### **Curriculum Vitae**

Tomohiro Hayase Ph.D. (Mathematical Sciences)

Researcher @ Fujitsu Artificial Intelligence Laboratories
Part-time Lecturer @ Ochanomizu University
<a href="https://thayafluss.github.io/">https://thayafluss.github.io/</a>

I have been studying machine learning and deep learning with a mathematical approach and its application to computer vision. Aiming at the rich fusion of physical space and information space (CG space) through information processing, I am advancing into the research and development of XR, starting with virtual reality.

#### **Education**

- 1. 2019, Mar. Ph.D. (Mathematical Science) Graduate School of Mathematical Sciences, The University of Tokyo (Supervisor: Yasuyuki, Kawahigashi)
- 2. 2014, Mar. Bachelor (Science) The University of Tokyo

#### Grant

2019~ JST ACT-X Research of Deep Learning via Free Probability Theory (Co-investigator) 2020~ JSPS Sakura Program Application of Random matrices and random tensors to quantum information and machine learning (Principal investigator: Motohisa Fukuda)

#### **Award**

The Mathematical Society of Japan, Cross-disciplinary and Cross-industrial Research Exchange Meeting 2018, Best Poster Award.

### **Overview of Projects**

### **Computer Vision**

- Parameter compression of neural networks for object recognition & detection for edge devices. (@Morpho). In particular, dimension-estimation / reduction with variational Bayesian matrix decomposition or random matrix theory [5].
- Detection of domain shift (@ Fujitsu Lab.). The algorithm is based on MCD (Maximum Classifier Discrepancy) and Bayesian Regression, and we got a patent.
- Research of unsupervised contrastive Learning (@ Fujitsu Lab.)
- cvpaper.challenge survey-team.

### **Deep Learning Theory**

- Theoretical research of learning dynamics of neural networks (@ PFN JST ACT-X). Mean field theory, neural tangent kernel, information geometry [3].
- Continual Learning (@ Fujitsu Lab.) [4]

#### **Virtual Reality**

- Viewpoint Planning of Projector Placement for Spatial Augmented Reality using Star-Kernel Decomposition (JST ACT-X) [1]
- Development of open-source virtual blackboard for a VRSNS [github, booth]
- Provision of VR blackboard to the Virtual Conference 2020 and poster presentation [Poster, PB4-1].
- A staff of virtual conference 2020.
- Contributed to the Journal of Virtual Reality Society of Japan [C3].
- Generation of avatar motions

### **Work Experience**

# 2019, May — Now, Researcher, Fujitsu Artificial Intelligence Laboratories.



Theoretical & applied research about deep learning. Assistance in infrastructure preservation (Docker & Nginx & Grafana & k8s). Mentoring of interns.

1. Detection of domain shift with maximum classifier discrepancy and Bayesian regression. (A patent) .

- 2. Selective forgetting of deep neural network for continual learning with information geometry[2].
- 3. Continual Learning[4].

In theoretical researches, we got grants JST ACT-X \( \subset JSPS \) Sakura Program and studied mean field theory, neural tangent kernel, information geometry of deep neural networks:

- 1. Learning rate[3]
- 2. Identity initialization and interpretability [2]

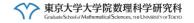
In addition, we studied VR[1].

### 2020, Nov. — Now, Part-time Lecturer, Department of Information Science, Ochanomizu University.



Lectures on entropy, codes, and communication in information theory

# 2019, Mar. ~ Aug. Collaborative Research Fellow, Graduate School of Mathematical Sciences, The University of Tokyo.



The research of deep learning theory.

### 2018, Jul. ~ Sep. Intern, Preferred Networks, inc.



The research of deep learning theory. Dimensionality-Reduction, Generative model of images, Network Architecture Search.

### 2017, Sep. ~ Nov. Institute Henri Poincare Student Researcher.



Application of random matrices to quantum information and machine learning.

2016 Apr. ~ 2017, Jul. Morpho, inc. Research Assistant.



Image Recognition, Object Detection, and Compression of DNN.

# 2014 ~ 2015 Teaching Assistant, Department of Mathematics, Faculty of Science, The University of Tokyo.

Fourier Analysis.

# Peer-reviewed International Conference and Journal Papers

- 1. Takefumi Hiraki, <u>Tomohiro Hayase</u>, Yuichi Ike, Takashi Tsuboi, Michio Yoshiwaki,"Viewpoint Planning of Projector Placement for Spatial Augmented Reality using Star-Kernel Decomposition", IEEE VR 2021 (<u>Link to Paper</u>)
- 2. Kubota Shohei, Hideaki Hayashi, <u>Tomohiro Hayase</u>, Seiichi Uchida, "Layer-wise Interpretation of deep neural networks using identity initialization" accepted into ICASSP 2021. (<u>arXiv:2102.13333</u>)
- 3. <u>Tomohiro Hayase</u>, Ryo Karakida, "The Spectrum of Fisher Information of Deep Networks Achieving Dynamical Isometry", accepted into AISTATS2021. (<u>arXiv:2006.07814</u>)
- 4. <u>Tomohiro Hayase</u>, Suguru Yasutomi, Takashi Kato, "Selective Forgetting of Deep Networks at a Finer Level than Samples", accepted into AAAI RSEML2021, (<u>arXiv:2012.11849</u>)
- 5. <u>Tomohiro Hayase</u>, "Cauchy noise loss for stochastic optimization of random matrix models via free deterministic equivalents", Journal of Mathematical Analysis and Applications Vol. 483, Issue 2, 123597 (2020). (<u>arXiv:1804.03154</u> [<u>stat.ML</u>])
- T. Hayase, "Identifiability of parametric random matrix models", Infinite
   Dimensional Analysis, Quantum Probability and Related Topics Vol. 22, No. 03, 1950018 (2019). (arXiv:1812.10678 [math.PR])
- 7. T. Hayase, "Free deterministic equivalent Z-scores of compound Wishart models: A goodness of fit test of 2DARMA models", RMTA, No.08, Issue No. 02. (2019) (arXiv:1710:09497 [math.ST]).
- 8. T. Hayase, "De Finetti theorem for a Boolean anaolgue of easy quantum groups",
  - J. Math. Sci., vol. 24, no. 03, pp. 355~398, 2017 (arXiv:1507.05563 [math.OA]).

### The Other works

- [C1] VR Blackboard (github, booth)
- [C2] How to implement a blackboard for a comfortable seminar in VRChat, The virtual conference 2020 (<u>Poster</u>, PB4-1)
- [C3]Takayuki Kameoka, Lcamu, Takato, Fuji, Katayu, Stera Amano, "Virtual Conference 2020", Virtual Reality Society of Japan Journal 2021, Vol. 26, No. 2, p. 14-20. (<a href="https://www.jstage.jst.go.jp/article/jyrsj/26/2/26\_14/">https://www.jstage.jst.go.jp/article/jyrsj/26/2/26\_14/</a> pdf/-char/ja)