

# KERRY CAWSE-NICHOLSON

SCIENTIST

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## ABOUT ME

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As a motivated image processing scientist with a PhD in Computational and Applied Mathematics, I am passionate about working with multi- and hyperspectral imagery, and developing new algorithms to better understand our Earth.

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## WORK EXPERIENCE

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### SCIENTIST

JPL, California, USA, 2016 - present

As a Scientist in the Carbon Cycles and Ecosystems group, I use hyperspectral imagery to build products that enable us to better understand our Earth. Current research includes thermal hyperspectral imagery, and multispectral satellite imagery for land surface temperature estimation.

### IMAGE PROCESSING SPECIALIST

TerraCore, Johannesburg, 2015-2016

I create and implement algorithms for data correction and validation for VNIR, SWIR and LWIR hyperspectral data. I design effective methods for mineral mapping and identification, target detection, feature mapping, etc. I also build models relating hyperspectral core images to known physical parameters, such as rock hardness.

### REMOTE SENSING SPECIALIST

Southern Mapping Company, Johannesburg, 2014 - 2015

I provided quotes for satellite and airborne hyperspectral imagery, and acted as liaison with clients. I produced orthorectified and atmospherically corrected satellite imagery, as well as digital elevation models.

### POST DOCTORAL RESEARCH SCIENTIST

RIT, New York, USA, 2012 - 2014

I assisted in the supervision of PhD students, meanwhile carrying out independent research, particularly focused on full-waveform lidar and hyperspectral-lidar fusion. I also built simulation models in DIRSIG, RIT's physics-based ray tracing software.

### STUDENT RESEARCHER (PHD)

Council for Scientific and Industrial Research 2009 - 2012

I investigated the Intrinsic Dimension, and corrected hyperspectral data that contained illumination artifacts, and assisted with a basic landcover classification for the purpose of mapping land degradation.

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## SPECIALISED SKILLS

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### Hyperspectral Imaging:

- Unmixing
- intrinsic dimension estimation
- handheld spectrometers

### Lidar:

- waveform lidar analysis
- terrestrial laser scanner

### Programming Software:

- Matlab
- IDL
- C#
- ENVI
- Latex
- LAStools

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## EDUCATION

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### PHD COMPUTATIONAL AND APPLIED MATHEMATICS

Johannesburg, 2009 - 2012 University of Witwatersrand

Title: *Using Random Matrix Theory to determine the intrinsic dimension of a hyperspectral image.*

### MS COMPUTATIONAL AND APPLIED MATHEMATICS

Johannesburg, 2008 - 2009 University of Witwatersrand

Title: *A new model of population dynamics of HIV-1 in vivo.*

### BS COMPUTATIONAL AND APPLIED MATHEMATICS

Johannesburg, 2004 - 2008 University of Witwatersrand

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## AWARDS

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### BEST PhD THESIS IN CAM

Rand Merchant Bank Gold Medal, 2013

### MSc BURSARY

DST/NRF Centre of Excellence in Epidemiological Modelling and Analysis (SACEMA), 2008

### PRIZE FOR ACHIEVEMENT IN CAM HONOURS

2008

### BEST HONOURS STUDENT IN CAM

Rand Merchant Bank Gold Medal, 2008

### BEST HONOURS STUDENT IN CAM

South African Mathematical Society Bronze Medal, 2008

### BEST STUDENT CONTRIBUTION

Prize for the best student contribution at the Math in Industry Study Group workshop for work on feature extraction for compression of hyperspectral data, 2008

## PUBLISHED WORKS

### Journal papers

- D. Kelbe, J. van Aardt, P. Romanczyk, M. van Leeuwen, **K. Cawse-Nicholson**, *Marker-free registration of forest terrestrial laser scanner data pairs with embedded confidence metrics*, IEEE Transactions on Geoscience and Remote Sensing (TGARS), accepted for publication in 2016.
- A. Robin, **K. Cawse-Nicholson**, A. Mahmood, M. Sears, *Estimation of the Intrinsic Dimension of Hyperspectral Images: Comparison of Current Methods*, IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing (JSTARS), Vol. 8 (6), pp. 2854 – 2861, 2015.
- D. Kelbe, J. van Aardt, P. Romanczyk, M. van Leeuwen, **K. Cawse-Nicholson**, *Single-scan stem reconstruction using sparse terrestrial laser scanner data*, Journal of Selected Topics in Applied Earth Observation and Remote Sensing (JSTARS), Vol. 8 (7), pp. 3414 – 3427, 2015.
- J. McGlinchy, J. van Aardt, B. Erasmus, G. Asner, R. Mathieu, K. Wessels, D. Knapp, T. Kennedy-Bowdoin, H. Rhody, J. Kerekes, E. Lentilucci, J. Wu, D. Sarrazin, **K. Cawse-Nicholson**, *Extracting structural vegetation components from small-footprint waveform lidar for biomass estimation in Savanna ecosystems*, Journal of Selected Topics in Applied Earth Observation and Remote Sensing (JSTARS), Vol. 7 (2), pp. 480 – 490, 2014.
- **K. Cawse-Nicholson**, S. Damelin, A. Robin, M. Sears, *Determining the intrinsic dimension of a hyperspectral image using Random Matrix Theory*, IEEE Transactions on Image Processing, Vol. 22 (4), pp. 1301 – 1310, 2013.
- **K. Cawse-Nicholson**, A. Robin, M. Sears, *The effect of correlation on determining the intrinsic dimension of a hyperspectral image*, Journal of Selected Topics in Applied Earth Observation and Remote Sensing, Vol. 6 (2), pp. 482 – 487, 2013.
- P. Romanczyk, J. van Aardt, **K. Cawse-Nicholson**, D. Kelbe, J. McGlinchy, K. Krause, *Assessing the impact of broadleaf tree structure on airborne full-waveform small-footprint lidar signals through simulation*, Canadian Journal of Remote Sensing, Vol 39 (S1), pp. S60 – S72, 2013.
- J. Wu, **K. Cawse-Nicholson**, J. van Aardt, *3D tree reconstruction from small footprint waveform lidar*, Photogrammetric Engineering and Remote Sensing (PE&RS), Vol. 79 (12), pp. 1147 – 1157, 2013.

### Fully refereed conference proceedings

- **K. Cawse-Nicholson**, M. Sears, A. Robin, *Evaluation of bands containing spectrally correlated noise in hyperspectral imagery*, IEEE Workshop in Hyperspectral Image and Signal Processing: Evolution in Remote Sensing (WHISPERS), Gainesville, Florida, June 2013.
- **K. Cawse-Nicholson**, A. Robin, M. Sears, *The effect of spectrally correlated noise on noise estimation methods*

*for hyperspectral images*, IEEE Workshop in Hyperspectral Image and Signal Processing: Evolution in Remote Sensing (WHISPERS), Shanghai, China, June 2012.

- **K. Cawse**, M. Sears, A. Robin, *The effect of noise whitening on methods for determining the intrinsic dimension of a hyperspectral image*, IEEE Workshop in Hyperspectral Image and Signal Processing: Evolution in Remote Sensing (WHISPERS), Lisbon, Portugal, June 2011.
- **K. Cawse**, M. Sears, A. Robin, S. Damelin, K. Wessels, F van den Bergh, R Mathieu, *Using random matrix theory to determine the number of endmembers in a hyperspectral image*, IEEE Workshop in Hyperspectral Image and Signal Processing: Evolution in Remote Sensing (WHISPERS), Reykjavik, Iceland, June 2010.

### Conference proceedings

- P. Romanczyk, J. van Aardt, **K. Cawse-Nicholson**, D. Kelbe, T. Ramond, *The effect of positioning error on the repeatability of small-footprint waveform lidar signals*, Silvilaser Annual Conference Proceedings, Beijing, China, October 2013.
- C. Schaaf, A. Strahler, J. van Aardt, S. Chakrabarti, Z. Li, Z. Wang, X. Yang, E. Saenz, I. Paynter, A. Erb, Y. Yang, Y. Liu, S. Rouhani, F. Peri, J. Kim, **K. Cawse-Nicholson**, P. Romanczyk, D. Kelbe, J. Faulring, T. Nicholson, E. Douglas, J. Martel, G. Howe, K. Hewawasam, T. Cook, D. Culvenor, G. Newnham, D. Jupp, J. Lovell, K. Krause, N. Leisso, T. Kampe, C. Meier, *Terrestrial lidar measures of forest structure*, Silvilaser Annual Conference Proceedings, Beijing, China, October 2013.
- M. Bandyopadhyay, J. van Aardt, **K. Cawse-Nicholson**, *Enhancing classification accuracy via registration of discrete return lidar and aerial imagery using the Levenberg-Marquardt nonlinear optimization method*, IEEE International Geoscience and Remote Sensing Symposium Melbourne, Australia, July 2013.
- D. Kelbe, P. Romanczyk, J. van Aardt, **K. Cawse-Nicholson**, *Reconstruction of 3-D tree stem models from low-cost terrestrial laser scanner data*, SPIE Defense, Security, and Sensing, Proceedings Volume 8731: Laser Radar Technology and Applications XVIII, 2013.
- M. Bandyopadhyay, J. van Aardt, **K. Cawse-Nicholson**, *Classification and extraction of trees and buildings from urban scenes using discrete return lidar and aerial color imagery*, SPIE Defense, Security, and Sensing, Proceedings Volume 8731: Laser Radar Technology and Applications XVIII, 2013.
- K. Krause, E. Hinckley, C. Meier, D. Barnett, N. Leisso, T. Kampe, D. Tazik, J. van Aardt, **K. Cawse-Nicholson**, C. Schaaf, A. Strahler, *NEON airborne observation platform test flights: validation of airborne lidar and hyperspectral data*, ASPRS Annual Conference, Baltimore, Maryland, USA, March 2013.
- **K. Cawse-Nicholson**, J. van Aardt, P. Romanczyk, D. Kelbe, K. Krause, T. Kampe, *A study of energy attenuation due to forest canopy in small-footprint waveform lidar signals*,

- ASPRS Annual Conference, Baltimore, Maryland, USA, March 2013.
- **K. Cawse-Nicholson**, J. van Aardt, D. Kelbe, P. Romanczyk, T. Kampe, K. Krause, *On the scalability of spectral leaf area index metrics*, ASPRS Annual Conference, Baltimore, Maryland, USA, March 2013.
- D. Kelbe, P. Romanczyk, J. van Aardt, **K. Cawse-Nicholson**, K. Krause, *Automatic extraction of tree stem models from single terrestrial lidar scans in structurally heterogeneous forest environments*, Silvilaser Annual Conference Proceedings, Vancouver, Canada, pp. 54-61, September 2012.
- P. Romanczyk, D. Kelbe, J. van Aardt, **K. Cawse-Nicholson**, J. McGlinchy, K. Krause, *Assessing the impact of broadleaf tree structure on airborne full-waveform small-footprint LiDAR signals*, Silvilaser Annual Conference Proceedings, Vancouver, Canada, pp. 271-492, September 2012.
- **K. Cawse**, S. Damelin, L. du Plessis, R. McIntyre, M. Mitchley and M. Sears, *An investigation of data compression techniques for hyperspectral core imager data*, Proceedings of the Mathematics in Industry Study Group, University of the Witwatersrand, 2008, 1-26.
- American Geological Union Fall Meeting, San Francisco, USA, December 2013.
- P. Romanczyk, J. van Aardt, **K. Cawse-Nicholson**, D. Kelbe, A. Strahler, C. Schaaf, T. Ramond, *Quantifying the attenuation due to geometry interactions in waveform lidar signals*, American Geological Union Fall Meeting, San Francisco, USA, December 2013.
- D. Kelbe, P. Romanczyk, J. van Aardt, **K. Cawse-Nicholson**, *Marker-free registration of terrestrial laser scanner data for forestry applications*, Silvilaser

## Conference presentations (no proceedings)

- **K. Cawse-Nicholson**, J. van Aardt, P. Romanczyk, D. Kelbe, M. Bandyopadhyay, W. Yao, K. Krause, T. Kampe, *The effect of lidar point density on LAI estimation*, American Geological Union Fall Meeting, San Francisco, USA, December 2013.
- T. Kampe, N. Leisso, K. Krause, J. Musinsky, S. Petroy, L. Wasser, **K. Cawse-Nicholson**, J. van Aardt, C. Schaaf, A. Strahler, S. Serbin, *NEON collaborative data collection campaign at Pacific South West site in CA*, American Geological Union Fall Meeting, San Francisco, USA, December 2013.
- J. Musinsky, L. Wasser, T. Kampe, N. Leisso, K. Krause, S. Petroy, **K. Cawse-Nicholson**, J. van Aardt, S. Serbin, *Developing a scalable remote sampling design for the NEON Airborne Observation Platform (AOP)*, American Geological Union Fall Meeting, San Francisco, USA, December 2013.
- C. Schaaf, I. Paynter, E. Saenz, F. Peri, Z. Wang, A. Erb, X. Yang, A. Strahler, Z. Li, J. van Aardt, D. Kelbe, P. Romanczyk, **K. Cawse-Nicholson**, K. Krause, N. Leisso, T. Kampe, C. Meier, C. Ritz, S. Chakrabarti, T. Cook, G. Howe, J. Martel, K. Hewawasam, E. Douglas, G. Newnham, M. Schaefer, J. Armston, J. Muir, D. Tindall, S. Phinn, *Canopy Biomass Lidar (CBL) acquisitions at NEON and TERN forest sites*, American Geological Union Fall Meeting, San Francisco, USA, December 2013.
- I. Paynter, E. Saenz, F. Peri, C. Schaaf, Z. Wang, A. Erb, Y. Yang, S. Rouhani, Y. Liu, X. Yang, R. Chen, S. Oktay, A. Gontz, E. Douglas, J. Kim, Q. Sun, A. Strahler, Z. Li, J. van Aardt, D. Kelbe, P. Romanczyk, **K. Cawse-Nicholson**, *Coastal applications of the Canopy Biomass Lidar (CBL)*,