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EMPLOYMENT

Since 2012 | **Research Associate/Research Fellow** — UNIVERSITY OF BRISTOL

I have won and worked within projects on AI-enhanced video compression, video quality assessment, perceptual video coding, intelligent creative technologies and drone cinematography.

EDUCATION

2008-2012	**PhD** in Electrical and Electronic Engineering	UNIVERSITY OF BRISTOL
2005-2008	**MEng** in Electronic Engineering	SHANGHAI JIAO TONG UNIVERSITY
2001-2005	**BEng (Hons)** in Electronic Engineering	SHANGHAI JIAO TONG UNIVERSITY

RESEARCH INTERESTS

Since 2016 | **Deep Video Coding**
–AI-enhanced deep video compression
–New CNN architectures for compression and perceptual loss functions
–New training methods and databases
–Reduced complexity architectures

Since 2012 | **Creative Technology**
–Video production workflows
–Immersive (HDR/HFR/HSR/360°/volumetric) video coding and quality assessment
–AI-based perceptual format adaptation and post-processing

Since 2010 | **Video Quality Assessment**
–Full reference/reduce reference quality metrics
–Machine learning based quality metrics
–HVS property characterisation and subjective quality assessment
–Crowd-sourced subjective testing

Since 2008 | **Perceptual Video Coding**
–Content-aware compression
–Rate quality optimisation and adaptive RDO/quantisation

MAJOR RESEARCH OUTPUT

DEEP VIDEO CODING

2019-2020 | **[RO1] MFRNet: a new CNN architecture for post processing and in-loop filters**
–This work offers superior coding gains over VVC but with relatively low complexity.
–It has been published in the IEEE J. Sel. Topics Signal Process. [11].

2018-2020 **[RO2] BVI-DVC: a training database for deep video compression [8]**
–It offers optimal training performance among all existing training databases.
–It has been formally adopted by MPEG for developing VVC neural network based tools.

2019-2020 **[RO3] Low complexity CNN-based spatial resolution adaptation [23]**
–This approach offers a trade-off solution between complexity and performance.
–It enables flexible complexity allocation between the encoder and decoder.
–The results show significant coding gains coupled with reduced complexity.

2018-2020 **[RO4] CVEGAN: a perceptual-inspired GAN for video compression**
–It features a new GAN architecture and perceptual loss functions.
–It significantly improves the coding performance of various compression tools.
–A paper related to this work is under review by IEEE CVPR 2020 [6].

2016-2019 **[RO5] ViSTRA: a compression framework based on resolution adaptation**
–It features intelligent resolution adaptation and CNN-based super resolution [10].
–It was submitted to MPEG JVET as a proposal for VVC, which was one of the single tools providing the most significant gains [3].
–It won the IEEE ICIP 2017 Video Compression Grand Challenge.

CREATIVE TECHNOLOGY

2017-2018 **[RO6] FRQM and SRQM: immersive video quality metrics**
–Published two bespoke quality metrics for resolution adaptations [37, 39].

2016-2018 **[RO7] BVI-HFR and BVI-SR: immersive video databases**
–Published two immersive video datasets associated with subjective data [13, 36].
–They have been downloaded for more than 100 times.
–This work was partially funded by BBC.

2015-2016 **[RO8] What's on TV: a large-scale study of modern broadcast video content**
–A comprehensive analysis of the videos in contemporary broadcast video [44].
–This work was based on the collaboration with BBC and the experts in Psychology.

2012-2014 **[RO9] BBC-Bristol Immersive Technology Laboratory**
–We developed stable production workflows for high dynamic range video processing, across content acquisition, post-production, delivery and experience [50].
–I worked with vision experts in Engineering, Psychology and Cinematography from UoB and BBC.

VIDEO QUALITY ASSESSMENT

2016-2018 **[RO10] BVI-HD: a subjective database on compressed video content**
–A large HD database for video compression evaluation and quality assessment.
–It has been published in the IEEE Trans. on Multimedia [14].
–The database has also been published online with more than 200 downloads.
–This project was based on the collaboration with the experts in Psychology.

2014-2016 **[RO11] A study on optimal video duration for subjective quality assessment**
–Two journal papers related to this work have been published in the IEEE Trans. on Multimedia and Elsevier Signal Processing: Image Communication [18, 19].
–This work was based on the results of a MSc project and an undergraduate internship project which I co-supervised.

2011-2013 **[RO12] PVM: a perceptual quality metric for video compression**
–This work exploits various human visual system properties and achieves superior correlation with subjective data compared to the state of the art.
–It is one of few quality metrics that works well with synthesis-based video coding.
–A paper related to this work has been published in the IEEE Trans. on CSVT [20].

PERCEPTUAL VIDEO CODING

2012-2015 **[RO13] Adaptive Lagrange multipliers and quantisation for RDO**
–A novel content-aware approach developed for rate-distortion optimisation.
–A paper related to this work has been published in the IEEE Trans. on CSVT [17].

2008-2011 **[RO14] Perceptual video compression using texture synthesis (PhD project)**
–It offered the best coding performance among approaches of this type.
–A paper has been published in the IEEE J. Sel. Topics in Signal Process. [22].
–It also led to the collaboration between UoB and Fraunhofer HHI Berlin, based on which we published a joint journal paper [21].

OTHER RESEARCH OUTPUT

2017-2019 **[RO15] UAV Cinematography simulation and parameterisation**
–A workflow has been proposed to build a user-friendly simulation tool based on realistic background environments and selectable foreground assets [24, 29].
–Typical UAV shot type grammar has been refined with optimal flight parameters obtained through subjective experiments [32].
–This work was based on the collaboration with academic and industrial partners including Thales, Aristotle University of Thessaloniki, University of Seville, Deutsche Welle, RAI and Instituto Superior Técnico.
–It led to further funding from EPSRC IAA on the commercial exploitation.

EDITORSHIP AND REVIEWING

2021-2022	IEEE Trans. on Circuits and Systems for Video Technology	ASSOCIATE EDITOR
2021	Picture Coding Symposium	META REVIEWER
Since 2020	Proceedings of IEEE	REVIEWER
Since 2019	IEEE Access	REVIEWER
Since 2018	IEEE Transactions on Broadcasting	REVIEWER
Since 2018	IEEE Transactions on Multimedia	REVIEWER
Since 2015	IEEE Transactions on Circuits and Systems for Video Technology	REVIEWER
Since 2015	IEEE Transactions on Image Processing	REVIEWER
Since 2014	IEEE Signal Processing Letters	REVIEWER
Since 2013	Elsevier Signal Processing: Image Communication	REVIEWER
Since 2019	Picture Coding Symposium	REVIEWER
Since 2019	European Signal Processing Conference (EUSIPCO)	REVIEWER
Since 2016	IEEE International Conference on Image Processing (ICIP)	REVIEWER
Since 2014	IEEE International Conference on VCIP	REVIEWER
Since 2012	IEEE International Conference on Multimedia and Expo (ICME)	REVIEWER

ESTEEM

2017	**1st Prize** in IEEE ICIP Video Compression Grand Challenge	BEIJING
2008-2011	Overseas Research Students Awards Scheme Scholarship	BRISTOL
2007	**2nd Prize** in National Instruments VI Cup	SHANGHAI
2006	**3rd Prize** in Texas Instruments DSP Contest	CHINA

PUBLICATIONS

Books and Chapters

[1] D. Bull and F. Zhang, "Intelligent image and video compression: Communicating pictures," Academic Press, 2 ed., In Press
[2] F. Zhang and D. R. Bull, "Measuring video quality," in *Academic Press Library in Signal Processing* (S. Theodoridis and R. Chellappa, eds.), vol. 5, ch. 7, pp. 227–249, Oxford: Acaddemic Press, 2014

Standard Proposals

[3] D. Bull, F. Zhang, and M. Afonso, "Description of SDR video coding technology proposal by University of Bristol (JVET-J0031)," in *the JVET meeting*, no. JVET-J0031, (San Diego, US), ITU-T and ISO/IEC, April 2018
[4] M. Papadopoulos, F. Zhang, D. Agrafiotis, D. Bull, and J.-R. Ohm, "BVI-Texture UHD 120fps test sequences for HEVC and beyond (JCTVC-V0099)," in *the JVET meeting*, no. JCTVC-V0099, (Geneva, CH), ITU-T and ISO/IEC, October 2015

Patent Pending

[5] D. Bull, F. Zhang, and M. Afonso, "Video processing method," 2017 (ViSTRA)

arXiv

[6] D. Ma, F. Zhang, and D. R. Bull, "CVEGAN: a perceptually-inspired GAN for compressed video enhancement," *arXiv preprint arXiv:2011.09190 (submitted to IEEE CVPR 2021)*, 2020
[7] F. Zhang, D. Ma, C. Feng, and D. R. Bull, "Video compression with CNN-based post processing," *arXiv preprint arXiv:2009.07583 (submitted to IEEE Multimedia Magazine - after minor revision)*, 2020
[8] D. Ma, F. Zhang, and D. R. Bull, "BVI-DVC: A training database for deep video compression," *arXiv preprint arXiv:2003.13552 (submitted to IEEE Trans. on Multimedia)*, 2020
[9] F. Zhang, A. V. Katsenou, M. Afonso, G. Dimitrov, and D. R. Bull, "Comparing VVC, HEVC and AV1 using objective and subjective assessments," *arXiv preprint arXiv:2003.10282*, 2020
[10] F. Zhang, M. Afonso, and D. R. Bull, "ViSTRA2: Video coding using spatial resolution and effective bit depth adaptation," *arXiv preprint arXiv:1911.02833 (submitted to Elsevier Signal Processing: Image Communication)*, 2019

Journal Papers

[11] D. Ma, F. Zhang, and D. R. Bull, "MFRNet: a new CNN architecture for post-processing and in-loop filtering," *IEEE Journal of Selected Topics in Signal Processing*, Accepted
[12] M. Afonso, F. Zhang, and D. R. Bull, "Video compression based on spatio-temporal resolution adaptation," *IEEE Transactions on Circuits and Systems for Video Technology*, vol. 29, pp. 275–280, January 2019
[13] A. Mackin, F. Zhang, and D. R. Bull, "A study of high frame rate video formats," *IEEE Transactions on Multimedia*, vol. 21, pp. 1499–1512, June 2019
[14] F. Zhang, F. Mercer Moss, R. Baddeley, and D. R. Bull, "BVI-HD: A video quality database for HEVC compressed and texture synthesised content," *IEEE Transactions on Multimedia*, vol. 20, pp. 2620–2630, October 2018
[15] A. V. Katsenou, A. Mackin, D. Ma, F. Zhang, and D. R. Bull, "Exploring the challenges of higher frame rates: from quality assessment to frame rate selection," *IEEE COMSOC MMTC Communications - Frontiers E-Letter*, vol. 13, pp. 5–10, May 2018
[16] F. D. A. Rahman, D. Agrafiotis, O. O. Khalifa, and F. Zhang, "Reduced-reference video quality metric using spatial information in salient regions," *Telkomnika*, vol. 16, no. 3, 2018

[17] F. Zhang and D. R. Bull, “Rate-distortion optimization using adaptive lagrange multipliers,” *IEEE Transactions on Circuits and Systems for Video Technology*, vol. 29, no. 10, pp. 3121–3131, 2018
[18] F. Mercer Moss, C.-T. Yeh, F. Zhang, R. Baddeley, and D. R. Bull, “Support for reduced presentation durations in subjective video quality assessment,” *Signal Processing: Image Communication*, vol. 48, pp. 38–49, 2016
[19] F. Mercer Moss, K. Wang, F. Zhang, R. Baddeley, and D. R. Bull, “On the optimal presentation duration for subjective video quality assessment,” *IEEE Transactions on Circuits and Systems for Video Technology*, vol. 26, no. 11, pp. 1977–1987, 2016
[20] F. Zhang and D. R. Bull, “A perception-based hybrid model for video quality assessment,” *IEEE Transactions on Circuits and Systems for Video Technology*, vol. 26, no. 6, pp. 1017–1028, 2016
[21] P. Ndjiki-Nya, D. Doshkov, H. Kaprykowsky, F. Zhang, D. Bull, and T. Wiegand, “Perception-oriented video coding based on image analysis and completion: a review,” *Signal Processing: Image Communication*, vol. 27, pp. 579–594, 2012
[22] F. Zhang and D. R. Bull, “A parametric framework for video compression using region-based texture models,” *IEEE Journal of Selected Topics in Signal Processing*, vol. 5, no. 7, pp. 1378–1392, 2011

Conference Papers

[23] D. Ma, F. Zhang, and D. R. Bull, “Video compression with low complexity CNN-based spatial resolution adaptation,” in *Applications of Digital Image Processing XLIII*, vol. 11510, p. 115100D, International Society for Optics and Photonics, 2020
[24] F. Zhang, D. Hall, T. Xu, S. Boyle, and D. Bull, “A simulation environment for drone cinematography,” in *International Broadcasting Convention (IBC)*, 2020
[25] D. Ma, F. Zhang, and D. R. Bull, “GAN-based effective bit depth adaptation for perceptual video compression,” in *Proc. IEEE Int Conf. on Multimedia & Expo*, 2020
[26] F. Zhang, C. Feng, and D. R. Bull, “Enhancing VVC through CNN-based post-processing,” in *Proc. IEEE Int Conf. on Multimedia & Expo*, 2020
[27] N. Anantrasirichai, F. Zhang, A. Malyugina, P. Hill, and A. Katsenou, “Encoding in the dark grand challenge: an overview,” in *IEEE International Conference on Multimedia & Expo Workshops (ICMEW)*, IEEE, 2020
[28] D. Ma, M. F. Afonso, F. Zhang, and D. R. Bull, “Perceptually-inspired super-resolution of compressed videos,” in *Applications of Digital Image Processing XLII*, vol. 11137, p. 1113717, International Society for Optics and Photonics, 2019
[29] S. Boyle, M. Newton, F. Zhang, and D. R. Bull, “Environment capture and simulation for UAV cinematography planning and training,” in *EUSIPCO*, 2019
[30] A. Mackin, F. Zhang, and D. R. Bull, “A frame rate conversion method based on a virtual shutter angle,” in *Proc. IEEE Int Conf. on Image Processing*, 2019
[31] F. Zhang, M. Afonso, and D. R. Bull, “Enhanced video compression based on effective bit depth adaptation,” in *Proc. IEEE Int Conf. on Image Processing*, pp. 1720–1724, 2019
[32] S. Boyle, F. Zhang, and D. R. Bull, “A subjective study of viewing experience for drone videos,” in *Proc. IEEE Int Conf. on Image Processing*, IEEE, 2019
[33] A. V. Katsenou, F. Zhang, M. Afonso, and D. R. Bull, “A subjective comparison of AV1 and HEVC for adaptive video streaming,” in *Proc. IEEE Int Conf. on Image Processing*, pp. 4145–4149, 2019
[34] M. Afonso, F. Zhang, and D. R. Bull, “Spatial resolution adaptation framework for video compression,” in *Proc. SPIE, Applications of Digital Image Processing XLI*, vol. 10752, p. 107520L, International Society for Optics and Photonics, 2018
[35] A. Messina, S. Metta, M. Montagnuolo, F. Negro, V. Mygdalis, I. Pitas, J. Capitán, A. Torres, S. Boyle, D. Bull, and F. Zhang, “The future of media production through multi-drones‘ eyes,” in *International Broadcasting Convention (IBC)*, 2018

[36] A. Mackin, F. Zhang, and D. Bull, “A study of subjective video quality at various spatial resolutions,” in *Proc. IEEE Int Conf. on Image Processing*, pp. 2830–2834, IEEE, 2018
[37] A. Mackin, M. Afonso, F. Zhang, and D. Bull, “SRQM: A video quality metric for spatial resolution adaptation,” in *Picture Coding Symposium (PCS)*, pp. 283–287, IEEE, 2018
[38] M. Afonso, F. Zhang, A. Katsenou, D. Agrafiotis, and D. Bull, “Low complexity video coding based on spatial resolution adaptation,” in *Proc. IEEE Int Conf. on Image Processing*, pp. 3011–3015, IEEE, 2017
[39] F. Zhang, A. Mackin, and D. R. Bull, “A frame rate dependant quality model based on temporal wavelet decomposition and spatiotemporal pooling,” in *Proc. IEEE Int Conf. on Image Processing*, IEEE, 2017
[40] A. Mackin, F. Zhang, M. A. Papadopoulos, and D. Bull, “Investigating the impact of high frame rates on video compression,” in *Proc. IEEE Int Conf. on Image Processing*, IEEE, 2017
[41] M. Afonso, A. Katsenou, F. Zhang, D. Agrafiotis, and D. Bull, “Video texture analysis based on HEVC encoding statistics,” in *Picture Coding Symposium (PCS)*, 2016
[42] M. A. Papadopoulos, F. Zhang, D. Agrafiotis, and D. R. Bull, “An adaptive QP offset determination method for HEVC,” in *Proc. IEEE Int Conf. on Image Processing*, IEEE, 2016
[43] F. Zhang and D. R. Bull, “HEVC enhancement using content-based local QP selection,” in *Proc. IEEE Int Conf. on Image Processing*, IEEE, 2016
[44] F. Mercer Moss, F. Zhang, R. Baddeley, and D. R. Bull, “What is on TV: A large scale quantitative characterisation of modern broadcast video content,” in *Proc. IEEE Int Conf. on Image Processing*, IEEE, 2016
[45] F. Mercer Moss, K. Wang, F. Zhang, R. Baddeley, and D. Bull, “Optimal sequence duration for subjective video quality assessment,” in *SPIE Optical Engineering+ Applications*, pp. 959915–959915, IEEE, 2015
[46] M. A. Papadopoulos, F. Zhang, D. Agrafiotis, and D. R. Bull, “A video texture database for perceptual compression and quality assessment,” in *Proc. IEEE Int Conf. on Image Processing*, pp. 2781–2785, IEEE, 2015
[47] A. Mackin, F. Zhang, and D. R. Bull, “A study of subjective video quality at various frame rates,” in *Proc. IEEE Int Conf. on Image Processing*, IEEE, 2015
[48] F. Zhang and D. R. Bull, “An adaptive Lagrange multiplier determination method for rate-distortion optimisation in hybrid video codecs,” in *Proc. IEEE Int Conf. on Image Processing*, IEEE, 2015
[49] M. Wang, F. Zhang, and D. Agrafiotis, “A very low complexity reduced reference video quality metric based on spatio-temporal information selection,” in *Proc. IEEE Int Conf. on Image Processing*, IEEE, 2015
[50] M. Price, D. Bull, T. Flaxton, S. Hinde, R. Salmon, A. Sheikh, G. Thomas, and F. Zhang, “Production of high dynamic range video,” in *International Broadcasting Convention (IBC)*, 2013
[51] F. Zhang and D. Bull, “Quality assessment method for perceptual video compression,” in *Proc. IEEE Int Conf. on Image Processing*, pp. 39–43, 2013
[52] F. Zhang and D. R. Bull, “Advances in region-based texture modelling for video compression,” in *Proc. SPIE 8135*, SPIE, 2011
[53] F. Zhang and D. R. Bull, “Enhanced video compression with region-based texture models,” in *Picture Coding Symposium (PCS)*, pp. 54–57, IEEE, 2010
[54] F. Zhang, D. R. Bull, and N. Canagarajah, “Region-based texture modelling for next generation video codecs,” in *Proc. IEEE Int Conf. on Image Processing*, pp. 2593–2596, IEEE, 2010