MATTHEW KING-HANG MA

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RESEARCH SUMMARY

Ph.D. in Electronic Engineering with interdisciplinary research integrating cognitive neuroscience, **digital signal processing**, and **generative AI**. Recent projects focus on modeling **EEG signals** with stimuli features, including LLM-derived ones, to investigate how ageing and cognitive decline affect human **speech and language** processing. Parallel work involves analyzing the layer-wise **inner working mechanism** of **LLMs** via homonym disambiguation. Broader experience includes developing deep learning models for brain age prediction (**structural MRI**), investigating the linguistic function of the cerebellum (**fMRI**), and assessing EEG feature reliability. Core technical competencies include experimental design, hands-on EEG data collection, statistical modeling, signal processing and the implementation of **deep learning models**. Experienced in grant applications, managing funded projects and interdisciplinary collaborations.

EDUCATION

2023	**The Chinese University of Hong Kong**, *PhD* Electronic Engineering, DSP & Speech Technology Laboratory (DSP-STL).
2015	**The Chinese University of Hong Kong**, *BEng (First-Class Honours)* Biomedical Engineering.

WORK EXPERIENCE

03/2023 – Present	**The Hong Kong Polytechnic University**, *Postdoctoral Fellow* Research Centre for Language, Cognition and Neuroscience, Department of Language Science and Technology PolyU Distinguished Postdoctoral Fellow HKRGC Postdoctoral Fellow
02/2023 – 03/2023	**The Hong Kong Polytechnic University**, *Research Associate* Research Centre for Language, Cognition and Neuroscience, Department of Chinese and Bilingual Studies
08/2015 – 07/2016	**The Chinese University of Hong Kong**, *Research Assistant* DSP & Speech Technology Laboratory (DSP-STL), Department of Electronic Engineering

PREPRINTS AND SUBMITTED MANUSCRIPTS

2026	**Ma, M. K-H.**, Fong, M. C.-M., & Wang, W. S. (2026). *A Path Toward Reproducibility: A Dual Perspective on Resting-State EEG Network Characteristics* [Manuscript

submitted for publication]. Department of Language Science and Technology, The Hong Kong Polytechnic University.

2026 **Ma, M. K.-H.**, Feng, Y.*, Li, C. P.-H.*, & Fong, M. C.-M. (2026). *More than a feeling: Expressive style influences cortical speech tracking in subjective cognitive decline* (No. arXiv:2509.21277). arXiv.

2025 Wang, B., **Ma, M. K-H.**, Huang, S. (2025). *Evidential Value of Cantonese Filled Pause in Forensic Voice Comparison – A comparison between acoustic phonetic and automatic speaker recognition systems*. [Manuscript submitted for publication]. Department of English and Communication, The Hong Kong Polytechnic University.

ENGINEERING AND DEVELOPMENT

2022 **Deep Learning-Based Voice Reconstruction for Laryngectomy Patients**: Initiated a **rehabilitation project** to help patients with their vocal cord removed as a part of treatment of their tongue, laryngeal or esophageal cancers. The team successfully developed and delivered a **deep learning text-to-speech system** to synthesize the patients' voice. The project has been reported and shared in local news [1], television programme [2] and university [3].
[1] 信報財經新聞. (2022, May 20). 中大電子工程學系教授李丹 為失聲者留下獨有聲線 (潘天惠). *EJ Tech*.
[2] i-cable. (2022, March 6). 【小事大意義】留住媽媽聲線：患舌癌須切除聲帶 大學團隊用 AI 為兒子留住媽媽聲線. *有線寬頻 i-CABLE*.
[3] *留住媽媽的聲音 | 善衡書院電子通訊*. (2022, November 9). https://www.shho.cuhk.edu.hk/tc/newsdetails/19679/

GRANT/FUNDING

2025 **Departmental Collaborative Research Fund (DCRF) (HKPolyU, 2025 – 2028, $500,000)**: The effects of combined tDCS and conversation therapy on language and cognitive performance of people with mild cognitive impairment with integration of a multimodal analyzer.

- PI: Prof. WONG Min Ney**.**
- Served as Co-I.

2023 **HKRGC Postdoctoral Fellowship Scheme (HKRGC, 2023 – 2026, $1351,352):** Attention and Attrition: Neural Speech Tracking of L1 and L2 Speech in Ageing Bilinguals.

- PI: Prof. WANG William Shiyuan
- Conceptualized the study, wrote the proposal, and conducted all primary research and analysis.

2022 **Inter-Faculty Collaboration Scheme for FH, FHSS and FENG (HKPolyU, 2022 – 2024, $489,934)**: What can we learn of subjective cognitive decline (SCD) from discourse comprehension? A neural speech tracking study.

- PI: Prof. WANG William Shiyuan

- Conceptualized the study, wrote the proposal, and conducted all primary research and analysis.

2021 **Dean's Reserve (HKPolyU, 2021 – 2023, $100,000)**: Complexity of electroencephalographic responses to speech and music: a comparison between patients with Alzheimer's disease and cognitively normal adults.

- PI: Prof. WANG William Shiyuan
- Conceptualized the study, wrote the proposal, and conducted all primary research and analysis.

SELECTED PUBLICATIONS

2026 **Ma, M. K.-H.**, Fong, M. C.-M., Feng, Y., Li, C. P.-H., & Wang, W. S. (Accepted, expected 2026). Keep Calm and Listen: Subjective Cognitive Decline Modulates Cortical Tracking of Speech and Music in Different Expressive Styles. *Speech Prosody 2026*.

2025 **Ma, M. K.-H.***, Xie, C.*, Wang, W., & Wang, W. S. (2025). Exploring Layer-wise Representations of English and Chinese Homonymy in Pre-trained Language Models. *Findings of the Association for Computational Linguistics: ACL 2025*, 19705–19724.

2025 Xie, C.*, **Ma, M. K.-H.***, Wang, W., & Wang, W. S. (2025). Context and POS in Action: A Comparative Study of Chinese Homonym Disambiguation in Human and Language Models. In C. Christodoulopoulos, T. Chakraborty, C. Rose, & V. Peng (Eds.), *Proceedings of the 2025 Conference on Empirical Methods in Natural Language Processing* (pp. 27596–27613). Association for Computational Linguistics.

2025 **Ma, M. K-H.**, Fong, M. C.-M., & Wang, W. S. (2025). A reliability study in resting-state EEG network characteristics: frequency of interest, number of oscillatory cycles and thresholding. *2025 47th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC)*.

2025 Rilliard, A. de Moraes, J. A., Erickson, D. Guerry, M., Hönemann, A., Lee, T., **Ma, M. K-H.**, Mixdorff, H., Rao, P., Shochi, T. (2025). Cross-cultural dimensions organizing prosodic attitudes reception: a meta-analysis of free labeling studies. *Journal of Speech Sciences*, *14*(00), e025012.

2025 Fong, M. C.-M., **Ma, M. K.-H.**, Ng, X. S.-W., Liu, J. C. H., Waye, M. M. Y., Chien, W. T., & Wang, W. S. (2025). Regional Brain Age Measures Based on Convolutional Neural Networks (CNNs)—Symmetry Properties and Associations with Fluid and Crystallized Intelligence. *2025 47th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC)*.

2025 Fong, M. C.-M., Liu, J. C. H., **Ma, M. K.-H.**, Ng, X. S.-W., Hui, C. L. L., Waye, M. M. Y., Chien, W. T., & Wang, W. S. (2025). Predicting Intelligence Profile and Brain Age with Single- and Dual-Channel Cnns: A Study Based on Human Connectome Projects. *2025 IEEE 22nd International Symposium on Biomedical Imaging (ISBI)*, 1–6.

2024 Wang, J., Wang, S., Fong, M. C.-M., **Ma, M. K. H.**, & Wang, W. S. Y. (2024). What Can Complex Systems Theory Tell Us About Understanding in the Human–AI Communication System? *2024 6th International Conference on Natural Language Processing (ICNLP)*, 650–656.

2023 **Ma, M. K.-H.** (2023). Six-Year Longitudinal Changes in EEG Spectral Characteristics

of a Healthy Older Individual. *In Inspirations from a Lofty Mountain: Festschrift in Honor of Professor William S.-Y. Wang on his 90th Birthday*.

2023 Xie, C., Fong, M. C.-M., **Ma, M. K.-H.**, Wang, J., & Wang, W. S. (2023). The retrogenesis of age-related decline in declarative and procedural memory. *Frontiers in Psychology*, 14.

2022 Fong, M. C-M., **Ma, M. K-H.**, Chui, J. Y. T., Law, T. S. T., Hui, N-Y., Au, A., & Wang, W. S. (2022). Foreign language learning in older adults: anatomical and cognitive markers of vocabulary learning success. *Frontiers in Human Neuroscience*, *16*, 787413.

2021 **Ma, M. K-H.**, Fong, M. C.-M., Xie, C., Lee, T., Chen, G., & Wang, W. S. (2021). Regularity and randomness in ageing: Differences in resting-state EEG complexity measured by largest Lyapunov exponent. *Neuroimage: Reports*, *1*(4), 100054.

2021 Fong, M. C.-M., Law, T. S.-T., **Ma, M. K.-H.**, Hui, N. Y., & Wang, W. S. (2021). Can inhibition deficit hypothesis account for age-related differences in semantic fluency? Converging evidence from Stroop color and word test and an ERP flanker task. *Brain and Language*, *218*, 104952.

2020 **Ma, M. K-H.**, Lee, T., Fong, M. C-M., & Wang, W. S. (2020). Resting-State EEG-Based Biometrics with Signals Features Extracted by Multivariate Empirical Mode Decomposition. *ICASSP 2020 - 2020 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)*, 991–995.

2020 Fong, M. C.-M., Hui, N. Y., Fung, E. S.-W., **Ma, M. K.-H.**, Law, T. S.-T., Wang, X., & Wang, W. S. (2020). Which cognitive functions subserve clustering and switching in category fluency? Generalisations from an extended set of semantic categories using linear mixed-effects modelling. *Quarterly Journal of Experimental Psychology*, *73*(12), 2132–2147

2018 Mixdorff, H., Rilliard, A., Lee, T., **Ma, M. K. H.**, & Hönemann, A. (2018). Cross-cultural (A)symmetries in Audio-visual Attitude Perception. *Interspeech 2018*, 426–430.

2018 Lee, T., **Ma, K. H. M.**, Rilliard, A., Mixdorff, H., & Hönemann, A. (2018). Free Labeling of Audio-visual Attitudinal Expressions in Cantonese. *Speech Prosody 2018*, 483–487.

2017 Mixdorff, H., Hönemann, A., Rilliard, A., Lee, T., & **Ma, M.** (2017). Cross-Language Perception of Audio-visual Attitudinal Expressions. *The 14th International Conference on Auditory-Visual Speech Processing*, 119–124.

2017 Mixdorff, H., Hönemann, A., Rilliard, A., Lee, T., & **Ma, M. K.** (2017). Audio-visual expressions of attitude: How many different attitudes can perceivers decode? *Speech Communication*, *95*, 114–126.

INVITED TALKS

2024 **Introduction to EEG/ERP analysis**. *CBS596 Neurolinguistics. HKPolyU.*

2023 **Age-related trajectory of resting-state EEG: spectral characteristics and signal complexity.** *1st RISA Symposium on Brain Ageing, Imaging and Stimulation. HKPolyU*.

TEACHING

Fall 2019	**Signal and Systems (Teaching Assistant)**. Instructor: Prof. LEE Tan. *CUHK*.
Fall 2018	**Introduction to Embedded System (Teaching Assistant)**. Instructor: Mr. YIP Kim Fung. *CUHK*.
Spring 2017	**Introduction to Electric Power Systems (Teaching Assistant)**. Instructor: Prof. LOH, Poh Chiang. *CUHK*.
Fall 2016	**Signal and Systems (Teaching Assistant)**. Instructor: Prof. LEE Tan. *CUHK*.

SELECTED ORAL/POSTER PRESENTATIONS

2023	**Ma, M. K.-H.**, Fong, M. C.-M., & Wang, W. S. (2023, May 8). *Lempel-Ziv complexity shows inverted U-shaped pattern across the adult lifespan* [Poster]. PolyU Academy for Interdisciplinary Research (PAIR) Conference, Hong Kong.
2023	**Ma, M. K.-H.**, Fong, M. C.-M., Lee, T., & Wang, W. S. (2023, August 20). *Resting-state EEG complexity: Antagonistic associations with cognition pre- and post-middle age* [Oral]. BrainConnects2023, Ho Chi Minh City, Vietnam.
2022	**Ma, M. K.-H.**, Fong, M. C.-M., Lee, T., & Wang, W. S. (2022, August 8). *Disentangling broadband EEG microstates into frequency-specific features of ageing* [Poster]. BrainConnects2022, Nagoya, Japan.
2020	**Ma, M. K.-H.**, Lee, T., Fong, M. C.-M., & Wang, W. S. (2020, May 2). *Using multivariate empirical mode decomposition to analyze broad-band EEG microstates*. 27th Annual Meeting, Cognitive Neuroscience Society, San Francisco, United States.
2019	**Ma, M. K.-H.**, Lee, T., Fong, M. C.-M., Hui, N. Y., & Wang, W. S. (2019, March 23). *Reliability of resting-state EEG spectral power—Advantage of normalization is not guaranteed* [Poster]. 26th Annual Meeting, Cognitive Neuroscience Society, San Francisco, United States.

SELECTED AWARDS

2023	**HKRGC Postdoctoral Fellowship**, *Hong Kong Research Grant Council*
2023	**PolyU Distinguished Postdoctoral Fellowship**, *HKPolyU*
2023	**Young Investigator Award**, *BrainConnects2023*
2022	**CUHK Outstanding Student Award**, *CUHK*
2022	**Excellent Presentation Award**, *BrainConnects2022*
2020	**Endeavour Merit Award 2019/2020**, *Hong Kong Government Scholarship Fund*
2020	**PCCW-HKT Scholarship**, *PCCW*
2020	**Tutor with Commendation**, *CUHK*

UNIVERSITY AND COMMUNITY SERVICES

2019	**Hong Kong Primary and Secondary Schools STEM Robotics Competition 2019 (Student Organizer)**, *CUHK*