017.
87. *“In Orbit Results of the ADCS Commissioning of a QB50 CubeSat”*, WH Steyn & L Visagie, 10<sup>th</sup> Pico and Nano Satellite Workshop, Würzburg Germany, 13-14 Sept 2017.
88. *“Historical Overview of South African Satellite Projects over the last 20 years”*, WH Steyn, United Nations/South Africa Symposium on Basic Space Technology, Stellenbosch South Africa, 11-15 Dec 2017.

### **13. Publications in Journals:**

**(Google Scholar Citations = 1239, h-index = 19)**

**(Scopus Citations = 466, h-index = 12)**

**(Research Gate RG Score = 21.84 @ 28/02/2016)**

1. *“Electronic Flow meter for Irrigation water based on an Orifice plate”*, WPJ Wessels & WH Steyn - Water SA, Vol.12, No.3, July 1986, pp. 161-166.
2. *“Optimal Drying of Lumber using a Discrete, On-line Mathematical Model of Moisture Movement”*, HF Vermaas, WH Steyn & JPS Viljoen - *Holzforschung und Holzverwertung*, Vol.45, No.1, March 1993, pp. 12-15.
3. *“Comparison of Low-Earth Orbiting Satellite Attitude Controllers Submitted to Controlability Constraints”*, WH Steyn - *AIAA Journal of Guidance, Control, and Dynamics*, Vol.17, No.4, July-Aug.1994, pp. 795-804. (Cited = 35, 2014)
4. *“Fuzzy Control for a Non-Linear MIMO Plant Subject to Control Constraints”*, WH Steyn - *IEEE Transactions on Systems, Man, and Cybernetics*, Vol.24, No.10, Oct.1994, pp. 1565-1571. (Cited = 21, 2014)
5. *“Near Minimum-Time Eigenaxis Rotation Maneuvers using Reaction Wheels”*, WH Steyn - *AIAA Journal of Guidance, Control, and Dynamics*, Vol.18, No.5, Sept.-Oct. 1995, pp. 1184-1189. (Cited = 42, 2014)
6. *“A new unified approach to power quality management”*, A van Zyl, JHR Enslin, WH Steyn & R Spee, *IEEE Transactions on Power Electronics*, Vol.11, No.5, 1996, pp.691-697. (Cited = 56, 2014)
7. *“Attitude control recovery of the CERISE microsatellite following an in-orbit collision”*, Y Hashida, NP Bean, WH Steyn & MS Hodgart, *Advances in the Astronautical Sciences*,



Vol.98, pp.655-663, 1998.

8. “*Optimal Combined Reaction-Wheel Momentum Management for Earth-Pointing Satellites*”, X.Chen, WH Steyn, S Hodgart & Y Hashida - AIAA Journal of Guidance, Control, and Dynamics, Vol.22, No.4, July-August 1999, pp. 543-550. (Cited = 30, 2014)
9. “*Control Moment Gyro (CMG) Gimbal Angle Compensation using Magnetic Control during External Disturbances*”, VJ Lappas, WH Steyn & CI Underwood – Electronic Letters, Vol.37, No.9, April 2001, pp. 603-604. (Cited = 15, 2014)
10. “*Attitude Tracking Maneuvers of a Low Earth Orbit Spacecraft*”, JF Li, M Xu & WH Steyn, Qinghua Daxue Xuebao/Journal of Tsinghua University 41 (2), pp. 102-104, 2001. (Cited = 11, 2012)
11. “*Attitude Control Systems for Small Satellites using Control Moment Gyros*”, VJ Lappas, WH Steyn & CI Underwood, Acta Astronautica, Elsevier & ScienceDirect, Vol.51, No.1-9, pp. 101-111, 2002. (Cited = 61, 2014)
12. “*Torque Amplification of Control Moment Gyros*”, VJ Lappas, WH Steyn & CI Underwood, Electronic Letters, Vol.38, No.15, July 2002, pp. 837-839. (Cited = 31, 2014)
13. “*Modelling and In-orbit Calibration Practice of a Miniature 2-Axis Analogue Sun Sensor*”, S-F Wu & WH Steyn, Aerospace Science and Technology Journal, Elsevier & Science Direct, Vol.6 (6), pp. 423-433, 2002. (Cited = 12, 2014)
14. “*In-orbit Thruster Calibration Techniques and Experiment Results with UoSAT-12*”, S-H Wu, WH Steyn & RE Bordany, Control Engineering Practice, Vol.12 (1), Jan.2004, pp. 87-98. (Cited = 6, 2014)
15. “*Cerise microsatellite recovery from first detected collision in low earth orbit*”, MN Sweeting, Y Hashida, NP Bean, MS Hodgart & H Steyn, Acta Astronautica, Vol.55, No.2, pp.139-142, 2004.
16. “*Experimental testing of a CMG cluster for agile microsatellites*”, VJ Lappas, WH Steyn & CI Underwood, Journal of the British Interplanetary Society, Vol.57 (9-10), pp.318-324, 2004. (Cited = 13, 2014)
17. “*Design and Testing of a Control Moment Gyroscope Cluster for Small Satellites*”, V Lappas, WH Steyn & C Underwood, AIAA Journal of Spacecraft and Rockets, Vol.42, No.4, July-August 2005, pp. 729-739. (Cited = 41, 2014)
18. “*A View Finder Control System for an Earth Observation Satellite*”, WH Steyn, Aerospace Science and Technology Journal, Elsevier & ScienceDirect, Vol.10 (3), pp. 248-255, 2006. (Cited = 10, 2014)
19. “*Robust Defocus Blur Identification in the Context of Blind Machine Image Quality Assessment*”, I vZ Marais & WH Steyn, Signal Processing: Image Communication Journal Vol.22 (10), Elsevier & ScienceDirect, pp. 833-844, Nov 2007. (Cited = 17, 2014)

20. “*A Dual-Wheel Multi-Mode Spacecraft Actuator for Near-Minimum-Time Large Angle Slew Maneuvers*”, WH Steyn, Online available since Feb 2008, Elsevier & ScienceDirect, Aerospace Science and Technology Journal, Vol.12 (7), pp. 545-554, 2008. (Cited = 6, 2014)
21. “*Kalman Filter Configurations for a Low-cost Loosely Integrated Inertial Navigation System on an Airship*”, J Bijker & WH Steyn, Online available since June 2008, Elsevier & ScienceDirect, Control Engineering Practice Journal, Vol.16 (12), pp. 1509-1518, 2008. (Cited = 52, 2014)
22. “*Sumbandililasat – An operational technology demonstrator*”, S Mostert, WH Steyn, H Burger & H Bosman, Online available since August 2008, Elsevier & ScienceDirect, Acta Astronautica, Vol.63, pp. 1273-1282, 2008. (Cited = 8, 2012)
23. “*An optimal image transform for threshold-based cloud detection using heteroscedastic discriminant analysis*”, I v Z Marais, JA du Preez & WH Steyn, International Journal of Remote Sensing, Vol.32. Issue 6, pp. 1713-1729, 2011. (Cited = 6, 2014)
24. “*Determining Vacuum Arc Thruster Performance using a Cathode Spot Model*”, J Lun, RT Dobson & WH Steyn, AIAA Journal of Propulsion and Power, Vol.26, No.4, July-August 2010, pp.663-672.
25. “*Cubesat Solar Sail 3-Axis Stabilization using Panel Translation and Magnetic Torquing*”, WH Steyn and V Lappas, Online available since Sept 2010, Elsevier & ScienceDirect, Aerospace Science and Technology Journal, Vol.15 (6), pp. 476-485, 2011. (Cited = 2, 2012)
26. “*CubeSail: A low cost CubeSat based solar sail demonstration mission*”, V Lappas, N Adeli, L Visagie, J Fernandez, T Theodorou, WH Steyn & M Perren, Online available since June 2011, Elsevier & Science Direct, Advances in Space Research Journal, Vol.48, Issue 11, pp. 1890-1901, 2011. (Cited = 38, 2014)
27. “*Performance Measurements of a Medium-Current Short-Pulsed Vacuum Arc Thruster*”, J Lun, RT Dobson & WH Steyn, Experimental Techniques, Society for Experimental Mechanics, Vol.38, Issue 3, pp.6-16, May/June 2014.
28. “*An active attitude control system for a drag sail satellite*”, WH Steyn & HW Jordaan, Online available since July 2016, Elsevier & Science Direct, Acta Astronautica, 128 (2016), pp. 313-321, 2016.
29. “*RemoveDebris: An in-orbit active debris removal demonstration mission*”, JL Foreshaw, et.al. & WH Steyn, Acta Astronautica, Online available since June 2016, Elsevier & Science Direct, 127 (2016), pp. 448-463, 2016.
30. “*Final payload test results for the RemoveDebris active debris removal mission*”, JL Forshaw et.al. & WH Steyn, Acta Astronautica, Elsevier & Science Direct, 138 (2017), pp. 326-342, 2017.

#### 14. Published Book Chapters:

1. “*Medium/large Vehicle Tracking System*”, J Auret, PJ Botma, E Chiyika, DJ de Villiers, E Louw, F Sagouo Minko, GA Mutch, M Roman, R Siebrits, S Smit, I Tadjadjeu Sokeng, Book Chapter in: Novel Ideas for Nanosatellite Constellation Missions, IAA Book Series, Vol.1 No.1, 2012, ISBN/EAN IAA: 978-2-917761-18-2. (Auret & Botma as my Master Students wrote 80% of the chapter for an International Student Competition, other students are from CPUT).
2. “*The OuterNet: A novel satellite communication relay constellation*”, M-A Kearney, PJ Botma, J Gerber, E Thesnaar, F Nolte, A Erlank, C Groenewald, A Barnard, Book Chapter in: Innovative Ideas for Micro/Nano-Satellite Missions, IAA Book Series, Vol.1, No.3, 2013, ISBN/EAN IAA: 978-2-917761-28-1. (Kearney, Botma, Gerber, Erlank & Groenewald were my Master Students in an International Student Competition).
4. “*The Attitude Control of a Tri-Spin Solar Sail Satellite*”, HW Jordaan & WH Steyn, Book Chapter in: Advances in Solar Sailing, Publisher Springer Praxis Books 2014, pp.755-769, ISBN: 978-3-642-34907-2.
5. “*A Nano-Satellite Constellation for Tracking and Monitoring Endangered Wildlife in Developing Countries*”, JH le Roux, A Heunis, G Janse van Vuuren, A Barnard, W Jordaan, D Steyn, N Rossouw, M Bin Othman, N Calitz, M Junaid & C Groenewald, Book Chapter in: Inventive Ideas for Micro/Nano-Satellites The MIC3 Report, IAA Book Series, Vol.1 No.5, 2015, ISBN/EAN IAA: 978-2-917761-38-0, pp.37-49. (All authors except JH le Roux were/are my Masters or PhD students for an International Student Competition).
6. “*Graphene Foam Deorbit Sail with Failsafe Release Mechanism*”, J Lüdemann, JH Wessels, A Buysse, A-J Merts, A Barnard, W Jordaan, Book Chapter in: Innovative Ideas on Micro/Nano-Satellite Missions and Systems Report on Deorbit Device Competition (DDC) and Mission Idea Contest (MIC4), IAA Book Series Vol.1 No.6, 2017, ISBN/EAN IAA: 978-2-917761-55-7, pp.63-75. (All authors except A-J Merts were/are my Masters or PhD students for the DDC international competition, I am also a co-editor for this book).

## **15. Published Project Reports:**

1. “*Register Insertion Ring Network*”, WH Steyn, December 1985, Thesis for the partial fulfillment for the M.Eng degree, University of Stellenbosch.
2. “*The Development of the necessary Hardware and Software for the Monitoring and Management of Irrigation*”, WPJ Wessels, WH Steyn & NdeW du Toit, Final report to the Water Research Commission, October 1986.
3. “*Attitude Control Algorithms and Simulation Programs for Low Earth Orbit Spacecraft*”, WH Steyn, September 1990, UoSAT Spacecraft Engineering Research Unit, Thesis for the degree of M.Sc in Satellite Engineering by Research, Univ. of Surrey UK.
4. “*A Multi-Mode Attitude Determination and Control System for Small Satellites*”, W.H. Steyn, December 1995, Ph.D Thesis, University of Stellenbosch. (Cited = 55, 2014)

## **16. Conference Plenary Presentation and Session Chairing:**

1. “*Space Strategies for Developing Countries (A South African Example)*”  
Plenary invited presentation by WH Steyn, 7<sup>th</sup> International Conference on Recent Advances in Space Technologies RAST 2015, 16-19 June 2015, Istanbul Turkey. Plenary Session-2.
2. “*Universities as Actors in Space*”  
Co-chair the 30<sup>th</sup> IAA/IISL Scientific-Legal Roundtable at the IAC 2015, 15 Oct 2015, Jerusalem Israel, Session E3.5.

## SHORT Curriculum Vitae

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**Prof Herman Steyn, BEng (Hons), MEng, MSc, PhD, SMAIAA, FSAAE, MIAA, Pr Ing**

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**Job Title** University of Stellenbosch: Professor in Electronic Engineering, Head of Electrical and Electronic Engineering Department

Denel Spaceteq and SA Space Industry: Consultant in AODCS

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**Qualifications** PhD – “A Multi-Mode Attitude Determination and Control System for Small Satellites”, from University of Stellenbosch (South Africa) 1995

MSc – “Attitude Control Algorithms and Simulation Programs for Low Earth Orbit Spacecraft”, from University of Surrey (UK) 1990

MEng – “Register Insertion Ring Network”, from University of Stellenbosch (South Africa) 1985

BEng (Hons), Electrical and Electronic Engineering from University of Stellenbosch (South Africa) 1980

Over 100 published international papers, 28 in accredited Journals, B3 rated researcher by National Research Foundation in South Africa. In 2009 he was elected as Fellow of the South African Academy of Engineers. In 2011 he was elected as Corresponding Member and in 2014 as Full Member of the International Academy of Astronautics.

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**Career History**

- 2013-current – Head of Computer, Control and Satellite Group within the Dept E&E Engineering at the University of Stellenbosch
  - 2011-12 – Head of Department Electrical and Electronic Engineering at the University of Stellenbosch
  - 2006-10 – Head of the Computer and Control Group within the Dept E&E Engineering at the University of Stellenbosch
  - 2004 – Professor in Electronic Engineering at University of Stellenbosch
  - 2002 – Head: Product Development at SSIS, Professor in Electronic Engineering at the University of Stellenbosch, South Africa
  - 1998 – Principal Engineer and Team Leader AODCS at SSTL, UK.
  - 1997 – Associate Professor in Electronic Engineering at University of Stellenbosch, South Africa.
  - 1987-96 – Senior Lecturer in Electronic Engineering at University of Stellenbosch
  - 1982-87 – Lecturer in Electronic Engineering at University of Stellenbosch
  - 1981 – Assistant Area Engineer (Instrumentation) SASOL 2
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**Experience and skills**

Herman has done a MSc in Satellite Engineering in 1990 in the Surrey Space Centre (UoSAT Unit) while he was still a lecturer in Electronic Engineering in South Africa. When he returned to his University, he became part of a team who

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designed and build the first South African microsatellite SUNSAT. He became the prime designer of the ADCS system for SUNSAT, the first microsatellite with full 3-axis control capability and a high resolution pushbroom imager

His research interest since 1990 concentrated on attitude determination and control hardware and software subsystems for small satellites. He joined SSTL as Principal Engineer in 1998 as the Team leader for spacecraft attitude and orbit control systems. At SSTL he was personally involved in six new satellite programs (1998 to 2001). He lead the planning, design and implementation of the AODCS system for SSTL's first 3-axis stabilized minisatellite UoSAT-12, microsatellite Tsinghua-1 and nanosatellite SNAP-1. He was also the technical lead for the development of a momentum wheel for the ESA Rosetta Lander spacecraft and responsible for the in-house development and calibration of various attitude sensors and actuators e.g. sun sensors, reaction wheels, magnetorquer rods and control moment gyros (CMGs).

He was also involved in various studies for NASA, ESA and commercial customers on new satellite missions, e.g. MMS (Multiscale Magnetospheric System) a constellation of spinning satellites with wire booms for NASA, GEODEM (Geostationary Demonstration Satellite) a bus design to fly various payloads for ESA into GEO and RAPIDEYE a constellation of minisatellites with high performance pointing requirements.

When he returned to South Africa in the beginning of 2002 he rejoined the University of Stellenbosch as a Professor in the Computer and Control Group of the Department Electrical and Electronic Engineering, currently he is also the Head of Department. Apart from supervising Masters and PhD students, he is responsible for post graduate modules in Satellite and Space Engineering and Advanced Control Systems and leading a research program in advanced attitude and orbit control systems. He is a executive Director of SunSpace & Information Systems and consultant for the AODCS group, leading the development and design of all commercial AODCS systems. Satellites already completed and qualified, includes an earth observation minisatellite for an international customer and South Africa's second micro-satellite, SumbandilaSat. The first satellite was launched in April 2007 and Sumbandila was launched in September 2009, both in low earth orbit.

He was elected as Member of the International Academy of Astronautics (IAA) in 2014. Herman is currently leading the partnership of the University of Stellenbosch with the Surrey Space Centre on a EU FP7 project called "Deorbit Sail", where a solar sail will deployed and actively controlled to accelerate the deorbiting of space debris in future.

He was leading the Space Engineering Expert Group (SEEG) of the National Space Program (NSP) of the South African National Space Agency (SANSA) during 2012.

He is currently the project leader of the international QB50 mission for the ZA-AeroSat Cubesat, the launch date for these 50 Cubesats from more than 50 institutions world-wide will be January 2017.

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