

2019 PROVOST'S LEARNING INNOVATIONS GRANTS CALL FOR PROPOSALS

The **Provost's Learning Innovations Grants** (PLIG) program was developed to broaden and enrich the learning experience of RIT students by funding faculty-initiated projects that enhance student learning. Managed by the Innovative Learning Institute (ILI), this program has been designed to:

- Better support dissemination of individual faculty learning to the wider faculty population
- Integrate funding with Institute priorities
- Support the scholarship of teaching and learning

I. ELIGIBILITY

All full-time RIT faculty (tenured, tenure-track, visiting, lecturers, etc.) are eligible to apply.

II. GRANT TYPES

There are two types of grants—Exploration and Focus—for PLIG 2019. Full details are available on the [Grants Types](#) page of the PLIG website (www.rit.edu/plig).

III. USE OF GRANT FUNDS

Provost's Learning Innovations Grants for 2019 may range from \$1,000-\$5,000.

Examples of the use of PLIG funds include:

- Course release (reasonable, actual replacement costs for faculty members removed from teaching)
- Development of new technology-based learning tools and/or environments
- Technologies or equipment required that are not normally provided by the department/college
- Resources for research design and consultation, data collection and aggregation, instrument development and/or purchase, secure data storage, data analysis, and report generation
- Travel to support research activity and/or meet with potential funding sources

IV. PLIG TIMELINE AND TASKS

The grant timeline assumes that most recipients will use the Spring 2019 and/or Summer 2019 term(s) to plan and develop their PLIG-funded project for delivery or implementation during the Fall 2019, Spring 2020, and/or Summer 2020 term(s). The full [timeline](#), including grantee tasks, is available on the PLIG website.

V. SELECTION COMMITTEE AND EVALUATION CRITERIA

Applications for PLIG funds are evaluated by the [PLIG selection committee](#) according to the following criteria:

- *Utility* (solves a defined problem; has potential to benefit many courses/faculty)
- *Creativity* (is a novel approach or application; represents a new paradigm)
- *Efficacy* (uses an evidence-based approach; impact to student learning and/or the student experience can be demonstrated)

The criteria are further defined, illustrated, and explained in the [Proposal Evaluation](#) section of the PLIG website.

VI. QUESTIONS

Please email plig@rit.edu with any questions about the PLIG process.

(Examples of previously funded projects are available in the [Previous Awards](#) section of the PLIG website).

2019 PROVOST'S LEARNING INNOVATIONS GRANTS

APPLICATION

INSTRUCTIONS

1. Complete this Application Form and save as "Lastname_Firstname_APP" (*using your name*).
2. Ask your Department Head to complete the Department Head Certification, scan and save as, "Lastname_Firstname_SIG" (*using your name*).
3. Email all documents to plig@rit.edu, **no later than 11:59pm ET, January 21, 2019**.

If you have any questions about completing this application, please contact Michael Starenko at 585-475-5035 or mssetc@rit.edu.

APPLICANT INFORMATION

This application is for a (please select *one* type of grant):

Exploration Grant

Focus Grant – Active Learning Across All Course Modes

Principal Applicant Name: Raymond Ptucha

Faculty Title: Assistant Professor **Email:** rwpeec@rit.edu **Phone:** 585-797-5561
(*Full-time only*)

College: KGCOE **Department:** Computer Engineering

Department Head Name: Shanchieh Yang **Email:** sjyeec@rit.edu

Others involved in the project (if any): _____

Project Name: Multi-Disciplinary Autonomous People Mover Multi-modal Sensing

Total Funds Requested (*as calculated on the budget worksheet on the next page*): \$5,000
(*requests of \$1,000 to \$5,000 will be considered*)

BUDGET

Complete the table below to calculate your budget

- The total shown on this worksheet must match the “Total funds requested” in the Applicant Information section on page 1 of this application form.
- If awarded, additional funds will be provided to cover any benefits and ITS expenses associated with the salary budget requested.
- Note that any equipment or other materials purchased with grant funds are the property of your department and revert to the department after your project is completed

Personnel	Purpose/Justification	Amount
Full-time Faculty/Staff		
Adjuncts, Part-time Faculty/Staff, Summer Salary		
Student Workers, Graduate Assistants		
Student Workers	Collect ground truth annotation data for supervised deep learning models. 100 hrs * 12.50/hr	1,250
Graduate Assistant	Build and design multi-modal deep learning models in conjunction with Multi-disciplinary senior design team. Concepts too difficult for senior design team. Work with MSD students during second semester. 15 weeks * 10 hrs/week * \$15/hr	2250
Personnel Total		\$ 3500.00
Equipment	Purpose/Justification	Amount
9" Outdoor high contrast touch LCD screen	Allows riders to enter destination, then view campus map with localization and sensor information on screen	1199
Equipment Total		\$ 1199.00
Travel	Purpose/Justification	Amount
ASEE Zone 1 (North East) Conference	Local ASEE publication for students: Demonstrate multi-disciplinary aspects of project. (Note: location TBD, in 2019 it is in Niagara Falls- it usually is within a drive from RIT)	500
Electronic Imaging Conference	International publication for students: Demonstrate state-of-the-art technical contributions of the project	2200

		Travel Total	\$ 2700.00
<i>Other (Specify)</i>	Purpose/Justification	Amount	
PI contribution	PI will contribute \$2399 in as max award is \$5000	(2399)	
		Other Total	\$ (2399.00)
		Total Award Requested	\$5,000.00

STATEMENT OF UTILITY (two pages maximum)

Using the evaluation criteria outlined in the [Proposal Evaluation](#) section of the PLIG website, please provide an overview of the project you are proposing, including:

- Project objectives
- An explanation of the teaching/learning problem(s) it is designed to address
- An explanation of the significance of the project to student outcomes and/or the student experience.
- A brief description of how the project integrates with activity already underway at RIT in a priority area and/or how this approach has been successfully used at RIT already.

Today, a family driving on the highway might become amused as they pass an autonomous vehicle. In the not too distant future, an analogous family riding in a car might also become amused, but perhaps alarmed if they passed a human driving a car. Humans drink, do drugs, get tired, get distracted, and have slow reaction times. Machines never get tired, are 100% focused on the road, can see 360 degrees all around, can identify, track, and communicate all surrounding vehicles and traffic signals at incredible speeds. In the future, it will be too dangerous to trust human drivers!

Since its inception, over \$30K in donations (including donations from Harris, Kodak Alaris, Maval, D3 Engineering, Progressive Machine and Design, and Wegmans) has been raised to convert an ordinary Kawasaki golf cart into an autonomous people mover. Under the stewardship of the PI and the Multi-disciplinary Senior Design (MSD) program in KGCOE, six teams of senior engineering students initially converted the golf cart to remote control, and then to limited autonomous functionality. The golf cart has been demonstrated at every ImagineRIT since its inception, and was recently showcased at the Detroit Auto Show in Jan 2019 for RIT marketing and recruitment efforts. In addition to giving real-life skills on pertinent and cutting-edge fields to senior undergraduate students, the golf cart has served as a research platform for several master's students.

We are so lucky to witness the huge transformation of the automobile market. Most hi-end cars already have some sort of driver assist systems (radar for brake assist and vision for lane assist). With each year, these technologies will get better, and in a few years full autonomy, first on controlled roadways, and then all roads will be realized. Directly responsible for this is the advancement of the field of machine learning, and specifically a new technology called deep learning. The PI is an expert at deep learning and has given dozens of tutorials on deep learning both at public conferences (EI'19, FG'18, ICFHR'18, UP-STAT'18, CSEC'18, GTC'18) as well as private/gov't companies/universities (Apple, Motorola, Harris, SRC, Kodak, VisualDx, Huawei, NVIDIA, NASA, UofR, Cornell). The PI is also an NVIDIA Deep Learning Institute certified instructor, and has served as the chief sponsor and stakeholder of the golf cart since its inception.

The golf cart has been a huge research success, with over 30 undergraduate students participating and six publications. This PLIG proposal will enable the golf cart to continue to integrate state of the art autonomous driving technology and demonstrate this cool technology to passengers (and the public at demonstrations) on a new high contrast LCD screen. Specifically, the deep learning technology used in this grant will fund the ability of the golf cart to realize categorical labeling of all pixels in a frontal computer vision system, and integrate this feature rich input with a Velodyne 16-channel LiDAR sensor for advanced situational awareness of the golf cart. The money from this grant will pay for a graduate student to support the project, pay for human workers to annotate supervised ground truth training data, and allow students to showcase their work at both a local ASEE conference (ASEE'20) as well as an international conference (EI'21).

The graduate student will have two main responsibilities:

1. Because the deep learning software and related algorithms are typically taught at the graduate level, this student, in conjunction with the PI, will teach the students the appropriate usage of deep learning libraries.
2. Assist the PI in seeking and writing grant applications, seeking sponsorship and support of the autonomous people mover

The human workers who collect ground truth data will use an existing interface based on the OneCut with Seeds program to label each pixel in a video frame belonging to the classes {blacktop path/road, brick path/plaza, dirt, grass, building, person, bike, skateboard/scooter, car, truck, golf cart, tree/vegetation, other} with additional field of {safe, non-safe}. These video streams will be synchronized with 16 channel LiDAR sensors for state-of-the-art multi-modal sensor fusion. Although this cart is targeted to drive autonomously, for safety and legal reasons, a trained driver will be onboard and walking in proximity of the cart. Both a manual and wireless kill switch will always be available in the unlikely event of an emergency.

Project objectives: To introduce the introduction of advanced deep learning vision and sensor fusion into the autonomous golf cart project in a fashion such that multi-disciplinary students can learn these methods, and such that these methods can be showcased to the public.

Teaching/learning objectives to be addressed: Videos and self-paced programming assignments are being created such that general science and/or engineering students can apply advanced deep learning concepts to their problems. These videos and assignments, in conjunction with existing online assignments will be used in a flipped classroom style to efficiently teach students.

Project significance: It is no longer a question *if* self-driving cars will transform the automotive industry, but *when*. Self-driving cars will make our roadways safer, our environment cleaner, our roads less congested, and our lifestyles more efficient. The USDOT has committed hundreds of millions of dollars in funding in the last few years. To compete for a piece of this funding, RIT needs to demonstrate some basic core competencies. The autonomous people mover is a huge step in that direction.

Project integration with existing RIT activity: This project is thoroughly integrated into the KGCOE Multidisciplinary Senior Design program. This project has already involved professors (and/or their students) from KGCOE, GCCIS, COS, and CAST.

The use of flipped classroom style videos to disseminate knowledge has had much success in classrooms. Similarly, the MOOC style of short videos with inline quizzes and accompanying tasks has also been successful. This effort will leverage the excellent resources in the Wallace center along with the many instructors who have participated in flipped classrooms

STATEMENT OF CREATIVITY (three paragraphs maximum)

Provide a brief description of how this is a novel approach, or a new application of an existing mode or model of teaching and learning, and/or research about how teaching and learning represents a new paradigm.

The autonomous people mover platform is shared amongst several departments and colleges and is a great way RIT can get firsthand experience on autonomous driving. The concept is so exciting that RIT's Reporter Magazine has done several articles on the cart, and RIT marketing showcased this project at the Detroit Auto Show in Jan 2019. Every year since its inception, the project has been showcased at Imagine RIT. The creativity in this application is the incredible research that will result and the priceless value it will bring to RIT. Projects on obstacle avoidance, localization, map making, human computer interfaces, ergonomics, and advanced machine learning have all resulted from this project. The creativity is also in the clever ways of reaching out to many disciplines through the use of online videos in a fashion that is intriguing, motivating, and understandable by all. All money for this project goes towards supporting student efforts and showcasing this amazing project to the public.

STATEMENT OF EFFICACY (two pages maximum)

Provide a brief description of the experiment/research design, methodology, and methods of data collection and analysis you will use to gauge efficacy.

The integration of the vision and LiDAR sensor will be done in conjunction with a KGCOE two-semester multidisciplinary senior design project. The golf cart is already being worked on by the sixth-generation senior design team- it has been and remains one of the most popular senior design projects. The funding from this PLIG grant will ensure that many future classes of students will be afforded the opportunity to work on this invaluable resource. This project follows best practice design and integration of research concepts. Both a project guide and sponsor ensure the students thoroughly investigate all options in semester one, and integrate hardware/software in semester two. As part of this integration, the team will explore the pros and cons of deep vision pixel segmentation systems, understand the various methods of LiDAR and vision sensor fusion, and become familiar with state-of-the-art autonomous driving technologies. To gauge the effectiveness of the project's goals, the students present their progress every three weeks and hold gate reviews at the end of each semester. At this year's Imagine RIT, the students will allow the people mover to drive autonomously through crowds of people along selected routes (once again with safety driver onboard and safety observer walking beside it with a kill switch).

ADDITIONAL CONSIDERATIONS

Please address these questions, if needed.

Will your project require assistance for extensive or unusual media, multimedia, simulation, and/or software development? If so, please explain?

No

All courses offered by RIT must be accessible to students with disabilities, according to Section 504 of the Rehabilitation Act of 1973 and Title II of the Americans with Disabilities Act of 1990 (rit.edu/studentaffairs/disabilityservices/info). Is your proposed teaching approach accessible to all students, with reasonable accommodation? If not, please explain.

Yes

RIT abides by the Family Educational Rights and Privacy Act of 1974 (FERPA), which prohibits instructors from making students' identities, course work, and educational records public without their consent (rit.edu/xVzNE). Will any data gathering or sharing for your project raise any FERPA issues? If so, please explain.

No

DISSEMINATION AGREEMENT

By completing this grant application, I agree to provide the materials and services described here, in support of disseminating what is learned from this project to the RIT community.

I also agree to return all/a portion of the funds that I receive for this project to RIT if I fail to complete or provide the materials described here:

- Full Project Plan (*including roles and responsibilities, milestone dates, and pertinent project details*)
- Preliminary Findings report (*may include experiment/study design, lessons learned, initial data collection, and/or literature review summary*)
- Participation in an ILI/TLS Preliminary Findings Roundtable dissemination event (*share and discuss your preliminary findings with your PLIG cohort*)
- Final Summary of Findings (*including data collection, lessons learned, implications for further study, and which may be in the form of an article abstract, conference presentation outline, or short report*)
- Final budget accounting (*reconciliation of budget provided with your application and the actual project expenses*)
- Participation in an ILI/TLS PLIG Showcase dissemination event (*present a poster or other display at the annual Showcase*)

By submitting this application, I accept this agreement. RWP (*applicant, please initial here*)

TIMELINE AND TASKS

Please indicate any variances to the planned PLIG 2019 schedule as described in the above Dissemination Agreement and the reasons for this variance. *If you do not intend to deviate from the schedule, you may leave this section blank.*

Task	Date	Proposed Variance and Reason
Full Project Plan submitted to TLS	August 16, 2019	
Preliminary Findings report submitted to TLS	January 10, 2020	
Participation in an ILI/TLS Preliminary Findings Roundtable dissemination event	February, 2020	
Summary of Final Findings report submitted to TLS	August 21, 2020	
Final Budget Accounting report submitted to TLS	August 21, 2020	
Participation in an ILI/TLS PLIG Showcase dissemination event	November 2020	

DISSEMINATION PLAN (*optional*)

Provide details about the journals, conferences, shows, or other external vehicles with strong potential for dissemination of your results (in addition to the ILI/TLS Preliminary Findings Roundtable and PLIG Showcase dissemination events). Include supporting documentation, such as preliminary interest or acceptance, with your application, if available. *(Please note that special consideration will be given to proposals that have a defined opportunity for external dissemination, such as an academic journal or professional conference.)*

Autonomous driving is a hot topic and only getting hotter. This project has been and will continue to be a showcase at Imagine RIT and other marketable events. The project excites students and media alike, and the ultimate goal is to secure prestige, notoriety, and large grant money in this booming sector of the transportation industry.

Thanks to prior PLIG grants, six publications have already resulted from this program. If this new PLIG is granted, it is anticipated two more publications may result at ASEE'20 and Electronic Imaging '21. Existing publications from this effort include:

1. R. Relyea, D. Chanushali A. Vashist, A. Ganguly, A. Kwasinski, M. Kuhl, R. Ptucha, "Multimodal localization for autonomous agents," Proceedings of Electronic Imaging: Image Processing Algorithms and Systems, San Francisco, CA, 2019.
2. Z. Carmichael, B. Glasstone, F. Cwitkowitz, K. Alexopoulos, R. Relyea, R. Ptucha, "Autonomous navigation using localization priors, sensor fusion, and terrain classification," Proceedings of Electronic Imaging: Image Processing Algorithms and Systems, San Francisco, CA, 2019.
3. S. Bag, V. Venkatachalapathy, R. Ptucha, "Motion Estimation Using Visual Odometry and Deep Learning Localization," Proceedings of Electronic Imaging, San Francisco, CA, 2017.
4. Avery, J. Hudden, D. Ruan, E. Schulken, C. Smith, J. VanGiesen, M. Zielinski, R. Ptucha, "Autonomous People Mover," Proceedings of American Society for Engineering Education, Ithaca, NY, 2016.
5. N. Briviano, M. Daigneau, J. Danko, C. Goss, A. Hintz, S. Kuhr, B. Tarloff, J. Kaemmerlen, R. Ptucha, "Autonomous People Mover: Adding Sensors", NY Cyber Security & Eng. Tech. Assoc., Roch, NY, 2015.
6. K. Knowles, N. Bovee, P. Gelose, D. Le, K. Martin, M. Pressman, J. Zimmerman, R. Lux, R. Ptucha, "Autonomous People Mover," Proc. of American Society for Engineering Education, Syracuse, NY, 2015.

DEPARTMENT HEAD CERTIFICATION

I support this PLIG application and verify that the principal applicant is a full-time faculty member in good standing in my department.

Principal Applicant Name: Raymond Ptucha

Department Head Name (PRINT): Shanchieh Yang **Email:** sjyeec@rit.edu

Department Head Signature: _____ **Date:** _____

NOTE: When signed, please scan and email with your Application Form to: plig@rit.edu