

Report of the NII IAB Meeting 2022

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Prof. Wen Gao, Prof. Takeo Kanade, Prof. Calton Pu, Prof. Bruno Sportisse

31 March 2022

Introduction

This is the report of the 2022 meeting of NII's International Advisory Board (IAB), which was carried out as two synchronous full-IAB meetings using the Webex videoconference tool on March 18th and March 29th in five different time zones (22:00-23:00(JST), 21:00-22:00(CST), 14:00-15:00(CET), 06:00-07:00(PDT), 09:00-10:00(EDT).

In addition, our evaluation is based on asynchronous NII project presentation videos for offline viewing by the IAB members and on-demand poster sessions for live interactions with the NII project teams.

This hybrid format with synchronous, asynchronous and on-demand elements was designed to maximize flexibility and efficiency in the given pandemic situation.

Three of the participants of the last IAB meeting in 2017 attended the current meeting (Wen Gao, Calton Pu, Wolfgang Wahlster). The other two new members of the IAB (Takeo Kanade, Bruno Sportisse) were newly recruited personalities with a very broad topical coverage and wide geographical distribution.

This report contains general observations and specific comments and recommendations on the positioning and strategy of NII, the research program, management and organization, industry engagement and the organization of the IAB. The report summarizes the consensus opinion of the entire IAB.

General Observations

2022 is NII's 10th year under the directorship of Professor Kitsuregawa. The Institute continues to flourish along all dimensions. In our view, the very positive development of NII since the last IAB meeting in 2017 is not only based on the management skills and the excellent academic, industrial and international network of the Director, but also on the fact that he is an active, internationally recognized researcher in important areas of Informatics like big data platforms on the environment and healthcare, and is thus serving as a role model for NII researchers. In 2020 he received the prestigious IEEE Innovation in Societal Infrastructure Award. The Award recognizes significant technological achievements and contributions to the establishment, development, and proliferation of innovative societal infrastructure systems through the application of information technology with an emphasis on distributed computing systems. The award is sponsored by Hitachi, Ltd. and the IEEE Computer Society.

The IAB commends NII for the term extension for the Director General due to COVID-19, so that there is a smooth transition from SINET5 to SINET6 and DataPlatform for two more years.

It is important to note that NII is the only national institute in Japan that is completely focused on Informatics. We congratulate NII for its 20th anniversary, which was celebrated in December 2020 with

5,500 online attendees. NII is a unique institution worldwide, since it combines leading-edge research with services for the academic information infrastructure.

The research agenda of NII is of central importance to the Japanese strategy towards Society 5.0, which integrates cyber space and physical space to generate new societal value from Super Smart Services. Key elements of a service platform for Society 5.0 are now being developed by NII. We are happy to see that current research at NII includes almost all relevant topics of modern informatics.

NII has an original mission of producing research and services that benefit the Japanese society, primarily the academic community. Although NII is allowed and encouraged to create intellectual property, e.g., patents, its main mission remains societal impact. Therefore, innovation can be a side-effect of NII's work (both research and services), but technology transfer cannot become its main activity, since this would distract NII from its original mission.

Professor Kitsuregawa and the entire staff of NII are to be congratulated on the significant scientific progress that has been made since the last IAB review in 2017. The IAB is pleased to observe that the concerns and recommendations from the last IAB report have been clearly and successfully addressed.

The success of NII is enabled by a continued increase in overall budget, despite a steady decrease of general expenditures (from Y3.37B in FY2015 to Y2.97B in 2022) allocated by the Ministry of Education, Culture, Sports, Science and Technology (MEXT).

Prof. Kitsuregawa and his team were able to increase the overall NII budget to an all-time record for 2020 by development and execution of a very successful external project acquisition strategy. The increase in commissioned research is a good indicator of the relevance of NII's research for Japan. It's good to see, that the commissioned research from private sources was also increased in 2021. With increased special expenditures, the total operating subsidy budget passed Y12B in FY2022, an all-time high.

Positioning and Strategy

As an Inter-University Research Institute, NII has become a springboard for advanced academic and industrial research careers, developing young researchers in an environment of research excellence to their full potential and helping them to get positions at prestigious research institutions in Japan or abroad. For example, since 2017 the number of best paper awards for NII researchers has increased to 41 awards till March 2022, some of them being best student paper awards.

In addition, the Fulkerson Prize awarded to Prof. Kawarabayashi in 2021 is the highest prize in discrete mathematics, including graph theory, worldwide. It shows that NII is able to attract and retain the best researchers worldwide in specific field of informatics.

The increase in the number of reports about NII in the media is very remarkable. In 2020, there were now close to six times more reports in the public media than in 2011. This has increased the value of NII as a brand name recognized in Japan and worldwide for outstanding research and academic services in Computer Science. In particular, 553 reports in magazines in 2020 was a new record, which was possibly due to the fact of NII's 20th anniversary with a commemorative Ceremony and Forum in December 2020.

We commend NII for taking a broad digitalization perspective and to embrace emerging fields, combining core computer science with other disciplines in an interdisciplinary fashion. The IAB is happy to see that current research at NII covers a wide range of relevant topics of modern informatics and is

able to adapt in a timely manner to new research trends like next generation data mining technologies, advanced deepfake recognition, AI for the humanities, inter-cloud operability, human-centered awareness platforms, and quantum AI.

The IAB recognizes and applauds NII's efforts on diversity and equality, by improving gender balance from 16% in 2015 to 22% (17 out of 76 total) of female faculty in 2021, which in contrast to only 6% female faculty in the engineering faculty at the university is a significant achievement. We support the special NII programs for better diversity including care for young kids and elderly persons in the family.

The international focus is particularly impressive and should be commended. The new office established in May 2017 by JETRO and NII in downtown San Francisco creates a two-way bridge between the NII ecosystem and the Bay Area ecosystem. It can become a cradle of innovation for NII and the companies cooperating with NII. The IAB was pleased to see that in the pandemic situation NII researchers have presented 5 webinars for Silicon Valley attendees, some of them with more than 700 participants. We recommend contact and collaboration with other international hubs of research close by in San Francisco, like the International Computer Science Research Center (ICSI) at the UC Berkeley campus, which focuses on the exchange of first-class Postdocs from all over the world.

SOKENDAI is an excellent Graduate University for Advanced Studies in which NII researchers play a very important role. It offers the advantage of enabling PhD students to carry out their studies in the most advanced research environment of inter-university research institutes, which operate under the auspices of the Ministry of Education, Culture, Sports, Science and Technology (MEXT). Informatics was very clearly the most popular topic at SOKENDAI with more than 90 students in 2021. Particle and Nuclear physics on the second place had less than half of the students of Informatics. The IAB was pleased to see the significant increase of foreign students of Informatics (53 in 2022) at SOKENDAI in spite of the pandemic situation. This is an important contribution of NII to educate the next generation of top IT experts for Japan.

Due to the pandemic situation caused by Covid-19 unfortunately all NII Shonan meetings had to be cancelled in 2020 and 2021, although for 2021 a peak rate of 23 workshops had been planned already. But nevertheless during our report period a total of 63 Dagstuhl-like seminars for the world's best 30 researchers on specific research topics in computer science have been held since 2017. We recommend a closer exchange with Dagstuhl, so that for instance a follow-up workshop of the most successful events in Dagstuhl or Shonan can be held in the other meeting place.

Research

It is not surprising that the breadth of the research and service spectrum of NII offers many existing and emerging opportunities to exploit machine learning, both in research projects, and in the development and extension of NII services. The new efforts of NII to establish a digital platform for Japanese Culture are very important for NII's societal mission. In particular, the IAB applauds NII's successful AI competition using the Kaggle platform in the domain of humanities on the task of Kuzushiji character recognition. A mobile App for AI-based OCR of the ancient cursing writing style opens access to printed books with Kuzushiji characters with an accuracy of more than 95% and thus 1000 years of Japanese culture.

The IAB was encouraged by the NII activities to include humanity and law as a new dimension of research. In doing so, we encourage NII to view it as not just an application area of AI but actually an area that demands new theories, techniques and technologies of computer science. For example, in law and AI, one should view AI as not only a convenient tool for jurisdiction, but also a tool to locate

the aspects that do not match with the current societal conditions or foresee the need of new legislations, as an analog of formal correctness proofs of programs and protocols.

The academic visibility of NII was further increased by curating and providing open access to annotated big data sets as AI challenges, training material for machine learning or benchmarking, that are shared with the worldwide academic community. Good examples for this are the Japanese Sign Language Corpus and ASVspoof challenge.

It was a very clever decision of NII's management to establish a new "Global Research Center for Synthetic Media" under the leadership of Prof. Echizen and Prof. Yamagishito. This is a very timely issue with enormous societal impact. The world's first deepfake detector for images and videos has attracted a lot of attention worldwide, since such fake synthetic media can be used to create misinformation in social media, fraud and security attacks. The Automatic Speaker Verification Spoofing and Countermeasures Challenge is another important international network for fake audio detection. The success of deep learning for the perfect imitation of voices created an enormous challenge for law enforcement agencies. NII has created an excellent international research network for the exchange of annotated training data and tools for detecting fake faces and voices.

The IAB commends the preparation of a new interdisciplinary research center on AI and law, since there is an urgent need to accelerate the legislation process using AI. Today most countries have laws that are not adapted to the most recent IT technologies and their legal challenges. The IAB recommends to extend the very good cooperation with France to the issue of technical standards and norms that can be automatically checked. So-called smart norms are a very hot topic in industrialized nations like Germany, China and Japan. The goal is to encode the norms in machine-understandable terms, so that the compliance with a standard can be automatically checked before a machine is introduced to the commercial market. The work on AI and law is a very interesting project with a strong multidisciplinary approach. There is a wide range of possible impact, from judgement support to legislation support. The development of Proleg seems to be an appropriate way in order to strengthen the integration of the resulting algorithm and to reinforce the diffusion, even at the international level (beyond Japan).

The work devoted to AI compliance is also another key issue. The IAB recommends to develop a partnership with the GPAI initiative (Japan is a member of this multilateral initiative).

We commend NII on having re-oriented the big ERATO project, Metamathematics for Systems Design headed by Ichiro Hasuo, according to our recommendations in 2017. During the extended funding period from 2022-2024 the goal has now shifted to best-effort logical guarantees for CPS applications like autonomous driving. The new idea of the logical confinement of uncertainties is a new paradigm between purely data-driven or purely logical approaches. It was good to see, that with this more pragmatic approach companies like Mazda and Mitsubishi are now interested in cooperations with this team bridging data-driven and model-based algorithms hybrid architectures.

Academic Information Infrastructures and Services

One of the original missions of NII is providing cyber infrastructure services for academic institutions, primarily universities. This mission includes the SINET5 (the primary academic internet service for Japanese universities), and various services built on SINET. During the last 5 years, NII expanded from SINET5 (this SINET is a 100Gbps backbone network for 850+ universities and research institutions) to SINET6, entering operations in April 2022. The backbone connections of SINET6 include a nationwide 400Gbps backbone, with 100Gbps international connections to Asia, Americas, and Europe. In addition, SINET6 will integrate seamlessly 5G mobile SINET (including private 5G and future wireless services)

through SINETStream and cloud storage services. We congratulate NII for the realization of the world's first long-distance 400 Gbps line already in December 2019 between Tokyo and Osaka with over 600 km of new fiber.

SINETStream is a wireless network aggregator library supporting transparently the entire network connection from several underlying mobile phone providers through SINET backbone to the expanding SINET platform and services, e.g., secure data storage and access. As an incipient service, working with application domains will be an important next step towards social and economic impact of the SINETStream system and software library.

The IAB commends that SINET5 has played an important role in some breakthrough scientific research (such as Belle II and Super Kamiokande experiments) and effectively supported some important applications (such as remote surgery operations). The IAB also recommends that the future SINET6 should continue to support a wider range of challenging scientific research and applications (such as Metaverse). More importantly, it is expected that with the more effective utilization of the extra-high bandwidth and ultra-low delay characteristics of SINET6, the related teams in NII (e.g., Research Center for Medical Bigdata), the real-world challenging applications over SINET5 and/or SINET6 (e.g., remote surgery operations), and even the supercomputer (e.g., Fugaku) can be truly connected together so as to form a systematic research hierarchy and meet various important needs from the society.

The growth of SINET and expansion of cloud-based services have been enabled by the successful establishment of NII Kashiwa Annex (2021) in a shared facility with University of Tokyo. The Kashiwa Annex is the hub of the 400Gbps network backbone of SINET6. With a mesh architecture, both SINET5 and SINET6 are highly reliable, e.g., surviving, with a total of estimated 3 million users. SINET has a mesh topology and provides significant quality of service properties, including high bandwidth (99 Gbps in Japan and 150 Gbps between Japan and USA) and low latency (173 msec RTT between Tokyo and New York, 161 msec RTT between Tokyo and London). SINET survived significant disasters such as the 2016 Kumamoto earthquake. The IAB considers SINET as a significant achievement and applauds its continued development and evolution to provide essential networking services for Japanese academic institutions.

The establishment of the RCMB (in 2017) has led to impressive results, on the basis of the ability of NII to run an operational cloud platform and to provide AI-based analysis of the medical images. The extent of the partnerships with the Japanese medical societies and with the institutes analyzing medical images illustrates the leading role of NII, with the funding of the AMED in this strategic field of digital healthcare. Some medical applications are also presented (including Covid 19 pneumonia, detection of breast tumor, abdominal echo, etc.). The IAB strongly supports this strategic project and is recommending to develop some works devoted to privacy. Moreover, the IAB is recommending to develop some new approaches, such a federated learning, which could be a powerful approach in the medical field.

In addition to higher bandwidth and robustness, SINET6 has implemented additional services. In the mobile SINET area, SINET6 will support significant wireless services including integrated private 5G services for stable local connections, the SINETStream software toolkit for next generation IoT applications, and end-to-end security services. At a higher level, SINET6 also provides access to cloud services with high quality of service, including the GakuNin Cloud Adoption Support services, On-demand Cloud Configuration services, and cloud storage services. At the application level, SINET6 provides an integrated Research Data Infrastructure that includes support for data governance and compliance (e.g., data management plans mandated by the 6th STI Basic Plan), the NII Research Data Cloud with the GakuNin RDM, CiNii discovery platform, JAIRO Cloud publication platform, all of which are being used by a steadily increasing number of institutions in Japan.

NII has been supporting the Gakunin Cloud aggregator service for quite some time. It is useful for a heterogeneous Japanese cloud market with 40+ cloud service providers. Gakunin can simplify the development of cloud-based (e.g., serverless) applications for SINET users, with concrete use cases as demonstration. As mature cloud services, it will be good to have more data on the number of users and applications, as well as total usage.

A vision for SINET6, which is planned for 2022, is under development. For real-time remote process control in industry (physical avatars), clinical surgery, traffic management and research, as well as advanced augmented and dual reality applications, networks with guaranteed latency will become a necessity. The so-called next generation Tactile Internet requires RTTs of less than 10 ms both on networked and wireless internet connectivity. The IAB recommends the exploration of collaborations with European and US institutions working on this topic.

Some highlights of Additional NII Research Data Cloud services provided by NII include:

- Cloud gateway: GakuNin RDM: cloud interface to all major public cloud service providers in Japan, including value-added services such as free data load for AWS.
- CiNii: Search service for Japanese research information (e.g., articles and dissertations); it links to several repositories and digital libraries, servicing about 60M queries in 2016. When there was a service disruption for 2 weeks, there were about 10,000 messages of users complaining that their academic work is massively disturbed by the lack of CiNii access. This shows that CiNii is a critical infrastructure for academia in Japan, so that its resilience is of major importance.
- JAIRO: cloud repository for Japanese academic institutions (714 institutions as of Feb 2022).
- Security infrastructure and services: security appliances to collect attack data, security data analytics, notification of attacks, user personnel education and cooperation.

The security services provided are of enterprise quality, with no major breaches reported since the beginning of SINET5 (April 2016). A major development is the availability of attack data to be made available to security researchers through academic data exchange programs. The statistical data about attacks and the large amount of malware samples being provided by NII may become very important assets for cybersecurity researchers worldwide. Thus, the IAB fully supports this major NII initiative.

Cybersecurity is of course a key issue for SINET, with the NII-SOC which operates different security systems, which trains the users and which makes the observed data available for researchers. The design of the next-generation security will rely on the use of Machine Learning (ML) approaches in order to strengthen the automation of many tasks and to be able to scale up: the IAB strongly supports this project since the combination of cybersecurity and ML-based approaches is a field of growing interest and a key component of the future security systems worldwide. This requires the establishment of multidisciplinary teams (cybersecurity, machine learning), which should be promoted. The IAB is wondering about the increased dissemination of observed data for the community of cybersecurity in Japan.

NII has been instrumental in supporting Japanese academic institutions going through the COVID-19 pandemic. An example is the COVID-19 Data Portal Japan, enabling efficient access to COVID-19 research data from around the world (currently 31 types of research data and tools). Another example consists of an effective support for online conferences and education, with a large number of successful conferences and workshops conducted online, some with thousands of attendees.

One area of significant current effort is timely research data sharing that started from the COVID-19 Data Portal. Due to the rapidly evolving pandemic, often with unprecedented novel developments (e.g.,

a new variant such as Delta and Omicron), typical AI/ML models fail rather quickly, usually in a matter of weeks. It is important to collect, process, and deliver new research data in a timely fashion. The IAB considers this work very important and urgent, and we encourage NII to continue the efforts to develop data platforms and software tools to enable the next generation of models that may be able to catch up with the evolving pandemic.

Organization of the IAB Meeting

The IAB thanks the staff of NII for the excellent preparation and organization of the meeting in spite of the COVID-19 constraints. The 17 prerecorded videos for on-demand viewing gave a very good overview on some of the most important NII projects. The PDF of the slides and the CV of the speakers were very useful for the IAB member.



March 31, 2022: Professor Dr. Dr. h.c. mult. Wolfgang WAHLSTER, IAB Chair

Appendix A

17 Videos about Selected Research Projects

The IAB has the following comments and recommendations for the projects presented via videos. As a general remark, it could be useful to indicate in a synthetic way the number of people who are involved in the projects, an estimation of the global budget dedicated for each project and the key partnerships. This is sometimes indicated, but not for all projects.

Basic Theory of Informatics

"Geometric Approaches to Machine Learning" Assoc. Prof. Sugiyama

"Theoretical algorithm that can still make huge impact" Prof. Kawarabayashi

"Average Sensitivity Analysis of Optimization Algorithms" Prof. Yoshida

Artificial Intelligence and Big Data

"Towards Engineerable AI: Automated Testing and Debugging Techniques for Optimization and Learning-based Systems" Assoc. Prof. F. Ishikawa

"Activities of Research Center for Medical Bigdata - Interplay between Medicine and IT on Cloud" Prof. S. Satoh & Prof. Mori

"Research on Juris-informatics", Prof. K. Satoh

"Photo Acoustic Imaging and Spectral Signature Analysis for Scene Understanding", Prof. I. Sato

Software and Hardware Architectures

"Formal Methods under Physical and Statistical Uncertainties: Towards Mathematical Trust in Software and Systems", Prof. Hasuo

"Towards Smart, Seamless and Sustainable Beyond 5G Wireless Networks", Assoc. Prof. Kaneko

Information and Society

"Synthetic media generation and its detection", Prof. Echizen & Prof. Yamagishi

"Online Cross-Signing Project: Understanding Cross-linguistic and Cross-cultural Phenomena of Video Conferencing Situations in the COVID-19 Era", Assoc. Prof. Bono

"How to fly around the isolated knowledge silos and create your own gallery of discovery" Prof. Takano

Academic Information Infrastructures and Services

"SINET6 - Next-generation network platform" Prof. Urushidani

"Research Data Infrastructure for accelerating open science in Japan", Prof. Yamaji

"Cyber Security Management on Next Generation Networks" Prof. Takakura

"Support for Cloud Adoption and Use", Prof. Aida

"SINETStream: Software Library for IoT Applications", Prof. Takefusa