2023 年　3 月　23 日 (Year/Month/Day)

名古屋大学 大学院情報学 研究科長 殿
To:　Dean of Graduate School of Informatics, Nagoya University

研究報告書

RESEARCH REPORT

滞在期間における研究報告書を，添付のとおり提出いたします。
This is the cover page of my attached research report.

A. Cover Page

1. 被招へい研究者　所属・職・氏名
   Affiliation (Country / Area), Position, Name of Visitor
   University of Bucharest, Faculty of Physics (Romania/Bucharest-Magurele), Professor, Ana-Nicoleta Bondar

2. 受入研究者　所属・職・氏名
   Affiliation, Position, Name of Host
   Nagoya University, Professor, Masataka Nagaoka

3. 滞在中の研究テーマ
   Research Theme during the Visit
   Molecular simulations of protonation dynamics and protonation-coupled bio-systems

4. 滞在期間 Period of Visit
   2023 年　3 月　4 日～ 2023 年　3 月　23 日
   From (Year/Month/Day)　To (Year/Month/Day)

5. 招へい教員の主な研究テーマ
   Main Research Themes of the Visitor
   Molecular simulations, proton transfer systems, graph-based algorithms of dynamic hydrogen-bond networks, protonation-coupled protein dynamics

6. 招へい教員の個人ページなどへのリンク
   Link (URL) to the Personal (or Project) Page of the Visitor
   https://unibuc.ro/user/ana.bondar/?lang=en

（注）「研究報告書」には、被招へい研究者の研究活動や講義等の写真を添付してください。なお、「研究報告書」（セクションA, B, C）及び写真は Web サイト等で公開される場合があります。個々の写真の公開を拒否される場合は、その旨記載して下さい。
Please select pictures which were taken when the visitor conducted his/her research or provided a lecture, and attach it to in this report. We may later upload the reports (sections A, B, and C) and/or pictures on our Web site. If the visitor does not want to have the picture(s) posted on our Web site, please indicate so per picture.

B. Research Activities (to be published at the Faculty Web Site)

1. 滞在中の共同研究テーマや(可能なら)成果の紹介

   Brief Introduction of the Joint Research and Result (if possible) during the Visit

   Proton reactions at bio-membrane interfaces are essential for bio-energetics and can be exploited for bio-medical applications. When bio-molecules like peptides in the bio-system of interest have multiple protonation sites, their protonation states may change in the pH range of interest. However, the accurate computations of the protonation states can become challenging. The joint research during the visit focused on identifying appropriate model systems and methodologies for efficient and accurate computations of protonation states of model peptides.

   During the research visit, two highly complementary directions of research were pursued by the Visitor together with the Host, as briefly summarized below.

   The first direction aims to validate the usefulness of the Constant pH Monte Carlo method developed recently by Kitamura & Nagaoka (J Chem Theor Comput 2021) for larger peptides. This direction of research, which is a collaboration with Ms. Fuka Inagaki and Ms. Haruka Yotsuya (Nagaoka laboratory), Prof. Yukichi Kitamura (Shizuoka University), and Prof. Yuko Okamoto (Nagoya University) involved in-depth discussion about the choice of the model peptide for the computation, the choice of the experimental values used as a reference, approaches to data analyses, error analyses, and the usage of water interactions as a marker for the protonation state of the titratable sidechain of interest.

   The second direction of research aimed to test somewhat larger peptides in which the titratable sidechain of interest could participate in intra-molecular interactions potentially important for the considerations of water interactions at the titratable site. To this aim, the Visitor and the Host selected two additional peptides for which pH titration behavior has been previously investigated with experiments. The Visitor prepared eight different simulation systems distinguished by the protonation state of the titratable sidechain, and by the treatment of the N- and C- termini of the peptides. Then, she used classical molecular simulation approaches to sample the motions of the peptides in each of the independent simulation systems. These preliminary simulations provide an atomistic view of the motions of the peptide, and of the preferred conformations sampled by the peptides in the conditions considered. Finally, they agreed that these simulations could also serve as a starting point to start computations of likely protonation states of the titratable side chains, leading to further collaborative research.

2. 滞在中に訪問した研究者

   Researcher(s) Visited during the Stay

   The research stay was hosted by Prof. Masataka Nagaoka, Nagoya University, Graduate School of Informatics. During the research stay in the laboratory of Prof. Nagaoka, the visitor discussed with Prof. Nagaoka and members of his laboratory; Prof. Tsutomu Kouyama, Prof. Yuko Okamoto, and Prof. Takahisa Yamato (Nagoya University, Graduate School of Physics); Prof. Hedong Zhang and Prof. Norio Yoshida (Nagoya University, Graduate School of Informatics); Prof. Hideki Kandori (Nagoya Institute of Technology); Prof. Yukichi Kitamura (Shizuoka University); Prof. John Straub (Boston University). Additional scientific discussions took place during the StudyCamp, and during and after the FVCRC lecture – including brief discussion with Prof. Florence Tama (Nagoya University, Graduate School of Physics and Dr. Osamu Miyashita (RIKEN Center for Computational Science). On the way back to Tokyo for the flight back to Europe, the Visitor met and discussed with Prof. Keiichi Inoue and Dr. Masae Konno (University of Tokyo, The Institute for Solid State Physics, Functional Materials Group).

3. 滞在中に参加したワークショップなど

   Workshop/Symposium/Conference Attended during the Visit


StudyCamp2022


FVCRC Lecture

1. StudyCamp2022 Ohmihachiman, March 6-7, 2023 (Invited talk)

2. Future Value Creation Research Center lecture, March 15 (Invited talk)

The Visitor presented recent research from her research group of the development of graph algorithms to analyze dynamic hydrogen-bond networks of bio-systems, and applications largely focused on membrane protein systems.

C. Life in Nagoya/Life in Japan (to be published at the Faculty Web Site)

観光/食/文化などなんでも.
名古屋あるいは日本に滞在して楽しかったことや印象に残ったことなど.
(Sightseeing, Food, Culture, etc. Please describe whatever you felt interesting or impressive during your stay in Nagoya and Japan.)

During her research stay in the Nagaoka laboratory, the Visitor had the opportunity to visit museums, including the Toyota Commemorative Museum of Science and Technology and the Nagoya Science Museum. With Prof. Minoru Sugihara (Meiji Pharmaceutical University), the Visitor had the opportunity to see several shrines in Ise Jingu, and the History Museum in Ise.

The Visitor was very much impressed with the impeccable organization of StudyCamp2022 in Ohmihachiman. The StudyCamp was organized by the students of the Nagaoka laboratory, particularly Mr. Yuki Shirasawa. The organization involved, besides the scientific talks, planning of transportation, accommodation, three meals (one dinner and breakfast on site, lunch in town), preparation of booklet with information about the site (in Japanese and English), the schedule of the meeting, travel by bus, and sightseeing around Ohmihachiman. All went as planned, and for the scientific sessions, the schedule was kept essentially to the minute.