Curriculum Vitae: Willie Nel

Last Revised: March 2016

Highest Qualification: MSc Eng. Digital Image Processing (University of Cape Town) 1998

Current Position: **Principal Radar Systems Engineer & Technology and Innovation Manager for Radar** at unit for Defence, Peace, Safety and Security (DPSS), Council for Scientific and Industrial Research (CSIR), South Africa.

Current Responsibilities: Technology management in Radar area, looking at ways to innovate more and improve time to market of technology demonstrators. Consult to several areas in radar including Radar NCTR research program, Radar Signal Processor development of AwareRad radar. Lead systems engineer for spaceborne radar, imaging radar, GPS reflectometry, multi-static radar and other new initiatives in REW, Chair CSIR ICT Governance Committee, Leader DPSS REW technology innovation leadership team, Technical Chair of IEEE Radar Conference held in October 2015 in South Africa. Involved as DPSS representative of South African Radar Interest Group.

Relevant experience:

2016: Recent International experience and recognition: **Selected to be a member of the IEEE Radar System Panel**, Invited to present Tutorial on Radar Based NCTR at CIE International Radar Conference in China. Also appointed session chair of ATR sessions at the conference. Invited to present lectures on NCTR at both Xidian University and Beijing Institute of Technology on invitation by Prof Teng Long, Director of the Radar Research Institute at BIT after he attended the NCTR tutorial presented at Radar Conference in South Africa

2013–2015 **New venture development in REW:** Responsible for development of new ventures and innovations within Radar team both locally and internationally. Jointly led the development of several proposals towards new R&D directions within REW in 2013/14, specifically focused on the area of imaging radar, including the development of a proposal towards a Spaceborne Synthetic Aperture Radar (SAR), the development of a proposal towards development of multi-static radar through research network with armasuisse, Switzerland, the development of proposals for a UAV Synthetic Aperture radar and development of a MTEF proposal towards establishing a new SAR earth observation facility. Driving establishment of software defined radar and signal processors within REW.

2013-2014: **NATO SET 196 Workgroup member**: Member of NATO 196 workgroup on multi-static radar imaging. Have been actively involved since first meeting.

2011: **Research Sabbatical, University of Pisa, Italy**: Invited to perform 4 month research sabbatical in the field of ISAR and radar target recognition at University of Pisa Radar Research Group in collaboration with Dr Marco Martorella. Led to joint publications and invitation to join NATO workgroup.

2013–present: **Involvement in International Radar R&D community**: Selected to serve as ***Technical Chair for IEEE Radar conference held in RSA 2015***. Have served on technical committees of 4 previous international radar conferences as reviewer. Have presented as ***invited session presenter on ISAR at two previous international conferences***. Involved in reviews of papers for several journals including the IEEE GRS Letters and the IET journal on radar sonar and navigation.

2013–2014: **Chair of the ICT governance committee of the CSIR**. Joined ICT governance committee in 2011. Was elected chair of the committee in 2013 and officially appointed in role by CSIR executive.

2008-2010: **Lead System engineer on TD 0.5 development** for the AwareNet program to develop a integrated persistent surveillance demonstrator using available technology building blocks as well as leading the effort to integrate several new technologies including target recognition processor, situational awareness displays, communications network, electro-optical cameras and a newly develop track while scan processor and mode for the MECORT facility. > R10m per year for 2 years, established several new technologies in REW and DPSS realm.

2008 – 2013: **Research Manager of the Parliamentary Grant Projects in REW.** Responsible for management / selection of projects to fund through CSIR PG funding and for ensuring delivery against PG mandate. Led efforts to improve governance of funds through establishment of review panels and ensuring that all outputs are reviewed externally. Played significant role in technology foresighting and innovation within the REW team and led multiple strategy sessions within REW to talk to innovation and technology development.

2006-present: **Research Team Leader of Radar Non-Cooperative Target Recognition Research Program.** Led efforts to established the NCTR research program. Conceptualized algorithm and mentored A Cilliers on first DPSS studentship in Micro-Doppler based recognition of helicopters - this research won an award for the best student paper at the 2008 IEEE International Radar Conference. Invited to write papers on Inverse Synthetic Aperture Radar (ISAR) for invited sessions at 2009 IEEE International Radar Conference and again at the CIE International conference, China in 2011. Supervision of several MSc and 1 PhD student as CSIR supervisor. External examiner in the field of ISAR and NCTR for several dissertations. Acting as reviewer for several journal and conference papers in Radar. Acting as part of review panel member for IEEE Radar Conferences held in the US, UK and France. Successfully coordinated and executed several trials with the MECORT and Fynmeet radar research facilities to

generate data sets for the NCTR research and other projects. Invited to present workshop on radar target recognition at Saudi Radar Conference, December 2014 and IEEE Tutorial at Radar Conference in RSA 2015.

2002–present: **Continued Development of DPSS High Resolution Radar Capability.** Development of new High Range Resolution radar modes and calibration techniques (2003-6) successfully used to measure signatures of the SAN Corvettes in 2004. Member of advisory panel on the official RCS acceptance trials of the SAN corvettes in Germany (2004). Lead system engineer of the IF sampler and data acquisition system which was successfully used at SAAF chaff measurement trials and to generate the widely used Awarenet Sea Clutter database (2005-2006). Conceptualisation and system engineering for concept demonstration of a new dechirp on receive wide-band HRR mode which increased the effective Doppler bandwidth of HRR measurements in the Fynmeet system by an order of magnitude. Member of national workgroup to propose Satellite Sensor CoC.

2003–2005: **System Engineer on MecORT Data Capture and Analysis Subsystem (DCAAN)** Led effort of 6 engineers (software, firmware) and 1 technician in cooperation with Mr C van Zyl. The project posed challenges in COTS hardware selection and integration, accurate time synchronisation of different high bandwidth data streams, as well as the digital capture of full bandwidth composite video streams.

2002–2003: **System Engineer on MecORT Data Processor concept demonstrator (MecHIL, MecSIM)**. Led team ranging between 4 to 7 software and signal processing engineers for 2 years. Concept demonstration environment is currently being used as basis for the Hardware in the loop radar target simulation developments at DPSS.

2000–2002: **Design and development of RoofSAR X Band radar concept demonstrator.** Responsibility spanned multiple disciplines including digital hardware, RF design, software engineering and mechanical engineering. The system produced the first X-Band SAR imagery in the RSA at a resolution of better than 30 cm. Novel elements included the implementation of a novel frequency domain stepped frequency High range Resolution processor.

1999–2000: **Integration and testing and qualification of VHFSAR system, South Africa's first airborne VHF Synthetic Aperture Radar**. Developed controller software for system. Responsible for system integration and testing.

Management Experience

Technical manager of n!Sane signal analysis and system design group – Defence Electronics Programme, CSIR (2002-2003). Member of the Defence Electronics Programme (Defencetek) Technology Visioneering Team 2004-2005, included contributions to EDERI BEST Plans to define technology direction. Part of DPSS work groups on technology road-maps for EDERI project (2007-2008). Proposals for the re-establishment of a research programme in NCTR using radar, which was accepted by Armscor and the SANDF (2006). Proposals for AwareNet, AwareRad and other follow on contracts with specific responsibility for Radar Target Recognition and Software Signal Processor. Lead member of team working on REW imaging radar and spaceborne radar initiatives since 2013.

Awards and Recognition

CSIR 2000 - Top Young Professional Award
CSIR DPSS 2012 - NCTR Outstanding Contribution (Team)
CSIR DPSS 2010 - Mentoring Award (Individual)
CSIR DPSS 2009 - Outstanding SET contribution (Individual)
CSIR DPSS 2009 - Contribution to R&D Impact (Team)
CSIR DPSS 2008 - Contract R&D Excellence Award (Team)
CSIR DPSS 2015 – Innovation Award for Software RSP work
CSIR DPSS 2015 - Established Researher Award for contributions to Internatinal Radar R&D

Relevant open publications (listed by citations as per Google Scholar Feb 2016)

[1] **W.A.J. NEL,** J TAIT, R.T. LORD, A WILKINSON**;** The use of a frequency domain stepped frequency technique to obtain high range resolution on the CSIR X-band SAR system. IEEE AFRICON. 6th; PROCEEDINGS OF IEEE REGION 8 CONFERENCE 2002. **(51 CITATIONS)**

[2] CILLIERS, **W.A.J NEL**, "Helicopter parameter extraction using joint time-frequency and tomographic techniques", 2008 INTERNATIONAL CONFERENCE ON RADAR, ADELAIDE 2-5 SEPTEMBER 2008 **(32 CITATIONS)**

[3] J.J. DE WITT, **W.A.J. NEL**, "Range Doppler dynamic range considerations for de-chirp on receive radar", AMSTERDAM, THE NETHERLANDS, 30 - 31 OCTOBER 2008; **(11 CITATIONS)**

[4] M.Y.A. Gaffar, W.A.J. Nel, M.R. INGGS, "Selecting Suitable Coherent Processing Time Window Lengths for Ground-Based ISAR Imaging of Cooperative Sea Vessels", IEEE transaction on Geoscience and Remote sensing, vol 47, issue 9, Sept 2009 **(10 CITATIONS)**

[5] R.T. LORD, **W.A.J. NEL**, M.Y.A GAFFAR; "Investigation of 3-D RCS image formation of ships using ISAR; EUROPEAN SYNTHETIC APERTURE RADAR CONFERENCE (EUSAR); MAY 2006; **(9 CITATIONS)**

[6] **W. Nel**, D. Stanton, Y Abdul Gaffar, "Detecting 3-D rotational motion and extracting target information from the principal component analysis of scatterer range histories", Radar Conference – invited session on ISAR, Oct 2009, France **(8 CITATIONS)**

[7] **W. Nel**, E. Giusti, M. Martorella, M.Y Abdul Gaffar, "A time domain phase-gradient based ISAR autofocus algorithm", 2011 CIE / IEEE Radar Conference Invited Session on ISAR, China **(6 CITATIONS)**

[8] M.Y. ABDUL GAFFAR, **W.A.J. NEL,** M.R. INGGS, "Quaternion based transformation for extraction of image-generating Doppler for ISAR", IEEE GEOSCIENCE AND REMOTE SENSING LETTERS, VOLUME 5(4), PAGES 560-563, OCT 2008; **(4 CITATIONS)**

[9] M.Y.A. Gaffar, **W.A.J. Nel**, K. Naicker, J. Steyn, T. Alanazi, T Alzamil, "Synthetic range profiling, ISAR imaging of sea vessels and feature extraction, using a multimode radar to classify targets: Initial results from field trials", 2011 Saudi International Electronics, Communications and Photonics Conference (SIECPC)

[10] L.O. Wabeke and **W.A.J. Nel**, "Utilizing Q-learning to allow a radar to choose its transmit frequency, adapting to its environment", presented at the Workshop on Cognitive Information Processing, Italy in June 2010

[11] M.Y. GAFFAR, **W.A.J. NEL**, "INVESTIGATING THE EFFECTS OF A TARGET'S TIME-VARYING AXIS OF ROTATION ON ISAR

IMAGE DISTORTION“ , IET RADAR CONFERENCE, OCTOBER 2007, EDINBURGH; **(4 citations)**

[12] M. Martorella, B Haywood, **W. Nel**, Y. Gaffar, J. Palmer, B. Bates, E. Giusti, F. Berizzi, “Optimal sensor placement for multibistatic ISAR imaging”, EURAD, 2011 **(4 citations)**

[13] J Tait, **WAJ Nel**, X-band synthetic aperture radar evaluation platform, Africon Conference in Africa, 2002. IEEE AFRICON. 6th 1, 13-18 **(2 citations)**

[14] W. Nel. An Investigation into Feature Selection Techniques for Reducing Input Dimensionality in Pattern Recognition Applications, MSc. University of Cape Town **(2 citations)**

[15] P.L. HERSELMAN, **W.A.J. NEL**, J.E. CILLIERS; “Effect of DRFM Phase Response on the Doppler Spectrum of a Coherent Radar: Critical implications and possible mitigation techniques”; INDIA INTERNATIONAL RADAR CONFERENCE; DEC 2005**. (1 citation)**

[16] V. J. van Rensburg; W. A. J. Nel; J. E. Cilliers; U. Boniger; U. Siegenthaler; P. Wellig, High level performance model and performance comparison for multistatic radar system design, 2015 IEEE Radar Conference, 2015

[17] W. D. van Eeden; J. P. de Villiers; W. A. J. Nel; K. H. Kloke; E. Blasch

[18] A comparative cepstral based analysis of simulated and measured S-band and X-band radar Doppler spectra of human motion, 2015 IEEE Radar Conference, 2015

[19] U. Kathree; **W. Nel**; V. J. van Rensburg; A. K. Mishra, Investigation of hopped frequency waveforms for range and velocity measurements of radar targets, 2015 IEEE Radar Conference, 2015

[20] JM Steyn, **WAJ Nel**, Using image quality measures and features to choose good images for classification of ISAR imagery, Radar Conference (Radar), 2014 International, 1-6

[21] M Martorella, E Giusti, F Berizzi, B Haywood, J Palmer, B Bates, **W Nel**, Application of optimal sensor positioning to bistatic ISAR Synthetic Aperture Radar, 2012. EUSAR. 9th European Conference on, 219-222

[22] A De Freitas, JP de Villiers, WAJ Nel, Joint inference of dominant scatterer locations and motion parameters of an extended target in high range-resolution radar IET Radar, Sonar & Navigation 9 (5), 519-530, 2015

[23] V Janse van Rensburg, A Mishra, W Nel, Quality measures for HRR alignment based ISAR imaging algorithms Radar Conference (RADAR), 2013 IEEE, 1-4

[24] MY Gaffar, WAJ Nel, K Naicker, J Steyn, T Alanazi, A Alzamil, Synthetic Range Profiling, ISAR imaging of sea vessels and feature extraction, using a multimode radar to classify targets: initial results from field trials, Electronics, Communications and Photonics Conference (SIECPC), 2011 Saudi

[25] **W NEL**, G DE JAGER ; “The search for more optimal input spaces“, PROCEEDINGS OF THE SOUTH AFRICAN SYMPOSIUM ON COMMUNICATIONS AND SIGNAL PROCESSING, 1998

[26] **NEL, W.A.J.**, DE JAGER, G. & GREENE, J.R.; “Improving pattern recognition systems using stochastic search methods”, EIGHTH SOUTH AFRICAN WORKSHOP ON PATTERN RECOGNITION, 1997;

[27] **W NEL,** L BOTHA, “SINGLE NOTE GUITAR MUSIC RECOGNITION”; PROCEEDINGS OF THE PATTERN RECOGNITION ASSOCIATION OF SOUTH AFRICA, 1996