

第 27 回博士後期課程学生発表会・アブストラクト集

The 27th Doctoral Program Student Presentation: Abstracts

2022 年 07 月 15 日 (Friday) 10:25 開始

GoogleMeet にてオンライン開催

はじめに

博士後期課程発表会は、博士後期課程の学生が日頃の研究の成果を発表するために催されるものです。今回の発表会は、通常より人数が多いため、4 つのセッションから構成し、1 セッションにつき 5-6 名の登壇者が発表を行います。**情報科学の最先端**はこの発表会に集約されるものと信じています。

今回の発表会も前年の発表会と同じく GoogleMeet を用いて、オンラインでの開催となります。当日はネット環境や音声関連で様々なトラブルが予想されます。皆様のご協力が必要となる場合もございますので、その際はよろしく願い申し上げます。

今回の発表会でも「**討論者制**」は一旦休止としますが、「**ベストプレゼンテーション賞**」は継続します。ベストプレゼンテーション賞とは、聴衆に対して「自身の研究の内容をわかりやすく伝えられたか、おもしろく伝えられたか」の観点からセッション毎に聴衆の投票で決定されます。今回は用紙での投票を行えないため、セッション終了後の休憩中(10 分間)に GoogleForm にて投票を行っていただきます。

最後に、**発表者以外の多くの方の参加をお待ちしております**。これまでのオフライン開催とは異なり、会場に足を運ぶ必要はございません。いつでもどこにいても、発表を聴講することができます。当日に、事務から発表会招待メールを全教員全学生に送らせていただきますので、是非最先端の研究発表をお聞きください！ もちろん、参加だけでなく、発表に対する質問やコメントもお待ちしております。皆さんで議論を活発化させ、発表会を盛り上げましょう。

Introduction

The Doctoral Program Student Presentation is held for students in the doctoral program to present their research. This presentation will consist of 4 sessions, with 5-6 speakers per session due to the more participants than usual. Certainly, this presentation is a compilation of the cutting edge of the information science.

Following last year, this presentation will be held online using Google Meet. Various troubles are expected on the day due to the internet environment and voice/hearing related problems. It may require everyone's cooperation, and thus, we would appreciate your support.

The “**designated discussant**” system will be again temporarily suspended; however, the “**best presentation award**” system will continue. This award is decided by the audiences' votes for each

session based on the standpoint of “whether the content of research is conveyed comprehensively and interestingly.” Since we cannot vote on paper this time, it will be conducted online during the break (10min.) after the session.

Finally, **we look forward to the participation of many people other than the presenters.** Unlike traditional offline events, this event does not require you to physically come to the venue. It is possible to listen to the presentation anytime anywhere. On the day of the event, the office will circulate an invitation email to all faculty members and students. Please participate and listen to the presentation on the latest research! Of course, we highly welcome questions and comments as well. Let’s liven up the presentation and discussion.

The presentation will be consisted of 15 min. and 5 min. Q and A

プログラム (Program)

10:25-10:30 Opening remarks -開会の辞- 研究科長 加藤寧教授 (Dean Prof. Nei Kato)

10:30-12:10 1st session

- 10:30-10:50 酒井高良 複数ボトルネック出発時刻選択問題を斬る
- 11:10-11:30 Schneider Victor A Lotka-Volterra competition system to discuss the potential prevention of species invasion in a patchy environment
- 11:30-11:50 宋文正 Matching in the Dark: A Dataset for Matching Image Pairs of Low-light Scenes
- 11:30-11:50 Alexander Christian Maas Controllable Difficulty Question Generation for English Reading Comprehension Exercises
- 11:50-12:10 Michael Zielewski Improving Quantum Annealing Efficiency through Monte Carlo Simulations

13:00-14:40 2nd session

- 13:00-13:20 Qian Ye Learning Regularized Multi-Scale Feature Flow for High Dynamic Range Imaging
- 13:20-13:40 小澤悠 不整地における高走破性を実現する弾性履帯式単輪クローラ機構
- 13:40-14:00 Liu Kang-Jun Study of the gap between asymmetric trick and feature decorrelation based representation learning
- 14:00-14:20 Fangzhou Lin Deep learning model for point cloud completion: towards a better way of 3D understanding
- 14:20-14:40 Zou Han Reference-based Motion Blur Removal

14:50-16:30 3rd session

- 14:50-15:10 Zhijie Wang Unsupervised Domain Adaptation for Semantic Segmentation via Cross-Region Alignment
- 15:10-15:30 Zhang Jie Knowledge Distillation for Image Anomaly Detection and Localization
- 15:30-15:50 繆仁軍 Estimation of attention states using facial expressions for online lectures
- 15:50-16:10 Nguyen Van Quang GRIT: Faster and Better Image-captioning Transformer using Dual Features
- 16:10-16:30 丸山尚貴 敵対的訓練におけるモデル容量の統計力学的解析

16:40-18:20 4th session

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|-------------|-------------------|--|
| 16:40-17:00 | LU XIANGYONG | Lightweight Neural Network Design for Resource-Constrained Edge Devices |
| 17:00-17:20 | Golsa Tabe Jamaat | Wall modeling for LES of turbulent channel flow using data-driven approach |
| 17:20-17:40 | 長谷川靖 | ボルツマンマシンを利用したカーネル学習 |
| 17:40-18:00 | Yunhan Du | A generalized human mobility model in realistic labor market conditions |
| 18:00-18:20 | 佐々木翔大 | サブワードに基づく単語埋め込みの縮約モデリング |

18:25-18:30 Closing remarks -閉会の辞- 副研究科長 田中和之教授

(Deputy Dean Prof. Kazuyuki Tanaka)

発表時間内訳(発表 15 分・質疑応答 5 分)

アブストラクト集 (Abstracts)

1st session (10:30-12:10)

氏名:酒井高良

題目:複数ボトルネック出発時刻選択問題を斬る

要約: 出発時刻選択問題とは、道路網上のボトルネックで生じる渋滞ダイナミクスと、その渋滞を避けつつ出来るだけ希望の時刻に目的地へ到着したいと考えるドライバーらの道路利用時刻選択行動との相互作用を記述した数理モデルである。このモデルは、時間依存の渋滞緩和施策の理論基盤として重要であるにも関わらず、その理論体系は単一ボトルネックのみを対象に構築されてきた。本研究では、複数ボトルネックを対象に、均衡状態と最適状態と間に整理する特別な対応関係に焦点を当てて、出発時刻選択問題の理論体系を再構築する。

氏名:Schneider Victor

題目:A Lotka-Volterra competition system to discuss the potential prevention of species invasion in a patchy environment

要約: With the recent changes in ecological environment, many species may gain a chance to invade a new site already hosting native species. In this research project, we consider a classic Lotka-Volterra competition system between two species in the habitat of two patches, where only one of two species can migrate between patches. In our modeling, such a migrating species is regarded as an invading one for the habitat of the other species. Through analytical and numerical model analyses, we can obtain the condition for the success of species invasion, while we discuss a potential disadvantage of the migration for the invading species itself at the same time.

氏名:宋 文正

題目:Matching in the Dark: A Dataset for Matching Image Pairs of Low-light Scenes

要約: This work considers matching images of low-light scenes, aiming to widen the frontier of SfM and visual SLAM applications. Recent image sensors can record the brightness of scenes with more than eight-bit precision, available in their RAW-format image. We are interested in making full use of such high-precision information to match extremely low-light scene images that conventional methods cannot handle. For extreme low-light scenes, even if some of their brightness information exists in the RAW format images' low bits, the standard raw image processing on cameras fails to utilize them properly. As was recently shown by Chen et al., CNNs can learn to produce images with a natural appearance from such RAW-format images. To consider if and how well we can utilize such information stored in RAW-format images for image matching, we have created a new dataset named MID (matching in the dark). Using it, we experimentally evaluated combinations of eight image-enhancing methods and eleven image matching methods consisting of classical/neural local descriptors and classical/neural initial point-matching methods. The results show the advantage of using the RAW-format images and the strengths and weaknesses of the above component methods. They also imply there is room for further research.

氏名:Alexander Christian Maas

題目:Controllable Difficulty Question Generation for English Reading Comprehension Exercises

要約: The purpose of this research is to automatically generate question/answer pairs of varying difficulty or possessing specific, desired traits, such as paraphrasing ability or whole-of-text understanding, according to the specifications of the end-user. While existing research on controllable text generation has focused on the theme of the generated text, they have yet to apply their techniques to generate exercises for language education. To address this lack in the literature, this research will use transformer-based neural networks to first label questions by their latent traits, then these labelled questions are used to train a controlled-generation architecture to create questions with the desired traits.

氏名: Michael Zielewski

題目: Improving Quantum Annealing Efficiency through Monte Carlo Simulations

要約: Quantum annealers are quantum computing devices that employ quantum fluctuations to efficiently search the solution space of an optimization problem. Typical system evolution follows a time-dependent Hamiltonian that gradually changes from an initial Hamiltonian towards a final

Hamiltonian representing the problem to be solved. Modifying how the system evolves, or the annealing schedule, can have a profound impact on performance. One such modification is pausing, in which the Hamiltonian is kept constant for a period of time. Finding the optimal parameters for a pause in a grid search-like fashion uses a significant amount of quantum annealing resources. In this work, we show that results from classical simulations of quantum annealing can be combined with machine learning technologies to produce high quality schedules without using quantum annealing resources.

2nd session (13:00-14:40)

氏名: Qian Ye

題目: Learning Regularized Multi-Scale Feature Flow for High Dynamic Range Imaging

要約: Reconstructing ghosting-free high dynamic range (HDR) images of dynamic scenes from a set of multi-exposure images is a challenging task, especially with large object motion and occlusions, leading to visible artifacts using existing methods. To address this problem, we propose a deep network that tries to learn multi-scale feature flow guided by the regularized loss. It first extracts multi-scale features and then aligns features from non-reference images. After alignment, we use residual channel attention blocks to merge the features from different images. Extensive qualitative and quantitative comparisons show that our approach achieves state-of-the-art performance and produces excellent results where color artifacts and geometric distortions are significantly reduced.

氏名: 小澤 悠

題目: 不整地における高走破性を実現する弾性履带式単輪クローラ機構

要約: 発表者の従事するプロジェクトでは、地震等の大規模災害発生時にドローンから小型ロボットを多数空中投入することで、瓦礫内の被災者を捜索する災害用探査ロボットシステムの開発が行われている。ドローンの運搬能力の限界により、ロボットは大きさ、重量の面で大きな成約を受けるが、小型軽量のロボットが瓦礫上を走行することは容易ではない。そこで、発表者は弾性を有する履帯を一輪のみで駆動するクローラ型移動機構を考案し、その開発と解析を行っている。

氏名: Liu Kang-Jun

題目: Study of the gap between asymmetric trick and feature decorrelation based representation learning

要約:To computers, images are just matrices. Therefore, teaching computers to recognize the contents of images is important. A common way is having a feature extractor; a function takes images as inputs and outputs a vector as a representation correspondingly. Recently, researchers proposed a method to learn a feature extractor; Barlow-Twins. The learning goal is making output vectors robust to augmentations; random crop, color jittering and blurring, and simultaneously decorrelating output features. However, the other researchers proposed another applicable one called BYOL, utilizing an asymmetric trick; an asymmetric model design with stopping the gradient flow at one side of Siamese networks. It is not trivial to understand how BYOL could perform equally well to Barlow-Twins. In our study, we find that BYOL is also doing feature decorrelation. We provide some mathematics derivations and empirical observations as supports.

氏名:Fangzhou Lin

題目:Deep learning model for point cloud completion: towards a better way of 3D understanding.

要約:Point clouds measured by 3D scanning devices often have partially missing data due to the view positioning of the scanner. The missing data can reduce the performance of a point cloud in downstream tasks such as segmentation, location, and pose estimation. In order to tackle this problem, we propose a novel neural network architecture, Cosmos Propagation Network (CP-Net), for 3D point cloud completion. CP-Net extracts latent features in different scales from incomplete point clouds used as input. For point cloud generation, we propose a novel point expand method using a Mirror Expand module.

氏名:Zou Han

題目:Reference-based Motion Blur Removal

要約: While there are limits to removing blurs from a single image, it has more potential to use multiple images. We propose a better method to use the information existing in a reference image for improving deblurring performance. Unlike video deblurring, the method does not need a strong assumption on the reference image. Our method first matches local patches of the target and reference images and then fuses their features to estimate a sharp image. We employ a strategy to solve the difficult problem of matching the blurry image with the sharp reference. Our method is implemented as a module that can be integrated into existing networks for deblurring. Experimental results show the effectiveness and usefulness of the proposed method and application.

3rd session (14:50–16:30)

氏名: Zhijie Wang

題目: Unsupervised Domain Adaptation for Semantic Segmentation via Cross-Region Alignment

要約: Semantic segmentation requires a lot of training data, which necessitates costly annotation. There have been many studies on unsupervised domain adaptation (UDA) from one domain to another, e.g., from computer graphics to real images. We propose a method that applies adversarial training to align two feature distributions in the target domain. It uses a self-training framework to split the image into two regions (i.e., trusted and untrusted), which form two distributions to align in the feature space. We term this approach cross-region adaptation (CRA). CRA can be applied after any CDA method. Experimental results show that this always improves the accuracy of the combined CDA method, having updated the state-of-the-art.

氏名: Zhang Jie

題目: Ensemble Knowledge Distillation for Image Anomaly Detection and Localization

要約: Image anomaly detection and localization aims to identify anomalous samples and further segment the defects in images. In this study, we focus on the application of industrial inspection, where usually only normal images are available during training. During testing, anomalies with different types and sizes should be detected and localized. As we only have a limited number of normal training data, knowledge distillation, which distills knowledge from a model pre-trained on a large natural image dataset, showed its promising potential in this task. We proposed an ensemble learning method that has two student models to better detect both small local defects and large or high semantic level defects. We achieved state-of-the-art performance on a public benchmark.

氏名: 繆仁軍

題目: Estimation of attention states using facial expressions for online lectures

要約: Online lectures such as massive open online courses are becoming popular and familiar. It is difficult for teachers to know whether students are concentrating on the contents due to the lack of interactivity in online lectures. The present study aimed to develop a method to estimate the state of attention from facial images while participating in online courses. We conducted an experiment to measure the level of attention based on reaction time measures to detect the disappearance of noise sound while watching lecture videos, assuming that reaction time for the detection of contents-irrelevant noise is longer when learners are paying attention to the contents more. We sought facial features that are useful for predicting the reaction time. Reaction time can be estimated in some amount from facial features, suggesting that facial expressions are useful for predicting attention state, or concentration level while watching online video lectures.

氏名:Nguyen Van Quang

題目:GRIT: Faster and Better Image-captioning Transformer using Dual Features

要約:Current state-of-the-art methods for image captioning employ region-based features, as they provide object-level information that is essential to describe the content of images; they are usually extracted by an object detector such as Faster R-CNN. However, they have several issues, such as lack of contextual information, the risk of inaccurate detection, and the high computational cost. The first two could be resolved by additionally using grid-based features. However, how to extract and fuse these two types of features is uncharted. Thus, we propose a Transformer-only neural architecture, dubbed GRIT (Grid and Region-based Image captioning Transformer), that effectively utilizes the two visual features to generate better captions. The experimental results on several image captioning benchmarks show that GRIT outperforms previous methods in inference accuracy and speed.

氏名:丸山尚貴

題目:敵対的訓練におけるモデル容量の統計力学的解析

要約:機械学習モデルに誤分類を引き起こさせる敵対的摂動の存在が、機械学習のセキュリティの問題となっている。敵対的訓練は、摂動が加えられたデータを学習することでその影響を軽減する方法であり、損失関数に正則化項を加える場合との対応関係が議論されている。本研究では情報統計力学におけるスピングラスの解析手法であるレプリカ法を用いて、モデルの容量を解析的に求めることで、敵対的訓練と正則化項を加える場合との違いについて明らかにする。

4th session (16:40-18:20)

氏名:LU XIANGYONG

題目:Lightweight Neural Network Design for Resource-Constrained Edge Devices

要約: With the breakthroughs in deep learning algorithms, recent years have witnessed a booming of powerful deep neural network (DNN) models and artificial intelligence (AI) applications on edge devices. Nonetheless, DNN models that achieve state-of-the-art performance are memory and computationally expensive. Their high performance depends on the availability of computing platforms with large memory and computing power. The tight resource constraints will obviously create tremendous challenges in the deployment of DNNs on the edge devices. Accordingly, there is an urgent need to develop efficient tiny and lightweight DNN models for these resource-constrained edge devices. Motivated by the

increasing demand for efficient tiny DNN models, my research mainly focuses on the problem of designing efficient lightweight neural networks under limited computing and memory resources.

氏名:Golsa Tabe Jamaat

題目:Wall modeling for LES of turbulent channel flow using data-driven approach

要約:Large eddy simulation (LES) is a popular approach for numerical simulation of turbulent flows. LES has reasonable accuracy while does not need much computational cost. However, its cost increases significantly for the wall-bounded flows, especially for highly turbulent flows. One methodology for reducing the cost of LES for wall-bounded flows is to use wall models. My present research is focused on developing an efficient wall model with reasonable accuracy using a machine learning algorithm called convolutional neural network. So far, the results of the a priori test have shown that the model has a good accuracy in establishing a wall model.

氏名:長谷川靖

題目:ボルツマンマシンを利用したカーネル学習

要約:カーネル法は機械学習において強力な手法である。平行移動不変なカーネル関数はフーリエ変換により周波数の確率分布の期待値で表現できる。この変換を利用して Random Fourier Features(RFF)は周波数をサンプリングし、カーネル関数を近似する[1]。さらに、データに適した周波数の確率分布を機械学習によって獲得する Implicit kernel learning が近年提案された[2]。この方法では生成モデルを利用してガウス分布をデータに適した確率分布に変換している。本発表では[2]で提案された方法においてボルツマンマシンを用いた場合の結果を紹介する。

[1] A, Rahimi and B, Recht, Adv, Neural Inf. Process. Syst., 1177 (2007).

[2] Chun-Liang Li et al, In The 22nd International Conference on Artificial Intelligence and Statistics, 2007 (2019).

氏名:Yunhan Du

題目:A generalized human mobility model in realistic labor market conditions

要約:Understanding human mobility is crucial to human societies due to its wide range of applications including preventing the spread of epidemics and estimating traffic demand. The radiation model is a prevailing framework to predict human mobility. However, the same distributions of job-seeker expectations and job-offer benefits are assumed in the radiation model, which is not consistent with the realistic labor market conditions. In our work, a generalized radiation model is proposed based on the distinct distributions of job-seeker expectations and job-offer benefits. Furthermore, using a mobility flow data set in the United States, we show the results of predictions compared with the original radiation model.

氏名:佐々木翔大

題目:サブワードに基づく単語埋め込みの縮約モデリング

要約:事前学習された単語埋め込みは、有用で基礎的な言語資源である一方で、i) 実行時の必要メモリ量が大きくなる点、ii) 語彙に含まれない単語(未知語)へ対応能力に欠ける点が、課題として取り上げられる。本研究ではサブワード(単語の部分文字列)を利用するアプローチにおいて、複数のサブワードでベクトルをシェアする“メモリ共有”とサブワード埋め込みから単語埋め込みを構成するベクトル演算である KVQ 演算を用いることで、モデルサイズの削減と未知語問題への対処を同時に行う。