

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。

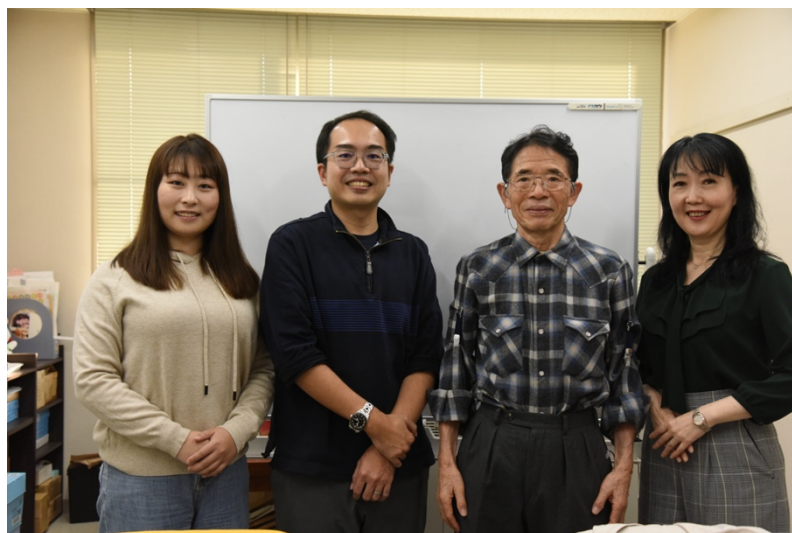
This is the cover page of my attached research report.

#### A. Cover Page

1. 被招へい研究者 所属・職・氏名 Affiliation (Country / Area), Position, Name of Visitor Faculty of Mechanical Engineering, Universiti Teknologi Malaysia, Johor Bahru, Malaysia Assoc. Professor, William Woei Fong Chong
2. 受入研究者 所属・職・氏名 Affiliation, Position, Name of Host Department of Complex Systems Science, Graduate School of Informatics, Nagoya University Professor, Hedong Zhang
3. 滞在中の研究テーマ Research Theme during the Visit Numerical modelling of macro lubricity in conjunctions with nanometer-thick films
4. 滞在期間 Period of Visit 2023 年 10 月 2 日 ~ 2024 年 1 月 5 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 Multi-scale Modelling, Tribology, and Green Lubrication
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 <a href="https://people.utm.my/william/">https://people.utm.my/william/</a>

(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.



Meeting Prof Yasunaga Mitsuya during one of his visits to Nagoya University



Guest lecture on 24<sup>th</sup> November 2023

## 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

Understanding the interaction between surface effects and large-scale forces is crucial for achieving ultra-low friction. Our research proposes a numerical framework that integrates surface and hydrodynamic effects to simulate macro-scale contacts separated by an initial nanometer-thick liquid film. Our model shows that at lower velocities, hydrodynamic effects are necessary to overcome attractive pressures from surface forces, sustaining the liquid film within the confined gap. As sliding velocities increase, hydrodynamic effects become more prominent, coinciding with the widening of the contact gap. This widening is attributed to increased viscosity within the nanoscopic confined area. Our numerical model, validated by experimental measurements, provides insights into the interplay between surface forces and hydrodynamic effects.

Our numerical framework adeptly simulates the interplay of competitive force laws under continuum assumptions, laying the groundwork for future enhancements. An imminent extension in our collaborative efforts entails refining Reynolds' equation through the application of viscous adsorption theory, aiming for a more precise depiction of lubricated connections featuring thin films adhered to boundaries. This refinement will also involve integrating structural surface forces arising from the interaction between adsorbed films and mobile liquid molecules, employing molecular-based techniques. The ultimate model is anticipated to significantly improve predictions of frictional performance across diverse molecules, considering the influence of adsorption.

### 2. 滞在中に訪問した研究者

Researcher(s) Visited during the Stay

Prof Mitsuya, Yasunaga – Meaningful discussions regarding the joint research took place throughout the visit. The valuable insights and expertise of Prof Mitsuya in this field were particularly instrumental in ensuring the feasibility and success of the research endeavors. We deeply appreciate Prof Mitsuya's substantial contributions to the collaborative efforts, enhancing the overall quality and viability of our research.

Prof Fukuzawa, Kenji's laboratory – I visited Prof Fukuzawa's laboratory. The visit focuses on exploring further experimental work collaboration on friction measurements using the existing in-house tribotesting equipment.

### 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

Throughout the 3-month visit, the primary objective was to accomplish the joint research activities. Consequently, there were no scheduled plans to attend workshops or conferences. In addition to actively engaging in the collaborative research endeavors, I collaborated with Prof Zhang in providing guidance to her postgraduate students and offering insights on research paper writing.

By the conclusion of the visit, we achieved a significant milestone by completing and submitting five journal papers, one of which has already been accepted by a high-impact journal with an impressive impact factor of 4.5. This productive outcome underscores the success of our collaborative efforts during the visit.

## 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.)

In the past few years, except for the pandemic period, my wife and I have established an annual tradition of visiting Japan. A highlight of these visits is our regular meeting with Professor Zhang at Nagoya University. Japan holds a special place in our hearts, providing a sense of belonging, especially for my wife who pursued her studies in Nagoya for two years. This time around, during my three-month stay at Nagoya University, my family had the wonderful opportunity to join me. This visit is particularly significant as it marks my son's inaugural experience in Japan.

Personally, my time spent living in Japan has been immensely enjoyable, largely owing to the systematic and convenient lifestyle that the country offers. The efficiency and orderliness contribute to a positive living experience, and I look forward to continuing to explore and create cherished memories in this captivating country.

