



## CHENG KANG

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### PROFILE

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During my Master's and Doctoral studies over the past 10 years (2014-2024), I developed a non-invasive brain-computer interface-based depression grading diagnosis system. This system can be embedded into LLMs to achieve multimodal interconnection. This toolkit was applied to LLMs, enhancing their multimodality performance in time-series signal analysis, particularly in medical time-series signals.

During my Doctoral studies (2020-2025), I conducted in-depth research on the theoretical foundations of artificial intelligence, especially artificial neural networks, including the currently popular large models. This opens a new door for the development, design, evaluation, and optimization of artificial intelligence in the industry.

### EXPERIENCE

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#### PhD Student, Junior Researcher

[Czech Technical University](#) · Prague 📍

📅 Sep 2020 ▶ Now

♦ Artificial Intelligence and Bio-cybernetics:

- Enhanced GLUE benchmark and SQuAD performance by approximately 5% compared to LoRA using a newly developed Shunting Inhibition Mechanism for language model adaptation;
- Engineered a novel Assistant Instruction framework for large language models, specifically tailored for application in psychotherapy. This work resulted in a significant enhancement of the models' professional psychotherapy knowledge;
- Presented findings that vector-quantized embeddings can enhance controllable diffusion language models, leading to faster convergence and reduced perplexity;
- Implemented analysis on why generation models have hallucination by using the Laplace transform, identifying that a vibration of the learning progress is the essential reason. Provided a practical solution to optimize the hallucination of generation models.

#### Algorithm and System Engineer

[Shenzhen Dymind Biotechnology Co.](#) · Shenzhen, China

📅 Sep 2019 ▶ Sep 2020

Hematology Analyzer (blood cells counting + inflammatory markers):

- Developed a new system to measure the number of blood cells and the inflammatory levels for pets;

#### Algorithm Engineer


[Wuhan Zoncare Bio-medical Electronics Co., Ltd.](#) · Wuhan, China

📅 Sep 2017 ▶ Sep 2018

Medical 12-lead electrocardiograms and AI:

- Helped senior engineers to develop a 12-lead ECG device that can automatically warn heart disease using artificial neural networks.

## Research Assistant

Li Ka Shing Faculty of Medicine in the University of Hong Kong · Hong Kong  Aug 2016 ▶ Aug 2019  
Brain-computer interface (BCI) systems using non-invasive EEG signals:

- Applied brain dynamics (functional brain networks) to analyze the abnormality of depressed people, and found new biomarkers.
- Designed a new non-invasive framework to measure the human brain dynamics under working memory tasks.

## EDUCATION

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**PhD, Czech Technical University** · Prague, Czech Republic   Sep 2020 ▶ Now

*Department of Cybernetics, CIIRC, Faculty of Elektrotechnická*


Major in Computer Science

Courses: (1) Practical Data Mining Problems; (2) Statistical Method in Natural Language Processing; (3) Deep Learning; (4) Bioinformatics; (5) Introduction to Computer Vision.

**MSc. Shenzhen University** · Shenzhen, China  Sep 2013 ▶ Jun 2016

*Department of Control Engineering and Cybernetics*

Major in Engineering

**B.S. Weifang University of Science and Technology** · Weifang, China  Sep 2009 ▶ Jun 2013

*Faculty of Electrical Engineering and Automatization*

Major in Engineering

## ADDITIONAL EDUCATION

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**Visiting Study, University of Leicester** · Leicester, United Kingdom  Sep 2018 ▶ Sep 2019

*School of Computing and Mathematic Sciences*

Major: Computer Sciences

Courses: (1) Distributed System; (2) Big Data and Predictive Analytics.

**Visiting Study, University of Hong Kong** · Hong Kong  Aug 2016 ▶ Aug 2017

*Li Ka Shing Faculty of Medicine*

Major: Biomedical Signal Processing and Machine Learning

## PROJECTS

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### Research Center for Informatics

supported by EU (CZ.02.1.01/0.0/0.0/16\_019/0000765)

Czech Technical University · Prague

 Sep 2019 ▶ Nov 2024

The goal of RCI is to foster collaboration between the experts in different fields of computer science, between fundamental scientists and application-driven researchers.

#### My Duty:

- To optimize language models using neuroscience knowledge (**Tools:** Python, SQL);
- To analyze the stability and controllability of Artificial Neural Networks on various optimization components (**Tools:** Python, MATLAB);
- To develop a psychotherapy chatbot by using language models (**Tools:** Python, JavaScript);

### Brain Dynamics

supported by EU and Czechia (CZ.02.01.01/00/22\_008/0004643)

Czech Technical University and National Mental Health Center in Prague · Prague 📍 📅 Oct 2024 ▶ Now  
 To understand what information is exchanged, in terms of brain recordings, the nature and the mechanisms of brain computation.

### *My Duty:*

- To construct functional brain networks via Granger causality, Transfer Entropy, Directed Information (*Tools*: MATLAB, eeglib);
- To bridge the connection between language models and EEG signals via open-source large language models (*Tools*: Python, MATLAB);
- To understand hidden specific information transfer dynamics in neural communication (*Tools*: Python, MATLAB, C/C++);

### PUBLICATIONS

\*=FIRST CO-AUTHOR, #=CORRESPONDING AUTHOR

1. Yao, X.\*; **Kang, C.\***; Zhang, X.; Wang, S.; Zhang, Y#. (2025). FuzH-PID: Highly Controllable and Stable DNN for COVID-19 Detection via Improved Stochastic Optimization. *Expert Systems with Applications* (2025): 126323.
2. **Kang, C.#**; Prokop, J.; Tong, L.; Zhou, H.; Hu, Y.; Novak, D. (2024). InA: Inhibition Adaption on pre-trained language models. *Neural Networks*, 178, 106410.  
<https://doi.org/10.1016/j.neunet.2024.106410>
3. **Kang, C.#**; Novak, D.; Urbanova, K.; Cheng, Y.; Hu, Y. (2024). Domain-Specific Improvement on Psychotherapy Chatbot Using Assistant. 2024 IEEE International Conference on Acoustics, Speech, and Signal Processing Workshops, Seoul, Republic of Korea, 2024, pp. 351-355, doi: 10.1109/ICASSPW62465.2024.10626529.
4. **Kang, C.#**; Cheng, X.; Novak, D.; Yao, X. (2024, December). Using Laplace Transform to Optimize the Hallucination of Generation Models. In 2024 18th International Conference on Control, Automation, Robotics and Vision (ICARCV) (pp. 447-453). IEEE.
5. Carson, E., Chen, X.#, & **Kang, C.** (2024). Quantized symbolic time series approximation. arXiv preprint [arXiv:2411.15209](https://arxiv.org/abs/2411.15209).
6. Carson, E.; Chen, X.; **Kang, C.#**. (2024). LLM-ABBA: Understanding time series via symbolic approximation. arXiv preprint [arXiv:2411.18506](https://arxiv.org/abs/2411.18506).
7. **Kang, C.\***, Yao, X.\* (2023). Based on What We Can Control Artificial Neural Networks. arXiv preprint [arXiv:2310.05692](https://arxiv.org/abs/2310.05692).
8. **Kang, C.#**, Chen, X., Hu, Y., & Novak, D. (2024). Quantized Embedding Vectors for Controllable Diffusion Language Models. arXiv preprint [arXiv:2402.10107](https://arxiv.org/abs/2402.10107).
9. **Kang, C.**; Novak, D.; Yao, X.; Xie, J.; Hu, Y#. (2023). Classifying and Scoring Major Depressive Disorders by Residual Neural Networks on Specific Frequencies and Brain Regions. *IEEE Trans Neural Syst Rehabil Eng.* 2023;31:2964-2973.
10. **Kang, C.#**; Yao, X.; Novak, D. (2023). Fuzzy Windows with Gaussian Process Labels for Ordinal Image Scoring Tasks. *Appl. Sci.* 2023, 13, 4019.

11. Yao, X.; Zhu, Z.; **Kang, C.**; Wang, S.; Gorriz, J.; Zhang, Y#. (2022). AdaD-FNN for Chest CT-Based COVID-19 Diagnosis. IEEE Transactions on Emerging Topics in Computational Intelligence, doi: 10.1109/TETCI.2022.3174868.
12. Yu, X.; **Kang, C.**; Guttery, DS; Kadry, S.; Chen, Y.; Zhang, Y#. (2020). ResNet-SCDA-50 for breast abnormality classification. IEEE / ACM transactions on computational biology and bioinformatics, vol. 18, no. 1, pp. 94-102, 1 Jan.-Feb. 2021, doi: 10.1109/TCBB.2020.2986544.
13. **Kang, C.\***; Li, Y.\*; Novak, D.; Zhang, Y.; Zhou, Q.; Hu, Y#. (2020). Brain Networks of Maintenance, Inhibition and Disinhibition During Working Memory. IEEE Transactions on Neural Systems and Rehabilitation Engineering, vol. 28, no. 7, pp. 1518-1527, July 2020.
14. **Kang, C.**; Yu, X.; Wang, S. H.; Guttery, D.; Pandey, H.; Tian, Y.; Zhang, Y#. (2020). A heuristic neural network structure relying on fuzzy logic for images scoring. IEEE Transactions on Fuzzy Systems., vol. 29, no. 1, pp. 34-45, Jan. 2021, doi: 10.1109/TFUZZ.2020.2966163.
15. Cui, H.; Li, H.; Li, G.; **Kang, C.**; Yao, X.; Feng, S.; Hu, Y#. (2019). Utility of trial-to-trial latency variability of somatosensory evoked potentials for diagnosis of spinal cord demyelination. Journal of neurotrauma, 36(24), 3356-3362, doi: 10.1089/neu.2018.6293.
16. Li, Y.\*; **Kang, C.\***; Wei, Z.; Qu, X.; Liu, T.; Zhou, Y.; Hu, Y#. (2017). Beta oscillations in major depression – signaling a new cortical circuit for central executive function. Scientific reports, 7 (1), 1-15, doi: 10.1038/s41598-017-18306-w.
17. Li, Y.\*; **Kang, C.\***; Qu, X.; Zhou, Y.; Wang, W.; Hu, Y#. (2016). Depression-related brain connectivity analyzed by EEG event-related phase synchrony measure. Frontiers in human neuroscience, 10, 477, doi: 10.3389/fnhum.2016.00477.

## TECHNICAL BLOGS

Embedding Neural Networks into Devices.	📅 Mar 2023
Fine-Tune Language Models: Instruction Tuning;	📅 Sep 2022
Medical Conversation and Diagnosis Chatbot: Conversation (A);	📅 Mar 2022
Medical Conversation and Diagnosis Chatbot: Diagnosis (B);	📅 Mar 2022
Basic Deep Learning Knowledge;	📅 Nov 2021
HRV for Sleep Scoring and Pressure Evaluating;	📅 Dec 2018

## SKILLS

</> Program Language	📖 Knowledge	📖 Open Libraries	🔧 Software	🗣️ Language
Python	Deep Learning	Pytorch	Pycharm	Mandarin
C/C++	NLP and LLM	SciPy	VS C++	English
MATLAB	Machine Learning	NumPy	CMake	Cantonese
SQL	Computer Vision	TensorFlow	Eclipse	
Java	Statistics	...	...	

Beginner Average Pro Master Contributor