

# CURRICULUM VITAE of ABRIE OBERHOLSTER

## 1 BIOGRAPHICAL SKETCH

1.1 GENERAL INFORMATION										
<b>Surname</b>	Oberholster			<b>First names</b>	Abraham Johannes					
<b>Citizenship</b>	South African			<b>Title</b>	Dr	<b>Female</b>	<input type="checkbox"/>	<b>Male</b>	<input checked="" type="checkbox"/>	
<b>Place of birth</b>	South Africa			<b>Date of birth</b>	1978-10-24					
<b>Population group</b>	<i>African</i>	<input type="checkbox"/>	<b>Coloured</b>	<input type="checkbox"/>	<b>Indian</b>	<input type="checkbox"/>	<b>White</b>	<input checked="" type="checkbox"/>	<i>Other (Please specify)</i>	<input type="checkbox"/>
<b>Department</b>	Mechanical and Aeronautical Engineering, University of Pretoria			<b>Position</b>	Senior lecturer					
<b>Direct Telephone</b>	012 420 3288			<b>Direct Telefax</b>						
<b>E-mail</b>	abrie.oberholster@up.ac.za									
<b>Date of appointment</b>	January 2021			<b>Permanent full-time</b>	<input checked="" type="checkbox"/>	<b>Temporary full-time</b>	<input type="checkbox"/>			

1.2 ACADEMIC QUALIFICATIONS OBTAINED				
Degree/Diploma	Field of study	Higher education institution	Year	Distinctions
B.Eng	Mechanical Engineering	University of Pretoria	2001	First class
M.Eng	Mechanical Engineering	University of Pretoria	2004	
PhD	Mechanical Engineering	University of Pretoria	2010	

1.3 WORK EXPERIENCE TO DATE		
Name of employer	Capacity and/or type of work	Period From mm//yy to mm//yy
Eskom (Kendal Power Station)	Engineer in training	From 02/03 to 04/07
Eskom (Corporate Services Division)	Engineer	From 05/07 to 04/11
Business Enterprises at University of Pretoria	Engineer	From 04/11 to 09/15
University of Pretoria	Senior project engineer	From 10/15 to 12/20
University of Pretoria	Senior lecturer	01/21 to date

## 2 TEACHING ACTIVITIES

2.1 Courses presented		
Course	Level (e.g. second year, Masters)	Self-developed (Yes or No)
Vibration-based condition monitoring MEV781 (2013, 2014) (Guest lecturer: Rotor dynamics)	Post-graduate (UP)	Yes
Vibrations MSY732 (Guest lecturer: Laser vibrometry)	Post-graduate (UP)	Yes
Vibrations MVR320 (Stand-in lecturer)	Third year (UP)	No
Vibration monitoring MIC780 (2016) (Guest lecturer: Advanced signal processing)	Post-graduate (UP)	Yes
Programming MPR213 (2021 - current)	Second year (UP)	No
Fatigue MSV780 (2021 - current)	Post-graduate (UP)	No
Mechatronics and Control MBB410 (2022 – current)	Final year (UP)	Yes

2.2 Other education and pedagogic courses presented			
Course	Year	Target group	Institution
Modal analysis master class	2016	Industry	Esteq
Digital Image Correlation with TEMA and IDT Vision	2017	Industry	Esteq

## 3 TEACHING OUTPUTS

3.1 Educational publications and products
<ol style="list-style-type: none"> <li>Oberholster, A.J. (2015) C-AIM Training Videos: Polytec PSV400 Scanning Laser Doppler Vibrometer [online video] Available at: <a href="https://youtu.be/swYDd0rqsAU">https://youtu.be/swYDd0rqsAU</a></li> <li>Oberholster, A.J. (2015) C-AIM Training Videos: OROS Modal2 (Parts 1 – 4) [online videos] Available at: <a href="https://youtu.be/tr4JLknO0-g">https://youtu.be/tr4JLknO0-g</a>, <a href="https://youtu.be/BIQOLoGLi1k">https://youtu.be/BIQOLoGLi1k</a>, <a href="https://youtu.be/8k619v9XmVk">https://youtu.be/8k619v9XmVk</a>, <a href="https://youtu.be/W_K9TNrNfHY">https://youtu.be/W_K9TNrNfHY</a></li> </ol>

## 4 RESEARCH ACTIVITIES

4.1 Former supervision or co-supervision ( <i>completed</i> )				
Name of student	Degree/Title of dissertation/ thesis and date	Supervisor	Co-supervisor(s)	Duration of studies (years)
Kruger, A	M.Eng Transient Dynamic Finite Element Modelling of Flexible Rotors with Nonlinear Fluid Film Bearings & Faults 2014	PS Heyns	AJ Oberholster	2
Gwashavanhu, B	M.Eng Evaluation of Optical Techniques Applied to Online Turbomachinery Blade Vibration Measurements 2015	PS Heyns	AJ Oberholster	2
Diamond, D	M.Eng A Novel Technique for Inferring Synchronous Turbomachinery Blade Vibration from Blade Tip Timing Data 2015	PS Heyns	AJ Oberholster	2
Diamond, D	PhD A Probabilistic Approach to Blade Tip Timing Data Processing 2017	PS Heyns	AJ Oberholster	2

4.2 Current post-graduate students					
Name of student	Degree enrolled for and date of first registration	Project title	Supervisor	Co-supervisor(s)	Year of registration
Gwashavanhu, B	PhD (Mech Eng) 2015	Shape Principal Component Analysis as a Targetless Photogrammetric Technique for Condition Monitoring of Rotating Machines	AJ Oberholster	PS Heyns	6
Molepo, M	PhD (Anatomy) 2018	Clinical and biomechanical considerations for acromioclavicular joint reconstruction: Does the tunnel position on the coracoid influence horizontal stability?	N Keough	E Hohmann AJ Oberholster	2
Moradi Dalvand, H	MEng (Mech) 2020	Application Of Deep Reinforcement Learning For Events In Dynamic And Drilling Operations	PS Heyns	AJ Oberholster	2

4.3 Obtaining research funds					
Origin of research funds	Title of research project or programme	Year granted	Grant number	Money allocated (ZAR)	Role
NRF National Equipment Programme	High speed imaging system	2017	105647	R 2,287,660.00	Co-applicant
NRF National Equipment Programme	Vehicle response measurement system	2019	116147	R 7,000,000.00	Co-user
UP Research Development Programme	Mechanical characterization and modelling of human skin	2022	3562	R 50,000.00	Applicant

## 5 RESEARCH OUTPUTS

### 5.1 Publications in peer-reviewed or refereed journals

- Oberholster, A. J., & Heyns, P. S. (2006). On-line fan blade damage detection using neural networks. *Mechanical Systems and Signal Processing*, 20(1), 78–93. <https://doi.org/10.1016/j.ymssp.2004.09.007>
- Oberholster, A. J., & Heyns, P. S. (2009). Online condition monitoring of axial-flow turbomachinery blades using rotor-axial Eulerian laser Doppler vibrometry. *Mechanical Systems and Signal Processing*, 23(5), 1634–1643. <https://doi.org/10.1016/j.ymssp.2009.01.001>
- Oberholster, A. J., & Heyns, P. S. (2011). Eulerian laser Doppler vibrometry: Online blade damage identification on a multi-blade test rotor. *Mechanical Systems and Signal Processing*, 25(1). <https://doi.org/10.1016/j.ymssp.2010.03.007>
- Gwashavanhu, B., Oberholster, A. J., & Heyns, P. S. (2016). Rotating blade vibration analysis using photogrammetry and tracking laser Doppler vibrometry. *Mechanical Systems and Signal Processing*. <https://doi.org/10.1016/j.ymssp.2016.02.019>
- Diamond, D. H., Heyns, P. S., & Oberholster, A. J. (2016). Online shaft encoder geometry compensation for arbitrary shaft speed profiles using Bayesian regression. *Mechanical Systems and Signal Processing*, 81, 402–418. <https://doi.org/10.1016/j.ymssp.2016.02.060>
- Diamond, D. H., Heyns, P. S., & Oberholster, A. J. (2017). Accuracy evaluation of sub-pixel structural vibration measurements through optical flow analysis of a video sequence. *Measurement*, 95, 166–172. <https://doi.org/10.1016/j.measurement.2016.10.021>
- Gwashavanhu, B., Heyns, P. S., & Oberholster, A. J. (2019). Shape principal component analysis as a targetless photogrammetric technique for condition monitoring of rotating machines. *Measurement: Journal of the International Measurement Confederation*, 132, 408–422. <https://doi.org/10.1016/j.measurement.2018.09.065>
- Diamond, D. H., Heyns, P. S., & Oberholster, A. J. (2019). Improved Blade Tip Timing measurements during transient conditions using a State Space Model. *Mechanical Systems and Signal Processing*, 122, 555–579. <https://doi.org/10.1016/j.ymssp.2018.12.033>

9. Grobler, J. M., Focke, W. W., Derrick, N. P., Oberholster, A. J., Kelly, C., & Labuschagne, G. (2020). Sensitising the micron-sized aluminium/potassium periodate thermite. *Journal of Energetic Materials*, 38(4), 455–466. <https://doi.org/10.1080/07370652.2020.1732499>

10. Diamond, D. H., Heyns, P. S., & Oberholster, A. J. (2021). Constant speed tip deflection determination using the instantaneous phase of blade tip timing data. *Mechanical Systems and Signal Processing*, 150, 107151. <https://doi.org/10.1016/j.ymssp.2020.107151>

#### **Submitted manuscripts**

11. Deetlefs, R., Heyns, P.S., Baggeröhr, S. & Oberholster, A.J. (Submitted). Rail surface anomaly detection: a deep learning approach for computer vision. *IEEE Transactions on Intelligent Transportation Systems* (Manuscript ID: T-ITS-19-02-0162).

12. Diamond, D.H., Heyns, P.S., & Oberholster, A.J. (Submitted). Rotor Blade Probabilistic High Cycle Fatigue Damage Determination using Blade Tip Timing Data. *International Journal of Fatigue* (Manuscript ID: IJFATIGUE-D-19-00699)

13. Cronjé, J. Y. et al. (Submitted) 'Peak load capacity of the tendinous and capsular layers of the rotator cuff complex: A biomechanical study', *The International Journal of Applied and Basic Nutritional Sciences*.

## **5.2 Books and/or chapters in books**

1. Diamond, D. H., Heyns, P. S., & Oberholster, A. J. (2015). A comparison between three blade tip timing algorithms for estimating synchronous turbomachine blade vibration. In *Lecture Notes in Mechanical Engineering* (Vol. 20). [https://doi.org/10.1007/978-3-319-15536-4\\_18](https://doi.org/10.1007/978-3-319-15536-4_18)

#### **Submitted manuscripts**

2. Govender, S., Cronjé, J. Y., Keough, N., Oberholster, A. J., Van Schoor, A. N., De Jager, E. J., & Naicker, J. (Submitted). Emerging Imaging Techniques in Anatomy - for teaching, research and clinical practice.', in Shapiro, L. and Rea, P. M. (eds) *Biomedical Visualisation* (Vol. 13). Springer Nature.

## **5.3 Published full-length conference papers/keynote addresses**

1. Heyns, P.S. & Oberholster, A.J. (2004). On-line fan blade damage detection. *Proceedings of the 11th International Congress on Sound and Vibration*, St. Petersburg, Russia, pp. 2921-2928.

2. Oberholster, A.J. & Heyns, P.S. (2007). The application of Eulerian Laser Doppler Vibrometry to on-line damage detection of axial-flow turbomachinery blades. *Proceedings of the 20th International Congress on Condition Monitoring and Diagnostic Engineering Management*, Faro, Portugal, pp. 637-645.

3. Heyns, P.S., Stander, C.J., Oberholster, A.J., Schön, P.P. & Ngwangwa, H.M. (2007). Machine and structural health monitoring: Some recent developments. *Proceedings of the Third International Conference on Structural Engineering, Mechanics and Computation*, Cape Town, South Africa, pp. 124-129.

4. Oberholster, A.J. & Heyns, P.S. (2008). A study of the non-harmonic Fourier analysis technique. Proceedings of the 21st International Congress on Condition Monitoring and Diagnostic Engineering Management, Prague, Czech Republic, pp. 361-370.
5. Heyns, P.S., Grové, A.P., Schön, P.P. & Oberholster, A.J. (2009). Development of a monitoring strategy for a large electrical generator. Condition Monitoring, Dublin, Ireland.
6. Oberholster, A.J.; Heyns, P.S. & Newby, M. (2012). The Removal of Speckle Noise from Torsional Laser Doppler Vibrometer Signals in Machine Health Monitoring. Proceedings of the 18th World Conference on Nondestructive Testing, 16-20 April, Durban, South Africa.
7. Oberholster, A.J., Heyns, P.S., & Newby, M. (2013). Structural peak frequency tracking of generator end windings from operational vibration measurements. Proceedings of the 26th International Congress on Condition Monitoring and Diagnostics Engineering Management (COMADEM). Helsinki, Finland.
8. Oberholster, A.J., Heyns, P.S., & Willemse, P. (2013). Removal of a core grid plate from a research nuclear reactor. Proceedings of the 26th International Congress on Condition Monitoring and Diagnostics Engineering Management (COMADEM). Helsinki, Finland.
9. Oberholster, A.J., Heyns, P.S., Newby, M. & Goldschagg, H. (2014). Damage detection of an air cooled condenser fan gearbox. Proceedings of the 11<sup>th</sup> International Conference on Condition Monitoring and Machinery Failure Prevention Technologies, Manchester, UK.
10. Oberholster, A.J. & Heyns, P.S. (2014). A study of radial-flow turbomachinery blade vibration measurements using Eulerian laser Doppler vibrometry. Proceedings of the 11<sup>th</sup> International Conference on Vibration Measurements by Laser and Noncontact Techniques - AIVELA 2014: Advances and Applications, Ancona, Italy.
11. Diamond, D., Heyns, S. and Oberholster, A. (2016). Using image processing techniques on proximity probe signals in rotordynamics. Proceedings of the 12<sup>th</sup> International Conference on Vibration Measurements by Laser and Noncontact Techniques – AIVELA 2016, Ancona, Italy. doi: 10.1063/1.4952655.
12. Diamond, D., Oberholster, A. and Heyns, S. (2016). Structural vibration field test using optical flow analysis of a video sequence. Proceedings of the 12<sup>th</sup> International Conference on Vibration Measurements by Laser and Noncontact Techniques – AIVELA 2016, Ancona, Italy. doi: 10.1063/1.4952678.
13. Gwashavanhu, B., Heyns, P.S., Oberholster, A.J. (2017). Statistical shape analysis as a noncontact method for condition monitoring of turbomachines. Proceedings of the 7th International Operational Modal Analysis Conference, IOMAC 2017, Ingolstadt, Germany.
14. Heyns, P.S., Krüger, A., Oberholster, A.J. (2017). Transient dynamic finite element modeling of flexible rotor systems with nonlinear fluid film bearings and faults. Proceedings of the 1st World Congress on Condition Monitoring 2017, WCCM 2017, London, UK.

15. Heyns, P.S., Deetlefs, R., Oberholster, A.J, Botha, T.R., Els, P.S. and Diamond, D.H. (2019). Computer vision for rail surface defect detection. Proceedings of the 16<sup>th</sup> International Conference on Condition Monitoring and Asset Management, CM 2019, Glasgow, UK.

#### 5.4 Non-refereed publications or popular articles

1. Oberholster, A.J. (2004). Turbine blade research study. The South African Mechanical Engineer 54(11), pp. 15.
2. Heyns, P.S., Oberholster, A.J. & Thoresson, M. (2006). Measuring vibration with lasers? The South African Mechanical Engineer 56, pp. 25-26.
3. Heyns, P. S., Deetlefs, R., Oberholster, A. J., Botha, T. R., Els, P. S., & Diamond, D. H. (2020, October). Computer vision for rail surface defect detection. Condition Monitor, 6–10.

#### 5.5 Patents

1. Oberholster, A.J. *et al.* (2016) 'Rail infrastructure condition monitoring', SA Patent application 2016/05967.
2. Diamond, D. H., Heyns, P. S. and Oberholster, A. J. (2019). A method and system for monitoring rotor blades of a turbomachine using blade tip timing (BTT). US 2019/0212188
3. Diamond, D. H., Heyns, P. S. and Oberholster, A. J. (2019). A method and system for monitoring rotor blades of a turbomachine using blade tip timing (BTT). US 2019/0376406
4. Diamond, D. H., Heyns, P. S. and Oberholster, A. J. (2020). A method and system for monitoring rotor blades of a turbomachine using blade tip timing (BTT). US 2020/0249074

## 6 CONSULTING ACTIVITIES

#### 6.1 Technical reports

Over 50 technical and research reports compiled for several companies including Eskom Research, Testing & Development, Bombela Operating Company, Bombela Concession Company, NECSA, South African Large Telescope, CSIR DPSS, Mitsubishi Hitachi Power Systems Africa, Mine Health and Safety Council (MHSC), Lonmin, Multotec, etc.

## 7 OTHER SCHOLARLY RESEARCH-BASED CONTRIBUTIONS

#### 7.1 Participation in conferences, workshops and short courses

##### 7.1.1 National conferences

1. Oberholster, A.J. (2005). Continuous scanning laser vibrometry of a moving target using a non-scanning LDV, presented at 'The 1st South African Laser Vibrometry Seminar', Pretoria, South Africa.

2. Oberholster, A.J. (2007). On-line turbomachinery blade condition monitoring, *presented at* 'Conference on Modelling in Non-Destructive Testing', Pretoria, South Africa.
3. Oberholster, A.J. (2010). Laser vibrometry applications at Eskom, *presented at* 'The 2010 South African Laser Vibrometry Workshop', Pretoria, South Africa.
4. Oberholster, A.J. (2010). Eulerian on-line blade vibration monitoring as a condition monitoring tool, *presented at* 'Esteq User's Conference', Pretoria, South Africa.
5. Oberholster, A.J.; Heyns, P.S. & Newby, M. (2011). Blade natural frequency measurements from rotor rundowns using a microwave sensor - Initial results, *presented at* 'Esteq User's Conference', Pretoria, South Africa.
6. Oberholster, A.J. (2012). Vibration monitoring in power generation, *presented at* 'Physical Asset Management and Condition Monitoring Research Seminar', 23 April, Pretoria, South Africa.
7. Oberholster, A.J. (2012). Vibration measurement and analysis research applications at the Dynamic Systems Group, *presented at* 'Dynamic Systems and Signal Processing (DSSP) 2012 seminar', 06 December, Pretoria, South Africa.
8. Oberholster, A.J. (2013). Basic rotordynamic theory, *presented at* 'Dynamic Systems and Signal Processing (DSSP) 2013 seminar', 29 May, Pretoria, South Africa.
9. Oberholster, A.J. (2013). The analysis of text: Contextual meaning vs. numerical processing, *presented at* 'Dynamic Systems and Signal Processing (DSSP) 2013 seminar', 30 May, Pretoria, South Africa.
10. Oberholster, A.J., Heyns, P.S., Newby, N., Goldschagg, H. (2014). Damage detection of an air cooled condenser fan gearbox. Presented at the Esteq Engineering Community Conference, Pretoria, South Africa.
11. Oberholster, A.J. (2016). Photogrammetry applications at the University of Pretoria. Presented at the Esteq Vision TechDay, Pretoria, South Africa.
12. Oberholster, A.J. (2016). 3D geometry measurement for condition assessment. Presented at the Esteq Engineering Community Conference, Pretoria, South Africa.
13. Oberholster, A.J., Gwashavanhu, B. & Heyns, P.S. (2016). Photogrammetry as a verification tool for laser Doppler vibrometry. Presented at Measuring by Light 2016, Pretoria, South Africa.
14. Oberholster, A.J., Pienaar, S., Gwashavanhu, B., Jami, A., Deetlefs, R. (2018). Photogrammetry applications at the University of Pretoria: More than just pretty pictures... Presented at the Esteq Engineering Community Conference, Pretoria, South Africa.
15. Oberholster, A.J., Dube, S., Heyns, P.S. (2019). Sound localisation using acoustic imaging. Presented at the Northern Cape Zero Harm Conference, Kimberly, South Africa.



16. Cronjé, J.Y., Mogale, N., Govender, S., McDuling, C., Oberholster, A.J., De Beer, M.A., Nkwenika, T., Keough, N. (2019). Biomechanical properties of the tendinous and capsular layers of the rotator cuff complex: A comparative study. Presented at the 47<sup>th</sup> Anatomical Society of Southern Africa (ASSA) Conference, South Africa.
17. Oberholster, A.J., Cronjé, J.Y., Mogale, N., Govender, S., McDuling, C., De Beer, M.A., Nkwenika, T., Keough, N. (2019). Full field measurements for difficult applications: Mechanical characterization of biomaterials / High speed acoustic imaging. Presented at the Esteq Engineering Community Conference, Pretoria, South Africa.
18. Cronjé, J.Y., Mogale, N., McDuling, C., Verbeek, R., Oberholster, A.J., De Beer, M.A., Govender, S., Oberholster, A.J., Keough, N. (2021) 'Elastic modulus biomechanics of the tendinous and capsular layers of the rotator cuff complex: A comparative study', Presented at the South African Orthopaedic Association Congress.
19. Grobler, J. M., Focke, W. W. and Oberholster, A. J. (2021) 'Al/KIO4/CuO/PTFE: A micron-sized thermite for nano-thermite applications', Presented at SABO Symposium 2021.

### **7.1.2 International conferences**

1. Oberholster, A.J., Heyns, P.S. & Newby, M. (2012). Signal processing of online generator end winding vibrations, *presented at* 'EPRI Generator End-winding Vibration On-line Monitoring (EPPRI Program 65) Webcast', 27 November.
2. Oberholster, A.J., Heyns, P.S. & Newby, M. (2014). Online turbomachinery blade damage detection using a continuous microwave sensor. Presented at the 11<sup>th</sup> International Conference on Vibration Measurements by Laser and Noncontact Techniques - AIVELA 2014: Advances and Applications, Ancona, Italy.
3. Oberholster, A.J., Heyns, P.S. & Newby, M. (2014). Optimal eddy current runout compensation for turbomachinery condition monitoring - A problem statement. Presented at the 11<sup>th</sup> International Conference on Vibration Measurements by Laser and Noncontact Techniques - AIVELA 2014: Advances and Applications, Ancona, Italy. (Plenary session)

### **7.2 Teamwork and collaboration with others:**

1. Prof Stephan Heyns (UP, Department of Mechanical and Aeronautical Engineering)
2. Dr Natalie Keough (UP, Department of Anatomy)
3. Prof Walter Focke (UP, Department of Chemical Engineering)
4. Prof Elsabe Kearsly (UP, Department of Civil Engineering)
5. Dr Philip Loveday (CSIR, Material Science and Manufacturing)
6. Dr Dave Reinecke (CSIR, DPSS Landward Sciences)
7. Dr Bertie Meyer (UP, Department of Mining Engineering)

8. Prof Waldo Kleynhans (UP, Department of Electrical, Electronic and Computer Engineering)
9. Prof Johan W Joubert (UP, Department of Industrial and Systems Engineering)
10. Prof Johann Wannenburg (UP, Department of Mechanical and Aeronautical Engineering)
11. Dr James Roberts (UP, Department of Geology)
12. Dr Michael van Schoor (CSIR, Geophysics)

### 7.3 Membership in national and international bodies

1. Engineering Council of South Africa (ECSA): Member (PrEng)
2. South African Institute for Mechanical Engineers (SAIMechE): Member
3. South African Ballistics Organisation (SABO): Member
4. Turbomachinery Technogroup: Committee member (2006 – 2009, 2013 – 2018); Secretary (2007 – 2009); Chairperson (2015 – 2016)
5. Scientific Imaging Association of South Africa (SIASA): Executive committee member

## 8 ARTISTIC OUTPUTS

1. Oberholster, A.J., Jordaan, A. (2001) U is daar. In:
  - a. Awesome God: A worship experience with Brooklyn Campus Doxa Deo [CD]
  - b. Die Nuwe Lied Versameling [CD]
2. Oberholster, A.J. (2001) Lead guitarist. In: Awesome God: A worship experience with Brooklyn Campus Doxa Deo [CD]

## 9 COMMUNITY SERVICE OR PROFESSIONAL SKILLS

### 9.1 Outreach projects

Worship leader/ musician / sound engineer at Harvest Church International since 2006

### 9.2 Involvement with other universities/scientific institutions

1. External examiner for: University of Pretoria (B.Eng level), Tshwane University of Technology (M.Tech level), University of Cape Town (M.Eng level)
2. Internal reviewer for University of Pretoria (M.Eng level)
3. Review panel member: National Research Foundation (SANAP 2014; NEP 2014)
4. Session chair: 11th International Conference on Vibration Measurements by Laser and Noncontact Techniques - AIVELA 2014: Advances and Applications, Ancona, Italy.
5. Organising committee: Measuring by Light Conference (2016), South Africa.

### 9.3 Referee duties

Refereed several articles for: Journal of Sound and Vibration; Mechanical Systems and Signal Processing; Applied Soft Computing; Journal of Health & Medical Informatics.

## 10 SELF EVALUATION: TEACHING AND RESEARCH OUTPUT PRACTICE

### 10.1 Teaching outputs

The retention and transfer of skills and knowledge should be a priority in any organisation. Noticing the absence of training videos on some of our specialised equipment, I created several YouTube training videos to enable our students to operate the equipment efficiently and safely. The training videos have also been used successfully by other institutions such as the University of Leicester (UK).

On several occasions I was a guest lecturer in post-graduate course work, focusing on non-contact measurements, rotordynamics and advanced signal processing.

As part of a three-day course to industry in 2016, I was a co-presenter with prof Stephan Heyns and dr Filip Deblauwe (Siemens). I also developed and presented a short course to industry on digital image correlation in 2017.

On three occasions in 2020, I gave online talks on experimental and modelling aspects around the mechanical characterisation of biological materials to the UP Department of Anatomy, CSIR, TUT, Wits and UNISA.

I am a lecturer in the MPR213 programming module since 2021, and I am the module coordinator for the final year MBB410 mechatronics and control module

### 10.2 Research outputs

During my PhD studies on the online condition monitoring of turbomachinery blades using laser Doppler vibrometry, I became aware of the blade tip timing (BTT) measurement technique. However, the standard practices in processing the data obtained with BTT yielded limited results. Being convinced that the correct processing approach applied to BTT could yield much richer information, I proposed it as an M.Eng research topic. Acting as co-supervisor for the particular student's M.Eng and subsequent PhD research, advanced techniques were developed that excel beyond what current approaches can deliver. Several patent applications were filed and I currently am part of a project team to perform a pilot installation on a steam turbine at one of Eskom's power stations.

Over a period of more than 4 years, I conducted projects involving field tests for Eskom to implement advanced signal processing techniques developed by Centre for Asset Integrity Management (C-AIM) students on industrial gearboxes. In one of these projects, damage initiation on one of the bearings of an air-cooled condenser fan gearbox was detected 18 months prior to gearbox failure.

I performed work for the MHSC through EUP to develop a low-cost rock mass condition assessment tool (RoMCAT) using online thermal imaging and acoustic signal processing. The result was a Raspberry Pi-based field-tested prototype with a factor 10 cost reduction compared to a prototype developed by the CSIR. A market study by MHSC for the RoMCAT is currently underway. Based on the outcomes, I am busy with a project for Lonmin to develop an ultrasonic rock bolt condition assessment tool.

Over time I have developed a keen research interest in photogrammetric applications, particularly related to motion analysis and digital image correlation (DIC). As part of a Technology Innovation Agency (TIA) seed funding project, I was responsible for an Enterprises University of Pretoria (EUP) project focused on employing stereo DIC for the condition monitoring of rails. This led to a patent application.

I successfully applied for NRF NEP funding as co-applicant with prof Stephan Heyns for a high-speed imaging and analysis system. Several undergraduate, M.Eng and PhD students have used the equipment in their research since commissioning in May 2017. Because of the multi-disciplinary application potential of the equipment, I initiated collaborative research with the Department of Anatomy and Department of Chemical Engineering at UP in 2018. From this initiative, two local conference papers (MSc Anatomy studies) and one journal article (PhD Chem Eng studies) have been produced to date. Two more journal papers are being prepared as part of MSc Anatomy studies and I am also co-supervising a PhD (Anatomy) student and along with the Department of Anatomy.

My current multi- and transdisciplinary collaboration partners are:

- Department of Civil Engineering, UP
- Department of Chemical Engineering, UP
- Department of Anatomy, UP
- Department of Companion Animal Clinical Studies, UP
- Department of Music, UP

Another area of research I am investigating is the combination of acoustic imaging with high-speed cameras.

### **10.3 Research vision**

My short to medium-term goal is to establish a biological material testing and characterisation facility at UP, which will facilitate trans-disciplinary research at the University of Pretoria, and ultimately lead to the establishment of a Department of Biomechanical Engineering at UP. I am pursuing this in collaboration with the UP Department of Anatomy.

Although the Department of Mechanical and Aeronautical Engineering at UP have a world-class testing laboratory with excellent infrastructure and equipment, its tensile testing machines are tailored for the testing of steel mechanical components. In terms of instrument sensitivities and ageing control capabilities, this presents limitations around test repeatability and accuracy required for the testing of biological soft materials. Although this equipment was used with some success in PhD (Anatomy) studies, it is now desired to have a dedicated electrical tensile testing machine situated at the Department of Anatomy for the following reasons:

- 1) With the two departments on separate campuses, it logistically makes sense to have the equipment in proximity of the proper specimen storage and handling facilities.

- 2) An electrical tensile test machine does not require additional infrastructure such as hydraulic power packs, which is not available at the Department of Anatomy. This also allows the machine to be moved to different locations in the department as required.

This equipment will be used in conjunction with the digital image correlation (DIC) capabilities available at the Department of Mechanical and Aeronautical Engineering, as the available cameras are mobile.