Yuuki Tachioka, Ph.D.

- Senior Researcher | LLMs, Multimodal AI, Recommendation, Knowledge-Augmented Systems, and Physics-Constrained AI Tokyo, Japan
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Professional Summary

Senior industrial AI researcher with over 17 years of experience in speech, language, multimodal recognition, recommender systems, information retrieval, and human-centered information access technologies. My current research focuses on knowledge- and constraint-aware AI systems: analyzing LLM behavior through information theory, improving recommendation with structured knowledge, grounding generation through retrieval, understanding multimodal documents, and incorporating physical constraints into generative models.

My recent work includes an ACL 2026 paper on diagnosing LLM behavior via information spectrum analysis, RecSys papers on knowledge prompting for recommendation, work on retrieval-augmented generation, semantic understanding of texts and tables, and physics-constrained diffusion models for wireless propagation. I also conduct 6G-oriented radio propagation research and numerical wave simulation verification.

I currently lead industry-academia collaborations on retrieval-augmented generation with Hitotsubashi University and multimodal recognition with the University of Tsukuba. My earlier research background includes speech enhancement, automatic speech recognition, speech synthesis, spoken dialogue systems, and practical speech interfaces. I have authored 1 book, 21 peer-reviewed journal papers, and over 70 international conference papers.

I specialize in bridging theoretical analysis, academic research, and deployable industrial AI systems using PyTorch, Python, Ubuntu/Linux, and research-oriented software prototyping.

Research Vision

My recent research is centered on how to make modern AI systems more reliable, efficient, interpretable, and grounded by incorporating external knowledge, structural information, multimodal evidence, and domain constraints.

This includes information-theoretic analysis of LLM behavior, knowledge-augmented recommendation with lightweight LLMs, retrieval-augmented generation over structured and unstructured knowledge sources, multimodal document understanding for figures and tables, and physics-constrained generative modeling for wireless propagation and 6G-oriented AI systems.

Research Interests

- Information-theoretic analysis of large language models
- Information spectrum theory for understanding LLM behavior
- Knowledge-augmented recommendation with lightweight LLMs
- Retrieval-augmented generation and document-grounded AI systems

- Multimodal document understanding, including figures, tables, and visually rich documents
- Text-table understanding and structured knowledge extraction
- Knowledge graphs for recommendation and information access
- Multimodal recognition and human-centered AI systems
- Physics-constrained generative modeling
- Diffusion models for wireless propagation and 6G-oriented AI systems
- Wave simulation verification and computational mechanics
- Practical deployment of AI technologies in industrial environments
- Spoken dialogue systems and voice-based interaction

Education

Tokyo Institute of Technology

Ph.D. in Engineering, Department of Information and Communications Engineering, School of Engineering
April 2017 – March 2018

Nihon University

B.A. in Japanese Language and Literature, College of Humanities and Sciences April 2011 – March 2014

The University of Tokyo

M.Env., Department of Socio-Cultural Environmental Studies, Graduate School of Frontier Sciences April 2006 – March 2008

The University of Tokyo

B.Eng., Department of Architecture, School of Engineering April 2002 – March 2006

Professional Experience

Denso IT Laboratory, Inc. — Senior Researcher

Tokyo, Japan April 2022 – Present

- Conduct research on large language models, multimodal AI, recommender systems, retrieval-augmented generation, multimodal document understanding, and 6G-oriented AI systems.
- Published an ACL 2026 paper analyzing LLM behavior using information spectrum theory, focusing on tail behavior and the effects of side information.
- Published RecSys-related work on efficient knowledge-augmented recommendation using lightweight LLMs and dynamic knowledge prompting.
- Conduct research on multimodal document understanding, including text-table relatedness, joint triple extraction from texts and tables, and semantic annotation of table cells.
- Lead industry-academia collaboration on retrieval-augmented generation with Hitotsubashi University.
- Lead industry-academia collaboration on multimodal recognition with the University of Tsukuba.
- Conduct 6G-oriented radio propagation research, including path loss map estimation with vision transformers and constraint-guided diffusion models.
- Explore physics-constrained generative modeling and wave simulation verification for physically grounded AI systems.

- Develop and evaluate deep learning models and research prototypes using PyTorch, Python, and Ubuntu/Linux environments.
- Coordinate cross-disciplinary research connecting LLM analysis, knowledge graphs, recommendation, retrieval, multimodal recognition, wireless propagation, and human-centered AI applications.

Denso IT Laboratory, Inc. — Researcher

Tokyo, Japan April 2018 – March 2022

- Conducted research on speech enhancement, automatic emotion recognition, speech synthesis, and spoken dialogue systems.
- Expanded research from speech recognition and synthesis toward dialogue systems, information retrieval, and user-facing AI interfaces.
- Developed spoken dialogue technologies by integrating speech-related technologies, information retrieval, and dialogue management.
- Published research results in peer-reviewed journals and international conferences.

Denso IT Laboratory, Inc. — Associate Researcher

Tokyo, Japan May 2017 – March 2018

- Conducted research and development on speech enhancement, automatic speech recognition, speech synthesis, and spoken dialogue systems.
- Worked on practical speech and dialogue technologies for real-world applications.

Mitsubishi Electric Corporation, Information Technology R&D Center — Researcher

Kamakura, Japan April 2008 – April 2017

- Conducted research and development on speech enhancement technologies and automatic speech recognition systems.
- Contributed to a Japanese automatic speech recognition system that achieved state-of-the-art performance on the Corpus of Spontaneous Japanese task.
- Developed speech recognition technology used in elevator systems, which received broad media coverage in newspapers and television.
- Built practical speech recognition systems by combining academic research, open-source software, and product-oriented engineering.
- Worked as a visiting researcher at Mitsubishi Electric Research Laboratories in the United States from November 2012 to February 2013.

Mitsubishi Electric Research Laboratories — Visiting Researcher

Cambridge, MA, USA November 2012 – February 2013

- Conducted collaborative research on speech recognition technologies with researchers at Mitsubishi Electric Research Laboratories.
- Gained experience working in an international industrial research environment.

Selected Recent Research Themes

LLM Analysis and Causal Reasoning

- Analyze LLM behavior using information spectrum theory, focusing on tail behavior and the effects of side information.
- Study LLM uncertainty, output characteristics, and generation behavior from an information-theoretic perspective.
- Develop precision-oriented causal reasoning methods using per-option surprisal and multi-stage gating.
- Representative publications:
    - Y. Tachioka, “Diagnosing LLMs via Information Spectrum Analysis: Tail Behavior and the Effects of Side Information,” ACL 2026.
    - Y. Terao and Y. Tachioka, “d-itlab at SemEval-2026 Task 12: Per-Option Surprisal and Multi-Stage Gating for Precision-Oriented Causal Reasoning,” SemEval 2026 @ ACL 2026.
    - Y. Tachioka, “Question Answer Summary Generation from Unstructured Texts by Using LLMs,” DASFAA 2024 Workshop.

Knowledge-Augmented Recommendation and User Modeling

- Develop recommendation methods that combine lightweight LLMs, knowledge graphs, user knowledge, venue knowledge, and behavioral representations.
- Dynamically inject knowledge graph information into prompts to improve both recommendation accuracy and inference efficiency.
- Study sequential recommendation, POI recommendation, knowledge work productivity, and universal user embeddings.
- Representative publications:
    - Y. Tachioka, “KP4POI: Efficient POI Recommendation on Large-Scale Datasets via Knowledge Prompting of Venues and Users,” RecSys 2025 Workshop on Recommenders in Tourism.
    - Y. Tachioka, “User Knowledge Prompt for Sequential Recommendation,” RecSys 2024 Late-Breaking Results.
    - Y. Tachioka, “Benchmarking Predictive and Recommendation Models for Knowledge Work Productivity on the RLKWiC Dataset,” RecSys 2025 Workshop on Recommender Systems for Human Resources.
    - Y. Tachioka, “Contrastive Learning of Temporal and Event-Based Behavioral Views for Universal User Embeddings,” APSIPA 2025.
    - Y. Tachioka, “Conditioning of Variational Autoencoder by User Traits for Item Recommendation,” RecSys 2023 Workshop.

Retrieval-Augmented Generation and Information Access

- Study retrieval-augmented generation for knowledge-intensive and document-grounded tasks.
- Develop methods for combining multiple retrieved contexts and reasoning paths inside LLMs.

- Contribute to evaluation tasks and test collections for Japanese information access technologies.
- Representative publications:
    - Y. Tachioka, “Fusion-in-LLM: A Parallel Approach to Improve Retrieval-Augmented Generation for Quiz-Based Question Answering,” NLDB 2025.
    - H. Joho, A. Keyaki, Y. Tachioka, and S. Yamamoto, “Overview of the NTCIR-18 Transfer-2 Task,” NTCIR-18, 2025.
    - Y. Tachioka and Y. Terao, “ditlab at the NTCIR-18 Transfer-2,” NTCIR-18, 2025.
    - H. Joho, A. Keyaki, Y. Tachioka, and S. Yamamoto, “Building Test Collections for Japanese Dense Information Retrieval Technologies and Beyond,” EMTCIR 2024.

Multimodal Document Understanding and Structured Knowledge Extraction

- Conduct research on understanding visually rich documents that include text, tables, figures, layouts, and structured information.
- Develop methods for text-table relatedness, table serialization, triple extraction, and cell entity annotation.
- Explore document structures that remain challenging for current LLMs and vision-language models.
- Representative publications:
    - Y. Tachioka, “Typed Candidate Generation and Neural Verification for Joint Triple Extraction from Texts and Tables,” Triplet Challenge @ ESWC 2026.
    - Y. Tachioka, “Candidate-Aware Table Serialization and Cross-Encoder Ranking for Table–Text Relatedness,” Triplet Challenge @ ESWC 2026.
    - Y. Tachioka and Y. Terao, “Cell Entity Annotation for SemTab 2025 MammoTab via Iterative Refinement with Transposed Contexts and Unsupervised Scoring,” ISWC 2025 Challenge.
    - Y. Tachioka, “Restoration of Hyperspectral Images from RGB Images by Using Two-Band Models,” ICCCM 2024.

Physics-Constrained AI, Wireless Propagation, and 6G-Oriented Modeling

- Conduct AI-based radio propagation research toward the 6G era.
- Develop wireless path loss map estimation methods using vision transformers, direct wave power integration, and constraint-guided diffusion.
- Explore training-free and physics-constrained generative modeling for physically grounded prediction.
- Study spatiotemporal error-scale estimation for solution verification of time-domain wave simulations.
- Representative publications:
    - Y. Tachioka, “Training-Free Constraint-Guided Diffusion for One-Shot Path Loss Map Estimation,” IEEE VTC 2026-Spring.
    - Y. Tachioka, “Enhancing Pathloss Estimation with Vision Transformers and Direct Wave Power Integration,” EUSIPCO 2025.

    - Y. Tachioka, “Spatiotemporal Error-Scale Estimation for Solution Verification of Time-Domain Wave Simulations,” WCCM-ECCOMAS 2026.
    - Y. Tachioka, “Impulse Response Classification Based on Persistent Homology,” TDA Week 2023.
    - Y. Tachioka, “Impulse Response Classification Focusing on Geometrical Structures,” ICA 2022.

Earlier Speech, Audio, and Spoken Dialogue Research

- Developed a state-of-the-art Japanese automatic speech recognition system using open-source software.
- Contributed to a system that achieved top performance on the Corpus of Spontaneous Japanese task, which was reported by Nikkei Shimbun, Nikkei Electronics, and Nikkan Kogyo Shimbun.
- Developed speech recognition technology for elevator systems, which was widely reported by newspapers and television.
- Conducted research on speech enhancement, speech recognition, speech synthesis, emotion recognition, spoken dialogue systems, audio watermarking, anomalous sound detection, and pronunciation scoring.
- Built practical technologies ranging from core algorithms to real-world systems.

Selected Recent Publications

- Y. Tachioka, “Diagnosing LLMs via Information Spectrum Analysis: Tail Behavior and the Effects of Side Information,” ACL 2026.
- Y. Terao and Y. Tachioka, “d-itlab at SemEval-2026 Task 12: Per-Option Surprisal and Multi-Stage Gating for Precision-Oriented Causal Reasoning,” SemEval 2026 @ ACL 2026.
- Y. Tachioka, “KP4POI: Efficient POI Recommendation on Large-Scale Datasets via Knowledge Prompting of Venues and Users,” RecSys 2025 Workshop on Recommenders in Tourism.
- Y. Tachioka, “User Knowledge Prompt for Sequential Recommendation,” RecSys 2024 Late-Breaking Results.
- Y. Tachioka, “Fusion-in-LLM: A Parallel Approach to Improve Retrieval-Augmented Generation for Quiz-Based Question Answering,” NLDB 2025.
- Y. Tachioka, “Typed Candidate Generation and Neural Verification for Joint Triple Extraction from Texts and Tables,” Triplet Challenge @ ESWC 2026.
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- Y. Tachioka, “Training-Free Constraint-Guided Diffusion for One-Shot Path Loss Map Estimation,” IEEE VTC 2026-Spring.
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- Y. Tachioka, “Benchmarking Predictive and Recommendation Models for Knowledge Work Productivity on the RLKWiC Dataset,” RecSys 2025 Workshop on Recommender Systems for Human Resources.
- Y. Tachioka, “Contrastive Learning of Temporal and Event-Based Behavioral Views for Universal User Embeddings,” APSIPA 2025.
- Y. Tachioka, “Spatiotemporal Error-Scale Estimation for Solution Verification of Time-Domain Wave Simulations,” WCCM-ECCOMAS 2026.

Academic Activities

- Authored 1 book, 21 peer-reviewed journal papers, and over 70 international conference papers.
- Senior member of the Information Processing Society of Japan.
- Served as a reviewer for journals including IEEE/ACM Transactions on Audio, Speech, and Language Processing, Speech Communication, and EURASIP Journal.
- Served as a reviewer for international conferences including ICASSP, ASRU, SLT, INTERSPEECH, and APSIPA.
- Full publication list available at: http://ytachioka.github.io/pub_en.html

Technical Skills

Research Areas

- Large language models
- Information-theoretic analysis of AI systems
- Information spectrum theory
- Multimodal AI
- Multimodal document understanding
- Text-table understanding
- Figure and table understanding
- Structured knowledge extraction
- Recommender systems
- Knowledge-augmented recommendation
- Knowledge graphs
- Retrieval-augmented generation
- Information retrieval
- Multimodal recognition
- Physics-constrained generative modeling
- Diffusion models
- Wireless propagation modeling
- 6G-oriented AI systems
- Computational wave simulation
- Speech and language processing
- Spoken dialogue systems
- Human-centered AI systems

Machine Learning and Research Engineering

- Deep learning
- Multimodal modeling
- Representation learning
- Generative modeling
- Contrastive learning
- Variational autoencoders
- Vision transformers
- Cross-encoder ranking
- Experimental design

- Benchmarking and evaluation
- Research prototype development
- Implementation of algorithms from academic papers

Programming and Development Environments

- Python
- PyTorch
- Ubuntu/Linux
- Bash
- C/C++
- MATLAB
- Perl

Previous Systems Experience

- Automatic speech recognition systems
- Speech enhancement systems
- Speech synthesis and spoken dialogue systems
- Desktop application development
- Android application development
- Embedded system applications
- μITRON-based development

Collaboration and Research Leadership

- Industry-academia collaboration
- Cross-disciplinary research coordination
- International conference publication
- Journal and conference peer review
- Research planning and experimental evaluation

Awards and Honors

- Master Thesis Award, Department of Socio-Cultural Environmental Studies, Graduate School of Frontier Sciences, The University of Tokyo, March 2008
- 19th Excellent Master's Thesis Prize, Architectural Institute of Japan, September 2008
- 35th Awaya Prize, Acoustical Society of Japan, March 2014
- Research Encouragement Award, IEICE Technical Committee on Speech, August 2017
- ISPACS 2018 Best Paper Award, November 2018
- IPSJ Yamashita SIG Research Award, March 2021
- Elevated to Senior Member, Information Processing Society of Japan, September 2021
- IEEE GCCE 2022 Excellent Paper Award, Gold Prize, December 2022

Representative Keywords

Large language models, information spectrum theory, multimodal AI, multimodal document understanding, text-table understanding, figure understanding, table understanding, structured knowledge extraction, knowledge-augmented recommendation, recommender systems, knowledge graphs, retrieval-augmented

generation, document-grounded AI, information retrieval, multimodal recognition, diffusion models, physics-constrained generative modeling, 6G, wireless propagation, path loss estimation, computational wave simulation, human-centered AI, spoken dialogue systems, industrial AI research, PyTorch, research-to-product translation.