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# FY2020 Annual Report for International Joint Research with Research Fund
# International Joint Digital Archiving Center for Japanese Art and Culture (ARC-iJAC), Art Research Center, Ritsumeikan University

Date (year/mm/dd): 2021/05/10

| 1. Title of the Research Project | |
|---|---|
| A Database Construction of Old Japanese Manuscripts and an Analysis Using Machine Learning | |
| 2. Research Leader | |
| Name | Organization and title |
| Toshiaki Aida | Graduate School of Interdisciplinary Science and Engineering in Health Systems, lecturer |
| 3. Co-researcher (Total: 2 persons) | |
| Name | Organization and title |
| Tomomi Kobayashi | Chikushi Jogakuen University, Associate professor |
| Aiko Aida | Japan Society for the Promotion of Science, Restart Postdoctoral Fellowship |

4. Overview of the Research Project (About 150 words) Note: If you have changed your project since the time of application submission, please write clearly where you made changes.

The first purpose of our research project was the construction of a comprehensive database of old Japanese Buddhist Sutra copies in Europe, utilizing the database system and cloud region of the Art Research Center at Ritsumeikan University. For this purpose, we planned to conduct field surveys in order to get their fundamental data and digital images. However, until now, the worldwide pandemic of coronavirus disease has been preventing us from conducting the field surveys of the sutra copies in Europe.

Therefore, we could not help changing the purpose to analyzing the transition of the characteristics of their painting styles over the ages by machine learning, based on our data on old sutra copies centering on the collection of the Fujii Eikan Bunko of the ARC. Here, as the methods of machine learning, we will apply deep learning, feature extraction e.g. by principal component analysis, inference of the number of groups and their classification by t-SNE or Bayesian Gaussian mixture model.

5. Overview of the Research Results Note: We may use this section for the Center's PR.

This year, we have cut out about 400 face images of persons such as Buddha or Bodhisattva from the images of the paintings in the old Japanese Buddhist Sutra copies our research group has ever collected, which are centering on the collection of the Fujii Eikan Bunko of the Art Research Center at Ritsumeikan University. Then, we have put the labels to them according to their production ages.

Among the face images, focusing on the ones of Heian and Kamakura periods, we have made their feature extraction, applying a pre-trained deep convolutional neural network, and learned their classification, combining support vector machine with principal component analysis as machine learning methods. Also, we have criticized and corrected, from the point of view of art history, the result of the inference of the production ages for test data, which we have made for performance evaluation of the classification by machine learning.

6. Research Activities

（１）著書　なし
（２）論文　なし
（３）研究発表等
i)「畳み込みニューラルネットワークによる胃癌深達度診断」, 2020.10.24, 2020 年度(第 71 回)電気・情報関連学会中国支部連合大会, オンライン, 中安弘也, 相田敏明, 河原祥朗, 濱田健太, 岡田裕之, 査読無.
ii)「局所フラクタル次元と畳み込みニューラルネットワークによる胃癌深達度診断」, 2020.10.24, 2020 年度(第 71 回)電気・情報関連学会中国支部連合大会, オンライン, 芥川幸平, 相田敏明, 河原祥朗, 濱田健太, 岡田裕之, 査読無.
iii)「畳み込みニューラルネットワークによる胃癌深達度診断システム」, 2021.3.12, 電子情報通信学会 2021 年総合大会, オンライン, 相田敏明, 河原祥朗, 濱田健太, 岡田裕之, 査読無.
iv)「深層ニューラルネットワークによる胃癌深達度診断」, 2021.3.15, 日本物理学会 第 76 回年次大会, オンライン, 相田敏明, 河原祥朗, 濱田健太, 岡田裕之, 査読無.
v) “A Quantitative Approach to a New Digital Platform of Ancient and Medieval Japanese Sutras (a Short Paper Session),” 2020 年 6 月, Digital Humanities Conference 2020, University of Ottawa and Carleton University (Online), Canada, Aiko Aida, 査読有.
vi) “Re-interpreting the Paintings and Poems of the Lotus Sutra through a Co-occurrence Network (a Poster Session),” 2020 年 11 月, The 10th Conference of Japanese Association for Digital Humanities (JADH2020) “A New Decade in Digital Scholarship: Microcosms and Hubs”, Osaka University (Online), Japan, Aiko Aida, 査読有.
（４）主催したシンポジウム・研究会等　なし
（５）その他研究活動（報道発表や講演会等）なし
（６）受賞学術賞　なし
（７）科学研究費助成事業
i) “圧縮センシングのための画像辞書への確率分布アプローチ,” 基盤研究(C)(一般), 平成 29 年 4 月－令和 4 年 3 月, 代表.
ii) “圧縮センシングによる超解像の統計力学的解析と拡散方程式逆問題への応用,” 基盤研究(C)(一般), 令和 2 年 4 月－令和 5 年 3 月, 代表.
iii) “日本中世装飾経の材質・技法・様式からみた変遷史観の実証的検討と図像解釈,” 特別研究員奨励費, 2019 年 4 月－2022 年 7 月, 代表.
（８）競争的資金等（科研費を除く）なし
（９）その他　なし