

FY2019 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): 2020/04/28

1. Title of the Research Project	
An Analysis and a Database Construction of Old Japanese Manuscripts using Single Image Super-resolution ; Focusing on the Fujii Eikan Bunko Collection stored by the Art Research Center	
2. Research Leader	
Name	Organization and title
Toshiaki AIDA	Lecturer, Graduate School of Interdisciplinary Science and Engineering in Health Systems, Okayama University
3. Co-researcher (Total: 3 persons)	
Name	Organization and title
Hiroto YOKOUCHI	Professor, Kyoto Prefectural University
Tomomi KOBAYASHI	Associate Professor, Chikushi Jogakuen University
Aiko AIDA	Japan Society for the Promotion of Science

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.
<p>The purpose of our research is as follows:</p> <p>(1) We apply single image super resolution to infrared images of the characters and signatures, which are hidden under indigo dyes in Buddhist Sutra copies written in gold ink on deep-blue papers. Then, we utilize them to analyze the background of production, date and technique of the papers for the Buddhist Sutra copies.</p> <p>(2) In order to transform low-resolution infrared images, taken in the past, to high-resolution ones, we make dictionary matrices needed for the transformation, which are obtained by learning the relation between pairs of the low and high resolution versions of various images.</p> <p>(3) We construct a database of old Buddhist Sutra copies, which consists of the visible, infrared and microscope images of them mainly in the collection of the Fujii Eikan Bunko of the Art Research Center at Ritsumeikan University.</p>
5. Overview of the Research Results Note: We may use this section for the Center's PR.
<p>The objects of our research are the Buddhist Sutra copies, written in gold ink on deep-blue papers in the late Heian period. Especially, we analyzed them in the collection of the Fujii Eikan Bunko of the Art Research Center at Ritsumeikan University. It is known that the copies of the period sometimes hide characters and signatures under indigo dyes, which can be revealed only by infrared imaging. However, the infrared images are not only of low resolution but also degraded by a specific type of high level noises. In our research until the last year, we successfully applied single image super resolution to the images, with noise reduction to some extent. In order to proceed further this year, we elaborated additional filter processing, and achieved more effective noise reduction and edge detection of the hidden characters than ever.</p> <p>Second, we constructed a database of hidden characters in the ARC research resource portal one.</p>

6. Research Activities**(1) Books****(2) Articles**

- “Bayesian Approach to the Classification of BMI Time Series Data from Babyhood to Junior High School Age of Japanese Children,” 共著, 2019.3.17, Proc. of 2019 4th International Conference on Big Data Analytics (ICBDA2019), pp. 21-25, Chiyori Haga, p. 5, 査読有

(3) Presentations

- 「疎符号化を用いた画像復元の解析的性能評価」, 2019.3.14, 日本物理学会第 74 回年次大会, 九州大学, 査読無
- “Replica Analysis of the Performance of Image Processing by Compressed Sensing,” 2019.5.8, Statistical Physics of Complex Systems, スウェーデン・ストックホルム, 査読無
- “Single Image Super Resolution Approach to the Signatures and Symbols Hidden in Buddhist Manuscript Sutras Written in Gold and Silver Inks on Indigo-Dyed Papers,” 2019.7.11, Digital Humanities 2019 (DH2019), オランダ・ユトレヒト, 査読有
- 「疎符号化による画像修復における辞書行列サイズのスケールリング」, 2019.9.10, 日本物理学会 2019 年秋季大会, 岐阜大学, 査読無
- 「胃癌深達度診断のための畳み込みニューラルネットワークの転移学習」, 2019.10.26, 和元年度(第 70 回)電気・情報関連学会中国支部連合大会, 鳥取大学, 査読無

(4) Symposiums and/or research meeting you organized**(5) Other research activities (Lectures to the general public, and appearances in/contributions to mass media)**

- 「人工知能(AI)を用いた早期胃癌内視鏡診断システムを開発」, 岡山大学 Press Release, 2019.5.23

(6) Academic awards**(7) Grants-in-Aid for Scientific Research -KAKENHI**

- “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 2 年 3 月, 代表

(8) Competitive grants other than KAKENHI**(9) Other achievements**