Professional Leave Report Cover Sheet

Name: Daming Zhang

Department: Industrial Technology

College: Jordan College of Ag Sciences & Technology

Leave taken: ◉ Sabbatical ○ Difference in Pay ○ Professional Leave without Pay

Time Period: ◉ Fall 2021

○ Spring

○ Academic Year

○ Other

Your report will be sent to your Dean for your PAF and to the Library Archives.

FRESNO STATE
Jordan College of Agricultural Sciences and Technology

MEMORANDUM

Date: March 31, 2022

To: Dr. Dennis Nef, Dean
Jordan College of Agricultural Sciences and Technology

Dr. Alex Alexandrou, Chair
Department of Industrial Technology

CC: Dr. Xuanning Fu, Provost

Diane Volpp, Office of Faculty Affairs

From: Daming Zhang, Ph.D.
Professor of Transportation Systems Management
Department of Industrial Technology

Subject: **Sabbatical Leave Report Fall 2021**

Section 1. Reporting on the Success of the Leave

I sent the sabbatical leave application and plan on September 11, 2020 (See Attachment 1). My application and plan were approved by JCAST Personnel Committee and Dean Dennis Nef in early November 2020 (See Attachment 2). I took Fall 2021 on sabbatical leave.

(a). Accomplishments
My sabbatical leave is a success in all three objectives, although the Objective 3 became weak principally because of COVID-19 pandemic and the travel restrictions, I lost the chances to visit some schools and international universities. I spent the time to cooperate with some international experts in the publication of 2 new peer reviewed journal papers.

For the Objective 1, Department, College, and University Advancement: I spent most of my sabbatical leave on creating and improving the hands-on labs and projects for my new courses: IT 126/226 – Intelligent Robot, and IT 128/228 – Self-driving Vehicles. Without this sabbatical leave, it will be difficult for me to have continuous time to work on those courses at the same time.

After my last sabbatical leave in the Fall 2014, I have created four brand new courses to our BSIT and MSIT programs at the Industrial Technology department, including the courses IT 124 – Hybrid and Alternative Fuel Vehicles to make our automotive curriculum updated, IT

217 – Quality Management Techniques to meet the need of a graduate level quality management course for our MSIT program, especially the two dual-level artificial intelligence related courses IT 126/226 – Intelligent Robot, and IT 128/228 – Self-driving Vehicles brought the newest technologies to our BSIT and MSIT programs. The high student ratings (all above 4.5 out of 5.0) and peer evaluations (all with 4.5 or 5.0 out of 5.0 rating) proved that the four new courses I created during the past six years are well received. However, because I never applied for any release time, all four new courses were created using my spare time. My desire of creating some hands-on labs and projects is delayed because of busy teaching loads and research projects.

During this sabbatical leave in the Fall 2021 semester, I finally got time to systematically create 14 Labs, 2 Projects, and the Final project for IT 126/226 – Intelligent Robot (See Attachment 4), and 14 Labs, 2 Projects, and the Final project for IT 128/228 – Self-driving Vehicles (See Attachment 5). Those Labs and Projects are closely related to the teaching modules of the two courses to help students to deeply understand the concepts and principles of artificial intelligence, machine learning, deep learning, deep neural networks, reinforcement learning, etc. through hands-on "fabrication", hands-on "programming", and hands-on "simulation". I spent time on every Lab and Project to actually go through the whole process to guarantee the correctness and completion.

The developed Labs and projects for IT 128/228 – Self-driving Vehicles have been used in this semester for the first time. It showed very clearly by Lab 01 to Lab 06 that students like those hands-on labs very much. Thanks to the university to make those possible through my sabbatical leave. I'm very happy to see that my "Learning by doing" teaching philosophy has been implemented successfully.
The developed labs and projects for IT 126/226 – Intelligent Robot will be used in the Fall 2022 semester for the first time. I expect to see the smiles on students' faces after they finish those hands-on labs.

I also used this sabbatical leave to explore the research opportunities in artificial intelligence, intelligent robotics, and self-driving vehicles. During the whole period of my sabbatical leave, I and Dr. The Nguyen worked with Noah Haworth, a graduate student from the Mechanical Engineering department. Noah took my IT 226 – Intelligent Robot in the Fall 2020 semester and became extremely interested in intelligent robotics. We are doing research on the design, analysis, simulation, and fabricating of a quadruped robot. The project was initiated from my thinking that wheeled robots become too pitchy when used in agriculture field because the field is generally not flat. Relatively, legged robots maybe easier to keep leveling which are important for the robotics used in the agriculture fields. Around the end of Fall 2021, we have finished the first part research on the frame design and gait design and finished the related analyses. The research work is continued in this Spring 2022 semester on the simulation of the robot and the fabrication works. We planned to finish the whole project around the end of this semester in May 2022. It's expected that

the designed quadruped robot may applications in the field doing agriculture work. The research achievements may be published as a journal paper.

For the Objective 2, Regional Industry and Business Engagement: I visited and/or talked to some local farms, industry, and business such as:
Bowles Farming Company
William Boos & Co Inc.
Peters Fruit Farms Inc.
Sihota Farms, Inc.
Sunrise Medical (US) LLC.
Saga Robotics

Through the visits, I want to investigate on what kind of new technologies the local farms and agricultural businesses would need. Based on that understanding, I have got some ideas for how to improve the IT 126/226 – Intelligent Robot, and IT 128/228 – Self-driving Vehicles courses to meet the needs of local farms and businesses. It's a pity that I couldn't join Dr. Alex Alexandrou when he and a student visited GUSS Automation LLC, a company in Kingsburg which develops and manufactures autonomous sprayers. I will visit GUSS in the future to discuss with them about our BSIT and MSIT curriculum and look for research opportunities.

As planned, I also talked with Professor Jianqiao Sun of the Mechanical Engineering department, University of California Merced. During a long discussion, I showed him the syllabi of IT 126/226 – Intelligent Robot, and IT 128/228 – Self-driving Vehicles courses. He's very interested on the topics I put into the two courses. He said that they don't have courses like these at their department. We agreed that artificial intelligence is an emerging technology area that we can never neglect. We should look for cooperation opportunities in the future.

But because of the COVID-19 pandemic, when I contacted Mr. Beau Sunahara of the Duncan Polytechnical High School, Mr. Jason Mullikin of the Clovis High School, Mr. Marty Kamimoto of the Fresno City College, and Irenio Garza, Tim Hunter, Stephen Rosendale, and Brett Nelson of the Reedley College, I didn't get permission to visit any of the high schools and community colleges. I will visit them in the future when the situations getting better.

For the Objective 3, Global Education Development: In my plan, "**If permitted by travel restrictions**, I hope to spend some time during my sabbatical leave to visit the National University of Singapore and National Taiwan University to develop new cooperation plans". Unfortunately, the travel restrictions were never lifted in Singapore and

Taiwan during my planned time. I didn't get chances to visit the National University of Singapore and National Taiwan University.

I used the time on the publication of two research papers (See Attachment 3). Before the COVID-19 pandemic, I cooperated with Professor Guohai Jia of the College of Mechanical and Electrical Engineering, Central South University of Forestry and Technology in Changsha, China to conduct some research projects. The publications of the results were delayed because of COVID-19 pandemic. We realized that the severe travel restriction cannot be lifted in the near future, and our research results cannot wait for too long. So, I worked with Professor Jia's team to organize papers based on our research results. After about two months discussions over the phone and email, we finalized two journal papers.
The first one, "Effects of Plateau Environment on Combustion and Emission Characteristics of a Plateau High-Pressure Common-Rail Diesel Engine with Different Blending Ratios of Biodiesel", was submitted to the "Energies" (ISSN 1996-1073, Impact Factor: 3.085). It has been published on January 13, 2022 (DOI: 10.3390/en15020550).
The second one, "Research on Combustion and Emission Characteristics of Tung Oil-based Biodiesel with Different Blending Ratios", was submitted to "Fuel" (ISSN: 0016-2361, Impact Factor: 4.059). It's in the review process.

(b). Modifications
I didn't request modifications because the travel plan in the original Objective 3 is based on "**If permitted by travel restrictions**". When I found that the travel restrictions were not lifted, I implemented international cooperation through phone and emails.

c). Goals not Accomplished
No goal was not accomplished. Even with the COVID-19 travel restrictions, I still did global collaborations with an international university and published papers.

Section 2. Benefits to Me as a Faculty Member

(a). Explain how this leave has led to a greater command of subject matter:
This sabbatical leave allowed me to develop hands-on labs and projects for IT 126/226 – Intelligent Robot, and IT 128/228 – Self-driving Vehicles courses. Those hands-on labs and projects greatly strengthened the quality of the two courses.

(b). Explain how this leave may have accomplished a shift in areas of academic emphasis of the faculty member:
This sabbatical leave gave me time to deeply dive into artificial intelligence. Other than machine learning and deep learning I taught in the IT 126/226 – Intelligent Robot, and IT 128/228 – Self-driving Vehicles courses, I myself also studied transfer learning and made a

hands-on lab on reinforcement learning. I'm thinking about including transfer learning into the two courses in the future.

(c). Explain how the leave might lead to improved organization of curricula:
During this sabbatical leave, I realized that big data is the base for self-driving technologies. I'll convert the topic course IT 191T/284T – Intelligent Big Data into a regular course. After the conversion, I may offer the course once a year as the foundation for the IT 126/226 – Intelligent Robot, and IT 128/228 – Self-driving Vehicles courses

(d). Explain how the leave has led to a command of advanced methods of teaching:
Based on my multi-year experiences in teaching artificial intelligent related courses, I can see that programming is the difficult part in studying. That's the principal reason I spent most of my sabbatical leave on the "soft" part of the hands-on labs. I have matched all important modules with hands-on coding labs to help students grasping the new knowledge firmly.

(e). Explain how the leave might lead to creative activities in one's field or in a closely related field:
During the whole period of my sabbatical leave, I worked with a graduate student of Mechanical Engineering department, who took my IT 226 – Intelligent Robot and became extremely interested in robotics. We are doing research on the design, analysis, simulation, and fabricating of a quadruped robot. The developed robot may be used in the field doing agriculture works.

Section 3. Benefit to the University

Benefits of this sabbatical leave to the university can be far reaching. The newly developed hands-on labs and projects will improve the new artificial intelligence related courses IT 126/226 – Intelligent Robot, and IT 128/228 – Self-driving Vehicles, and make those courses more attractive to the students of the IT department, of the Jordan College, and of Fresno State. This sabbatical leave also gave me the time to explore the possibility of applying artificial intelligence, self-driving vehicles, and intelligent robotics to agriculture. It will facilitate the embodiment of the IT department to the body of JCAST. Consequently, it may solidify the JCAST goal on integration of academic program into research unit.

Section 4. Original Proposal

See Attachment 1.

Section 5. Seminar

I will be willing to present my sabbatical leave to our peers, but the JCAST seminars have never been arranged in recent years. I will look for a chance to present in the future when the seminars are reopened.