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数理解析研究所講究録2102

ＲＩＭＳ共同研究（グループ型）

信号解析と時間周波数解析

京都大学数理解析研究所

２０１９年２月

数理解析研究所講究録は，京都大学数理解析研究所の共同利用研究集会および共同研究の記録として1964年に刊行が開始されました．当研究所が全国共同利用研究所として発足した翌年のことでしたが，以来半世紀，毎年数十巻を刊行し，2016年には第2000巻が刊行されるに至りました．第1巻から第2000巻までに収録された論文数は29,265編，総頁数は342,960頁という膨大なものであり，最先端の数学・数理科学分野の研究状況を伝えるのみならず，我が国の数学・数理科学の発展の歴史を留める文献として，他に類例を見ない論文集となっています．

講究録の内容は当研究所のウェブサイトおよび京都大学の学術情報リポジトリにおいても公開され，年間の総アクセス数は1,380,032回（2017年度）を数えるなど，多数の方にご利用いただいています．

講究録の使用言語は論文著者の判断に任されていますが，結果的に日本語が多用されていることが特徴の一つとなっています．その結果，講究録は，数学・数理科学の広い領域における最先端の専門知識に母国語でアクセスできるものとして，近年の英語化の流れの中で，重要な文献となりつつあります．

当研究所の共同利用事業に参加し講究録の論文を執筆していただいた多数の方々に対し，講究録を大きく成長させていただいたことを深く感謝いたしますとともに，これからも，当研究所の国際共同利用・共同研究拠点(*)としての活動にご参加いただき，講究録の発展にご協力いただけますよう心よりお願い申し上げます．

*数理解析研究所は2018年11月13日，共同利用・共同研究拠点の認定が廃止され，新しく国際共同利用・共同研究拠点に認定されました．

RIMS Kôkyûroku 2102

Signal analysis and time-frequency analysis

October 23 ~ 24, 2017

edited by Ryuichi Ashino

February, 2019

Research Institute for Mathematical Sciences

Kyoto University, Kyoto, Japan

講究録

Kôkyûroku

RIMS Kôkyûroku was started in 1964 as the proceedings of symposia, colloquia and workshops supported by RIMS, the Research Institute for Mathematical Sciences, Kyoto University. It was the next year of the establishment of RIMS as one of the Nationwide Cooperative Research Centers. For half a century since then, several dozen volumes have been issued each year, and the 2,000th volume was issued in 2016. The volumes of Kôkyûroku from the 1st through the 2,000th, containing enormous 29,265 articles and 342,960 pages, not only deliver the latest research activities in mathematics and mathematical sciences but also constitute valuable and incomparable collections of articles that pass down history of progress of mathematics and mathematical science in Japan.

Articles in Kôkyûroku are available on the websites of RIMS and Kyoto University Research Information Repository. They are very frequently accessed on the internet, with a total of as many as 1,380,032 accesses in 2017.

The authors choose the languages to write articles, and many are written in Japanese, which is one of the characteristics of Kôkyûroku. As a result, Kôkyûroku is regarded as a significant and important literature which allows easy access to the latest specialized knowledge in the large fields of mathematics and mathematical sciences written in native language for Japanese readers, while more and more research papers are being written in English in recent years.

We are deeply grateful to many of those who have participated in cooperative research activities of RIMS and greatly developed Kôkyûroku. We heartily ask for your continuous participation in research activities at RIMS as an International Joint Usage/Research Center(*) and your warm support and cooperation for the fruitful development of Kôkyûroku.

* RIMS was certified as an International Joint Usage/Research Center on Nov. 13, 2018.

2017 RIMS Joint Research

Advanced Innovation powered by Mathematics Platform

Signal analysis and time-frequency analysis

Organizer: Ryuichi Ashino
(Mathematics and Information Sciences, Osaka Kyoiku University)

Period: 2017-10-23–2017-10-24

Location: Research Institute for Mathematical Sciences, Room 110
Kyoto University, Kyoto 606-8502, Japan

Program

October 23, Monday

13:00 – 14:00 **Hongmei Zhu** Department of Mathematics & Statistics, York University, Toronto

From the Fourier transform to the S-transform, and beyond

The S-transform is an effective time-frequency analysis technique that can provide a time-frequency representation of a nonstationary signal. In addition, its multi-scale analysis allows more accurate detection of subtle signal changes while interpretation in a time-frequency domain is easy to understand. It has been used successfully in various fields including ocean analysis, medical and industrial application. In this talk, we will overview the theory of the ST and introduce the various forms of the S-transforms.

14:15 – 15:15 **Kensuke Fujinoki** Department of Mathematical Sciences, Tokai University

Multi-lapped directional wavelet transforms and their applications to image analysis

Various types of framelets have been developed and their redundant transforms proven to be a useful tool for applications such as image and video processing. While high redundancy rate provides significant flexibility in wavelet design, computational cost increases exponentially as the dimension increases. In this talk, we introduce a two-dimensional redundant wavelet transform that offers a good tradeoff between redundancy and computational cost. We show how our redundancy makes the directional selectivity of the wavelet transform improve and how it leads to better performance in image processing tasks.

15:45 – 16:45 **Hisashi Yoshida** Department of Computational Systems Biology, Kindai University

Application of time-frequency analysis in biomedical signals and the challenges

Biomedical signals, such as EEG, ECG and EMG usually have time-varying characteristic. Time-frequency representation is effective way to track the change but it is often too much information for automatic diagnosis. In this talk, we introduce information theoretic instantaneous bandwidths which is defined on positive time-frequency distribution and show some results of biomedical signal applications.

October 24, Tuesday

9:30 – 10:30 **Hongmei Zhu** Department of Mathematics & Statistics, York University, Toronto

Looking inside of biomedical signals using the S-transform

Biomedical signals are typically finite duration, dynamic and non-stationary processes whose frequency characteristics vary over time or space. This often requires algorithms capable of locally analyzing and processing signals. The S-transform (ST) combines the time-frequency representation of the windowed Fourier transform with the multi-scale analysis of the wavelet transforms. It is easy interpretation and multi-scale analysis make it popular in various applications. In this talk, we illustrate its effectiveness of the S-transform in biomedical applications.

10:45 – 11:45 **Kazuaki Nakane** Graduate School of Medicine, Osaka University

A tissue image analysis method via the homology concept

With the development of imaging devices in recent years, many tissue images have been taken as data. For clearly shaped images, analysis is being carried out by using deep learning and other techniques. Effective methods have not yet been developed, however, for very complex images like medical tissue images. For this reason, many tissue image data have been hoarded without being utilized. These can also be called "image data type big data". Developing a method to analyze such images is important issue. In this talk, we introduce the imaging method via the homology concept and several applied examples. This method has been applied to analyze the colon cancer tissue images and got significant results.

13:15 – 14:15 **Kohei Arai** Saga University

Phytoplankton and zooplankton identification with microscopic images using shape feature extracted by wavelet descriptor

Method for phytoplankton and zooplankton identification with microscopic images using shape feature extracted by wavelet descriptor is proposed. Planktons have a plenty of shape features. Therefore, shape features are effective for plankton identification rather than tone and color features as well as textural features. The effectiveness of these features is compared for plankton image identifications.

14:30 – 15:30 **Kiyoshi Mizohata** Department of Mathematical Sciences, Doshisha University

The analysis of big data and applications of wavelets

The amount of social media data is now growing exponentially. Such data is now called 'Big Data'. In this talk, we shall show several interesting results on comments of niconico-douga (famous social media in Japan) obtained by using Hadoop system and wavelets.

For more information, visit our website at

▷ `http://www.osaka-kyoiku.ac.jp/~ashino/rims2017/`

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RIMS 共同研究（グループ型）報告集

２０１７年１０月２３日 ～ １０月２４日

研究代表者　芦野　隆一 (Ryuichi Ashino)

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