

# Beth Jelfs

*My research interests are in adaptive signal processing especially statistical signal processing and signal characterisation. In particular I am interested in the intersection of signal processing and machine learning and how signal processing techniques can be used to inform machine learning algorithms. I also have a specific interest in how these techniques can be applied to multichannel and multimodal data particularly with reference to biomedical and neural applications.*

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## Education

**PhD Electrical & Electronic Engineering**  
Imperial College London, UK  
September 2005 – March 2010

Thesis Title: Collaborative Adaptive Filtering for Machine Learning  
Awarded Engineering & Physical Sciences Research Council Doctoral Training Award

**MEng Electronic & Software Engineering**  
University of Leicester, UK  
September 2001 – June 2005

1st Class Honours  
Awarded British Computer Society's prize for best graduating student

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## Employment

**Vice-Chancellor's Research Fellow**  
School of Engineering, RMIT University, Australia  
March 2017 – Present

My fellowship research is on adaptive signal processing algorithms for signal characterisation and machine learning, projects include:

- Development of time-varying delay estimation algorithms;
- Integration of image processing & machine learning for tracking cellular & tissue responses
- Investigation of feasibility of a self-organising constellation of low-cost, station-keeping, high-altitude balloons.

**Research Fellow**  
Dept. Electronic Engineering, City University of Hong Kong, Hong Kong  
August 2013 – October 2016

Project coordinator for "Fingers Working in Coordination: Hierarchy of EEG, EMG and Kinematics" funded by the Hong Kong Research Grant Council.  
Also worked on development of computational methods for neural synchronization and information transfer as part of the Centre for Biosystems, Neuroscience, and Nanotechnology.

**Postdoctoral Research Associate**  
Dept. Medical Physics & Bioengineering, University College London, UK  
June 2011 – June 2013

Designing the signal processing aspects of project "Integrating monitoring & modelling for real time tracking of cerebral circulation & metabolism" funded by Wellcome Trust Project Grant.

**Postdoctoral Research Assistant**

Dept. Chemistry & Dept. Physics,  
University of Oxford, UK  
06/2010–06/2011

Using statistical signal processing techniques to investigate nanopore technology and the accuracy of classification for DNA sequencing.

**Wetenschappelijk Medewerker  
(Scientific Assistant)**

Dept. Neurosciences, Katholieke  
Universiteit Leuven, Belgium  
July 2009 – November 2009

Research on complex-valued echo state networks, funded by the European research project “Neuroprobes”.

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## Teaching Experience

**Lecturer**

RMIT University  
2019–2020

Signals & Systems 1

Offshore course taught at School for Higher and Professional Education, Vocational Training Council, Hong Kong.

**Course Coordinator**

RMIT University  
2018–2020

Biomedical Signal Analysis

**Guest Lecturer**

City University of Hong Kong  
2014–2015

Brain Machine Interface: Technology, Culture, and Society

Lecturing on BMI Technology & Neural Computation for a Gateway Education course.

**Graduate Teaching Assistant**

City University of Hong Kong  
2013–2015

International Transition Team

Providing English language support including student tutorials, proofreading of academic papers & preparation of teaching materials.

**Study Group Tutor**

Imperial College London  
2006–2008

Communications I

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## Grants & Awards

**Ideation Challenge**

SmartSat Cooperative Research  
Centre  
2020

Vision based stratospheric balloon attitude determination.

**Project for the Defence Artificial  
Intelligence Centre**

Trusted Autonomous Systems  
Defence Cooperative Research Centre  
2020-2021

A self-organising low-cost high-altitude balloon constellation for persistent surveillance and communications.

**Maxwell Eagle Endowment Award**

RMIT University  
2020

Using machine-based learning to develop prognostics of CAR T cell outcomes in older patients.

**Capability Development Fund**

RMIT University  
2019

High throughput platform for tracking cellular response.

<b>Global Connections Fund Bridging Grant</b> Australian Academy of Technology Sciences and Engineering 2017–2018	Muscle fatigue monitor.
<b>Scheme for Teaching and Learning Research</b> RMIT University 2017	Developing the framework for problem based learning workshop style education.
<b>Research Fellowships</b> RMIT University 2017–2021	Vice-Chancellor's Research Fellowship.
<b>Research Exchange Project</b> BayChina 2015	Collaboration with Neuroscientific Theory Group at TU München.
<b>Best Student Paper Award</b> International Symposium on Neural Networks 2010	For paper “Modelling of Brain Consciousness based on Collaborative Adaptive Filters”.
<b>Academic Research Collaboration Project</b> British Council and DAAD 2008	Collaboration with TU München and the Max-Planck-Institute for Dynamics and Self-Organization.
<b>International Travel Grant</b> Royal Academy of Engineering 2007	Awarded to attend IEEE International Conference on Acoustics Speech and Signal Processing.

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## Service to Field

<b>Reviewer</b> Ongoing	For journals including: - Entropy, Signal Processing, IEEE Transactions on Signal Processing, IEEE Signal Processing Letters, IEEE Transactions on Neural Systems and Rehabilitation, Neurocomputing, International Journal of Adaptive Control and Signal Processing.
<b>Steering Committee Member</b> SmartSat Cooperative Research Centre 2020–Present	AI4Space Research Network: to progress research and development in AI applied to space systems and technologies.
<b>Topic Editor</b> Entropy 2020–Present	Leading special issues, suggesting new topics, and recommending Guest Editors for these new topics; supervising the editorial process.
<b>Organiser special session</b> APSIPA Annual Summit & Conference, Auckland, New Zealand 2020	Multidimensional Biomedical Signal and Image Processing.

**Organiser special session**  
 APSIPA Annual Summit &  
 Conference, Honolulu, USA  
 2018

Emerging Technologies for Healthcare.

**Vice-Chancellor's Fellows  
 Advisory Group**  
 RMIT University  
 2017–2020

Liasing with Reaseach & Innovation Office to provide improved  
 procedures for fellows.

Organising events to promote the fellows' research and collaboration  
 between fellows.

**Organising committee**  
 "enGENEious" conference, Oxford, UK  
 2012

Student & Post-doc lead conference on microbial engineering.

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## Public Engagement & Invited Talks

**Engaging for Impact**  
 RMIT University, Australia  
 2020

Talk on Tissue Image Processing for Innovation in Healthcare with  
 Precision Medicine session.

**Biomedical Engineering Dept.**  
 Shantou University, China  
 2019

Invited lecture series on biomedical signal processing.

**Bioinformatics Network  
 Symposium**  
 RMIT University, Australia  
 2019

Talk on Machine Learning for High Throughput Cell Imaging.

**Pint of Science**  
 London, UK  
 2013

Event manager for science festival for the general public.

**UCL Outreach**  
 University College London, UK  
 2011–2013

Lead demonstrations and talks with school children for events  
 including:

- Medical Physics Masterclass;
- Women in Engineering Taster Day;
- University Challenge Event.

**Doctoral Training Centre**  
 University of Oxford, UK  
 2011

Talk on DNA Nanopore Sequencing.

**Faculty of Computer Science**  
 University of Applied Sciences  
 Schmalkalden, Germany  
 2008

Talk on Signal Modality Characterisation Using Collaborative Adap-  
 tive Filters.

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## Professional Associations

Asia-Pacific Signal & Information  
 Processing Association (APSIPA)  
 2018–present

### Member

- Member Biomedical Signal Processing & Systems Technical  
 Committee

Institute of Electrical and Electronics  
Engineers  
2006–present

#### Member

- Affiliate member of Bio Imaging and Signal Processing Technical Committee
- Member of Signal Processing Society
- Member of Engineering in Medicine and Biology Society

## Publications

### Preprints

- [1] Q. She, **B. Jelfs**, A. S. Charles, and R. H. M. Chan. Network modeling of short over-dispersed spike-counts: A hierarchical parametric empirical bayes framework. arXiv:1605.02869.

### Journal Articles

- [1] R. Viswanathan, S. P. Arjunan, A. Bingham, **B. Jelfs**, P. Kempster, S. Raghav, and D. K. Kumar, "Complexity measures of voice recordings as a discriminative tool for parkinson's disease," *Biosensors*, vol. 10, no. 1:1, 2020.
- [2] D. K. Kumar, **B. Jelfs**, X. Sui, and S. P. Arjunan, "Prosthetic hand control: A multidisciplinary review to identify strengths, shortcomings, and the future," *Biomedical Signal Processing and Control*, vol. 53, no. 101588, 2019.
- [3] S. M. Keloth, R. Viswanathan, **B. Jelfs**, S. Arjunan, S. Raghav, and D. Kumar, "Which gait parameters and walking patterns show the significant differences between parkinson's disease and healthy participants?" *Biosensors*, vol. 9, no. 2:59, 2019.
- [4] A. Bingham, S. P. Arjunan, **B. Jelfs**, and D. K. Kumar, "Normalised mutual information of high-density surface electromyography during muscle fatigue," *Entropy*, vol. 19, no. 12, p. 697, 2017.
- [5] **B. Jelfs** and R. H. M. Chan, "Directionality indices: Testing information transfer with surrogate correction," *Physical Review E*, vol. 96, no. 5:052220, 2017.
- [6] X. Zhai, **B. Jelfs**, R. H. M. Chan, and C. Tin, "Self-recalibrating surface EMG pattern recognition for neuroprosthesis control based on convolutional neural network," *Frontiers in Neuroscience*, vol. 11, no. 379, 2017.
- [7] B. Cao, J. Wang, M. Shahed, **B. Jelfs**, R. H. M. Chan, and Y. Li, "Vagus nerve stimulation alters phase synchrony of the anterior cingulate cortex and facilitates decision making in rats," *Scientific Reports*, vol. 6, no. 35135, 2016.
- [8] Y. Gao, G. Zhang, **B. Jelfs**, R. Carmer, P. Venkatraman, M. Ghadami, S. A. Brown, C. P. Pang, Y. F. Leung, R. H. M. Chan, and M. Zhang, "Computational classification of different wild-type zebrafish strains based on their variation in light-induced locomotor response," *Computers in Biology and Medicine*, vol. 69, pp. 1–9, 2016.
- [9] B. Cao, J. Wang, X. Zhang, X. Yang, D. C.-H. Poon, **B. Jelfs**, R. H. M. Chan, J. C.-Y. Wu, and Y. Li, "Impairment of decision making and disruption of synchrony between basolateral amygdala and anterior cingulate cortex in the maternally separated rat," *Neurobiology of Learning and Memory*, vol. 136, pp. 74–85, 2016.
- [10] J. Wang, B. Cao, T. R. Yu, **B. Jelfs**, J. Yan, R. H. M. Chan, and Y. Li, "Theta-frequency phase-locking of single anterior cingulate cortex neurons and synchronization with the medial thalamus are modulated by visceral noxious stimulation in rats," *Neuroscience*, vol. 298, pp. 200–210, 2015.
- [11] L. Mu, J. Wang, B. Cao, **B. Jelfs**, R. H. M. Chan, X. Xu, M. Hasan, X. Zhang, and Y. Li, "Impairment of cognitive function by chemotherapy: Association with the disruption of phase-locking and synchronization in anterior cingulate cortex," *Molecular Brain*, vol. 8, no. 32, 2015.

- [12] **B. Jelfs** and D. P. Mandic, "A unifying framework for the analysis of proportionate nlms algorithms," *International Journal of Adaptive Control and Signal Processing*, vol. 29, no. 9, pp. 1073–1085, 2014.
- [13] **B. Jelfs**, M. Banaji, I. Tachtsidis, C. E. Cooper, and C. E. Elwell, "Modelling noninvasively measured cerebral signals during a hypoxemia challenge: Steps towards individualised modelling," *PLoS ONE*, vol. 7, no. 6:e38297, 2012.
- [14] **B. Jelfs**, D. P. Mandic, and S. C. Douglas, "An adaptive approach for the identification of improper complex signals," *Signal Processing*, vol. 92, no. 2, pp. 335–344, 2012.
- [15] L. Li, Y. Xia, **B. Jelfs**, J. Cao, and D. P. Mandic, "Modelling of brain consciousness based on collaborative adaptive filters," *Neurocomputing*, vol. 76, no. 1, pp. 36–43, 2012.
- [16] Y. Xia, **B. Jelfs**, M. M. V. Hulle, J. C. Principe, and D. P. Mandic, "An augmented echo state network for nonlinear adaptive filtering of complex noncircular signals," *IEEE Transactions on Neural Networks*, vol. 22, no. 1, pp. 74–83, 2011.
- [17] **B. Jelfs**, S. Javidi, P. Vayanos, and D. Mandic, "Characterisation of signal modality: Exploiting signal nonlinearity in machine learning and signal processing," *Journal of Signal Processing Systems*, vol. 61, no. 1, pp. 105–115, 2010.

### Book Chapters

- [1] **B. Jelfs**, P. Vayanos, S. Javidi, V. S. L. Goh, and D. Mandic, "Collaborative adaptive filters for online knowledge extraction and information fusion," in *Signal Processing Techniques for Knowledge Extraction and Information Fusion*, D. Mandic et al., Ed. Springer, 2008, pp. 3–21.
- [2] P. Vayanos, M. Chen, **B. Jelfs**, and D. P. Mandic, "Exploiting nonlinearity in adaptive signal processing," in *Advances in Nonlinear Speech Processing*, M. Chetouani et al., Ed. Springer Berlin Heidelberg, 2007, pp. 57–77.
- [3] **B. Jelfs**, P. Vayanos, M. Chen, S. L. Goh, C. Boukis, T. Gautama, T. Rutkowski, T. Kuh, and D. Mandic, "An online method for detecting nonlinearity within a signal," in *Knowledge-Based Intelligent Information and Engineering Systems*, B. Gabrys et al., Ed. Springer Berlin Heidelberg, 2006, pp. 1216–1223.

### Peer Reviewed Conference Proceedings

- [1] **B. Jelfs** and C. Gilliam, "Application of image processing and circular statistics to 3d cellular alignment," in *Proc. Asia-Pacific Signal and Information Processing Association Annual Summit and Conference*, 2020.
- [2] **B. Jelfs** and C. Gilliam, "Fast & efficient delay estimation using local all-pass & kalman filters," in *Proc. Asia-Pacific Signal and Information Processing Association Annual Summit and Conference*, 2019, pp. 1533–1539.
- [3] R. Viswanathan, A. Bingham, S. Raghav, S. P. Arjunan, **B. Jelfs**, P. Kempster, and D. K. Kumar, "Normalized mutual information of phonetic sound to distinguish the speech of parkinson's disease," in *Proc. Annual International Conference of the IEEE Engineering in Medicine and Biology Society*, 2019, pp. 3525–3526.
- [4] C. Gilliam and **B. Jelfs**, "Estimating muscle fibre conduction velocity in the presence of array misalignment," in *Proc. Asia-Pacific Signal and Information Processing Association Annual Summit and Conference*, 2018, pp. 853–860.
- [5] A. Bingham, **B. Jelfs**, S. P. Arjunan, and D. K. Kumar, "Identifying noisy electrodes in high density surface electromyography recordings through analysis of spatial similarities," in *Proc. Annual*

*International Conference of the IEEE Engineering in Medicine and Biology Society*, 2018, pp. 2325–2328.

- [6] C. Gilliam, A. Bingham, T. Blu, and **B. Jelfs**, “Time-varying delay estimation using common local all-pass filters with application to surface electromyography,” in *Proc. IEEE International Conference on Acoustics, Speech and Signal Processing*, 2018, pp. 841–845.
- [7] S. Bhowmik, **B. Jelfs**, S. P. Arjunan, and D. K. Kumar, “Outlier removal in facial surface electromyography through hampel filtering technique,” in *Proc. IEEE Life Sciences Conference*, 2017, pp. 258–261.
- [8] Y. Li, **B. Jelfs**, and R. H. Chan, “Entropy of surface EMG reflects object weight in grasp-and-lift task,” in *Proc. Annual International Conference of the IEEE Engineering in Medicine and Biology Society*, 2017, pp. 2530–2533.
- [9] W. K. Y. So, L. Yang, **B. Jelfs**, Q. She, S. W. H. Wong, J. N. Mak, and R. H. M. Chan, “Cross-frequency information transfer from EEG to EMG in grasping,” in *Proc. Annual International Conference of the IEEE Engineering in Medicine and Biology Society*, 2016, pp. 4531–4534.
- [10] X. Zhai, **B. Jelfs**, R. H. M. Chan, and C. Tin, “Short latency hand movement classification based on surface EMG spectrogram with PCA,” in *Proc. Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC)*, 2016, pp. 327–330.
- [11] **B. Jelfs**, L. Li, C. Tin, and R. H. M. Chan, “Fuzzy entropy based nonnegative matrix factorization for muscle synergy extraction,” in *Proc. IEEE International Conference on Acoustics, Speech and Signal Processing*, 2016, pp. 739–743.
- [12] **B. Jelfs**, S. Zhou, B. K. Y. Wong, C. Tin, and R. H. M. Chan, “Recruitment of small synergistic movement makes a good pianist,” in *Proc. Annual International Conference of the IEEE Engineering in Medicine and Biology Society*, 2015, pp. 242–245.
- [13] **B. Jelfs**, J. Panovska-Griffiths, I. Tachtsidis, M. Banaji, and C. Elwell, “Individualised optimisation of modelled cerebral oxygenation near-infrared spectroscopy signals,” in *Biomedical Optics and 3-D Imaging*, no. JM3A.32, 2012.
- [14] S. Javidi, **B. Jelfs**, and D. P. Mandic, “Blind extraction of noncircular complex signals using a widely linear predictor,” in *Proc. IEEE Workshop on Statistical Signal Processing*, 2009, pp. 501–504.
- [15] **B. Jelfs**, Y. Xia, D. P. Mandic, and S. C. Douglas, “Collaborative adaptive filtering in the complex domain,” in *Proc. IEEE Workshop on Machine Learning for Signal Processing*, 2008, pp. 421–425.
- [16] **B. Jelfs** and D. Mandic, “Signal modality characterisation using collaborative adaptive filters,” in *Proc. IAPR Workshop on Cognitive Information Processing*, 2008.
- [17] D. P. Mandic, P. Vayanos, S. Javidi, **B. Jelfs**, and K. Aihara, “Online tracking of the degree of nonlinearity within complex signals,” in *Proc. IEEE International Conference on Acoustics, Speech and Signal Processing*, 2008, pp. 2061–2064.
- [18] **B. Jelfs**, D. P. Mandic, and A. Cichocki, “A unifying approach to the derivation of the class of PNLMS algorithms,” in *Proc. International Conference on Digital Signal Processing*, 2007, pp. 35–38.
- [19] **B. Jelfs**, D. P. Mandic, and J. Benesty, “A class of adaptively regularised PNLMS algorithms,” in *Proc. International Conference on Digital Signal Processing*, 2007, pp. 19–22.
- [20] D. Mandic, P. Vayanos, C. Boukis, **B. Jelfs**, S. L. Goh, T. Gautama, and T. Rutkowski, “Collaborative adaptive learning using hybrid filters,” in *Proc. IEEE International Conference on Acoustics, Speech and Signal Processing*, 2007, pp. 921–924.

- [21] M. Chen, T. Rutkowski, **B. Jelfs**, G. Souretis, J. Cao, and D. Mandic, "Assessment of nonlinearity in brain electrical activity: A dvv approach," in *Proc. RISP International Workshop on Nonlinear Circuits and Signal Processing*, 2007, pp. 461–464.
- [22] **B. Jelfs** and D. Mandic, "Towards online monitoring of the changes in signal modality: The degree of sparsity," in *Proc. IMA International Conference on Mathematics in Signal Processing*, 2006, pp. 29–32.
- [23] F. Schlindwein, A. Boardman, S. Vali, N. Wright, **B. Jelfs**, S. Mauger, A. Das, J. Waugh, R. Pannerai, and D. Evans, "Noninvasive determination of fetal heart rate and short term heart rate variability using solely doppler ultrasound with autocorrelation," in *Proc. International Conference on Medical Signal & Information Processing*, 2004.