Program Progress Performance Report
University Transportation Centers
Cover Page TranLIVE

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Project Title: TranLIVE (Transportation for Livability by Integrating Vehicles and the Environment)

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Signature of Submitting Official:

Tami Noble

SEMI-ANNUAL REPORTING CATEGORIES
TranLIVE
January 1, 2013 to June 30, 2013

1. ACCOMPLISHMENTS:

A. University of Idaho:

- Karen Den Braven, Ahmed Abdel-Rahim, and Michael Dixon attended TRB.
- Joint graduate seminar series among all five partner universities for summer semester was a success. Twenty five to thirty people attended each seminar.
- First meeting of the TranLIVE advisory board was held in May.

i. *Developing and Testing Eco-Traffic Signal System Applications*

The primary focus of the research activities during this period was to investigate different corridor traffic management plans and examine their potential benefit in reducing vehicle emissions and fuel consumption.

Corridor optimization and microscopic traffic simulation models were used to develop and test different corridor traffic management plans and to assess their operational and environmental impacts. A case study of a corridor in Moscow, Idaho was modeled using twelve signal timing plans that were generated based on different objective functions specific to TRANSYT-7F and PTV VISTRO signal optimization tools. The timing plans were then input and simulated in INTEGRATION to compare and estimate fuel consumption and vehicle emissions for each objective function. INTEGRATION estimates emissions and fuel consumption based on instantaneous accelerations and speeds. It was found to have consistent energy and emissions estimates when compared to the Oak Ridge National Laboratory's field data.

The initial conclusion of the analysis is that small and medium size communities may see an increase in air quality and fuel efficiency on signalized corridors by updating signal management plans. Based on the results of this research, it is recommended that transportation staff optimize corridor plans based on a mix of progression opportunities and control delay to minimize environmental impacts.

ii. *In situ Transesterification of Microalgal Oil to Produce Algal Biodiesel*

We continued exploring the effect of operating variables on the process efficiency of the in situ processing of microalgal biomass in super-/sub-critical methanol for biodiesel production. These important process variables include the processing temperature, pressure, retention time, biomass to methanol ratio, and addition of co-solvent carbon dioxide (CO_2).

Although the lipids conversion was encouraging, it is still low compared to traditional homogenous catalytic methods. To improve the conversion efficiency, a co-solvent carbon dioxide was applied to the system to promote the transesterification. Experimental results showed that the addition of CO_2 improved the lipids conversion to 84%mol.

Systematical investigation on the effects of all process parameters is currently on-going. Process optimization will be conducted once the most influential process parameters are identified via preliminary experiments.

Additionally, one phenomenon caught our attention in comparing the traditional two-step process (extraction and then transesterification) with the proposed one-step in situ process. The lipids extracted from S. limacinum are very difficult transesterify into biodiesel using the traditional method. This indicates that the extracted lipids may contain quite a different content despite the same fatty acid composition. This difficulty might be caused by the

cellulosic matters that were also extracted into solvent during solvent extraction. We are currently exploring this phenomenon along with our main tasks.

iii. ***Security and Survivability of Real-Time Communication Architecture for Connected-Vehicle Eco-Traffic Signal System Applications***

The following standards were revisited to identify interesting scenarios to be used as case studies: 802.11p standard for information technology telecommunications and information exchange, DSRC introduced by ASTM E2213-03, SAE J2735 message set standard (BSM, ACM, RSA, PVD, PDM) and IEEE 1609.[0,1,2,3,4,11,12] WAVE standards. We identified four different scenarios that can be mapped to ongoing external projects. These scenarios fit what is introduced in the SAE message set standard as certified applications as will be implemented by manufactures to prevent selected crash scenarios. They are tested by the VSC-A team (by NHTSA) in collaboration between USDOT and the VSC2 Consortium (FORD, GENERAL MOTORS, HONDA, MERCEDES-BENZ and TOYOTA). The foundations for survivability measures that do not require extension to the current standards have been derived and are currently formally specified for publication.

iv. ***Developing Active Learning Materials for the Introductory Transportation Engineering Course***

The purpose of this project is to learn about student misconceptions on signalized intersection operations and to prepare new curriculum for use in the introductory transportation engineering course on this topic. The research completed identified and documented several areas of student learning difficulties. The research also focused on how the topic of signalized intersection operations was covered in several commonly used textbooks. This work formed the basis for the development of new curriculum.

v. ***Calibration of Multi-Scale Energy and Emissions Models***

The primary goal of the project is to provide vehicle emission and fuel consumption data that can be used to calibrate and validate multi-scale energy and emission models to assess the environmental impact of different transportation alternatives.

A document summarizing different alternatives for measuring fuel consumption and vehicle emission in the field and in the lab has been developed.

A vehicle emission field data collection tool, consisting of an emissions analyzer connected to the vehicle's exhaust tail pipe, has been used to collect emissions data in the field using different vehicle types under different speed and acceleration models. Vehicle emission and fuel consumption data were generated using the GT-Suite advanced engine modeling software.

vi. ***Pyrolysis Bio-Oil Upgrading to Renewable Fuels***

a. We have successfully produced pyrolysis bio-oil from Douglas-fir and hybrid poplar and chemically characterized the bio-oils.
b. We have synthesized Co-NS catalysts on a stainless steel mesh support and characterized the active surface.
c. We have commissioned our hydrogenation reactor and undertaken preliminary hydrogenation trial on guaiacol and pyrolysis bio-oil.
d. We have constructed a tube furnace for catalyst activation (reduction) for hydrogenation trials.

vii. ***Progress in Catalytic Ignition Fabrication, Modeling and Infrastructure***

a. Work has progressed on updating some of the Small Engine Research Facility equipment. A flowbench was remodeled to take detailed flow measurements of engine exhaust systems that are used by both our Formula Hybrid and Clean Snowmobile Challenge teams. Additionally, a dynamometer-equipped engine has been setup to train student

researchers on how to safely and properly use the dynamometer and emissions equipment before they do those types of tests on their research engines.
The Small Engine Research Facility moved into the new Vehicle Research Building that was recently renovated on campus. The move occurred over the break between the Fall and Spring semesters. Much, but not all, of the equipment has been re-installed, calibrated, and is in service.

b. Understanding the catalytic ignition of alternative transportation fuels requires measurement of the light-off temperature of fuel-oxidizer mixtures on different catalyst surfaces. A key component of the measurement is the variable temperature coefficient of resistance, $\alpha(T)$, for combustion catalysts including platinum. Literature data gives $\alpha(T)$ for 273-373 K and 1200-1900 K, but no values in between where most of the fuel-oxidizer mixtures react on the catalyst surface.

Experiments in a muffle furnace were conducted to obtain the missing data. Using a 4-lead technique, the electrical resistance of a platinum wire was determined as a function of temperature. Discrepancies in the data at high temperatures suggested that thermal radiation was interfering with the measurement.
With use of radiation shielding, wire temperatures were in better agreement with the furnace's thermocouple. However, discrepancies still remained (Figure 1). To eliminate thermal stratification as a possible cause, a propeller system was designed to run through the access port in the rear of the furnace and used to promote mixing.
The process of measuring $\alpha(T)$ will be applied to nanospring catalyst systems, which are composed of platinum-coated silicon dioxide structures on a tungsten base. Preliminary measurements suggest that $\alpha(T)$ for the nanosprings system is dominated by tungsten.

viii. ***Design Improvements and Performance Validation of a Competitive Hybrid FSAE Vehicle***
The second iteration hybrid vehicle has been completed. Design changes and improvements from the last iteration were based on a performance model developed by a graduate student. The construction of the second hybrid vehicle wholly occupied the team's time for the entire 2012-2013 school year. Notable achievements of this vehicle's construction include a professionally constructed chassis frame, a unique trailing link rear suspension, and extremely compact hybrid architecture resulting in a total weight reduction of 120 pounds. As expected, the second iteration took much less time to construct than the first, being completed in less than one year. Manufacturing began in summer 2012 and was completed spring 2013. The testing phase has begun and will be complete by the end of summer.

ix. ***Curriculum Development for K-12 Sustainable Transportation Education***
The Instructor's Guide for the ten-day summer camp was completed. The Institutional Review Board (IRB) for human subjects research approved the team to administer a survey to the students before and after the camp to assess impact on critical thinking ability and personal motivation to pursue careers in engineering. Scheduled and organized meetings with transportation professionals for the field trip to Washington D.C.

B. <u>Old Dominion University</u>:

i. ***New Strategies for the Emergency Vehicle Routing to Reduce Response Time Using Vehicle-to-Vehicle Communications***
A microscopic simulation model was previously created in VISSIM to evaluate different strategies for expediting the travel times for Emergency Vehicles (EVs) through signalized intersections. These strategies involve both signal preemption and controlling movement of some vehicles within the queues to open gaps for the emergency vehicles. Based on the initial

results, the proposed platoon split strategy was found to be very effective in reducing the EV travel times where there is significant congestion at the intersections.
In addition, a separate microscopic simulation model was created in VISSIM to evaluate preemption timing at signalized intersections to improve emergency vehicle travel time in a network. The strategies involve preempting signalized intersections further downstream to reduce congestion prior to the preemption of signals upstream. The preemption timing is based on queue lengths and the estimated arrival time of the emergency vehicle. The results of the testing are currently being compiled for inclusion of a paper to be submitted to the TRB national meeting.

ii. ***Real-Time Prediction of Queues at Signalized Intersections to Support Eco-driving Applications***

A model was developed to predict the evolution of queues at signalized intersections from the known locations of probe vehicles when they join the back of the queue. The performance of the model is being tested and evaluated based on trajectory data produced by VISSIM. In addition, work is underway to develop an integrated model to estimate fuel consumption by utilizing the Virginia Tech Comprehensive Power-based Fuel Consumption Model (VT-CPFM). The integrated model will be useful in assessing how accurately fuel consumption can be estimated as the percentage of probe vehicles changes in the traffic stream.
In addition, models are being developed to inform a vehicle in advance about the downstream queuing conditions so that a more fuel-efficeint trajectory is followed by adjusting its speed to avoid unnecessary stops and speed variations. The importance of when and where the vehicle should be advised to change its speed in the upstream is being investigated.

iii. ***Exploring Image-based Classification to Detect Vehicle Make and Model***

Two software products were developed to solve tasks related to the project. These products are described in the next section. In the development of these products, the adaptive mixture of Gaussians algorithm, Kalman filtering for object tracking, feature extraction and tracking using SIFT/SURF, super-resolution, application of morphological properties, Hough transform line detection, support vector machine classification, and expectation-maximization was learned. Additionally, optical flow, energy-based learning, and techniques for non-linear contrast enhancement have been explored.

iv. ***A Study on the Impact of Parameter Uncertainty on the Emission-based Ranking of Transportation Projects***

Using a test site in Virginia Beach, we have conducted extensive analyses investigating the impact of capacity, demand and emission uncertainty on the ranking of capacity expansion projects when the goal is to reduce vehicular emissions. Results show that these rankings can differ in up to 60% of the cases (compared to when uncertainty is ignored), depending on the source of uncertainty.

v. ***Reducing Energy Use and Emissions through Innovative Community Designs: Methodology and Application***

A framework was developed for behavioral decisions that are associated with energy consumption and emissions. The behavioral decisions were categorized as episodes of high acceleration or deceleration. In this regard the project research staff worked on preparing a behavioral survey. The survey will investigate short-term decision making. In addition, it will answer questions about how travelers respond to various strategies that may affect their decisions directly, e.g., how they respond to eco-information on routes and modes, whether they will change their travel decisions based on availability of eco-information, and whether they are willing to pay for such information. The behavioral data will be used to model acquisition and use of various types of information about the environment. The results of behavioral analysis will be incorporated in traffic modeling and simulation to be conducted.

Given that micro-simulation requires more detailed information about the roadway network and associated traffic operation conditions, we are accounting for the network inputs required in simulations.

As part of understanding traveler's behavior and their episodic driving decisions, e.g., speed and acceleration, we are also analyzing the Atlanta Regional Commission — Regional Travel Survey with GPS Sub-Sample. This is a rich database that allows us to analyze the episodic decisions and aggressive behavior exhibited by drivers. Specifically, the purpose is to explore the relationships between socio-demographic and trip characteristics on the one hand and aggressive driving on the other hand.

vi. ***Optimize Freight Routes and Modes to Minimize Environmental Impacts***

a. Literature review of the current status of research for emission modeling of heavy trucks in a mesoscopic/macroscopic environment is complete.
b. Key attributes have been identified in order to improve the calculation of emissions for a route.
c. Emission modeling tools/algorithms have been identified and compared for use in mesoscopic/macroscopic environments. Preparations for initial application tests are in progress.

C. <u>Syracuse University:</u>

i. The TranLIVE research projects undertaken by Syracuse University are as follows:–

a. Project 1: *Enhancing TSM&O Strategies Through User Cost Analysis and Life Cycle Assessment*;
b. Project 2: *Assessing Social and Environmental Impacts of Work-Zones in Arterial Improvement Projects*;
c. Project 3: *Assessing Environmental Impacts of Traffic Congestion and Vehicular Emissions on Groundwater and Fresh Water Supplies*.

The research projects have progressed significantly and are on schedule.

ii. The following graduate students are fully engaged in their research activities and have made significant progresses in their respective projects.

a. Xifan (Jeff) Chen, the lead research assistant for Project 1, supervised by Dr. Salem, has completed conducting detailed literature search on Enhancing TSM&O strategies through user cost analysis as well as life cycle assessment. The goal of his literature search is to understand the mechanism behind different existing LCA models, studying their feasibility with the TSM&O project and also to find out the different cost estimation processes involved at each stage of TSM&O. The critical analysis of the information gathered from the literature search helped him to understand the subject matter well, choose the right model to conduct the life cycle assessment and formulate the data collection strategy. Jeff is now in the process of collecting various ITS elements data from different resources to calculate their lifecycle impacts using Gabi and Simapro. Jeff, along with Sudipta, has also prepared a comprehensive framework for TranLIVE LCA.
b. Sudipta Ghorai, the lead research assistant for Project 2, supervised by Dr. Salem, has finished conducting literature search on Accelerated Construction Techniques, Work Zone Management Practices, Life Cycle Assessment (LCA) and Existing User Cost and Environmental impact assessment tools for maintenance, repair and renewal activities. He also looked into identifying data sources on environmental impact tools for maintenance, repair and renewal activities. He has developed a data collection strategy to address the research issues and in the process of acquiring the data from various sources.
c. Sharareh Pirzadeh, a graduate student working with Dr. Salem, has completed conducting a detailed literature search on various LCA software and is helping Sudipta in analyzing

data regarding material compositions, transportation needs and energy requirements using software like GaBi and SimaPro to calculate their carbon footprints and GHG effects.

d. Jeremy Tamargo, a research assistant for Project 3, supervised by Dr. Davidson, is working on the issues of contamination of Urban Surface Water by Vehicle Emissions. His project deals with creating a mass balance of PAHs in Syracuse urban environment, identifying the major sources of PAHs to urban environment, measuring urban airborne concentrations of PAHs, directly measuring deposition of PAHs, measuring concentrations of PAHs in the storm water runoffs and comparing measured results with the modeled results and data from literature. He has successfully completed an extensive literature search and is now working on the data collection strategy.

e. Mallory Squier, also a research assistant for Project 3, supervised by Dr. Davidson, is working on the performance of the Green infrastructures to reduce storm water runoffs. Green infrastructure near roadways can capture runoff but it is difficult to study the run-off at surface or below ground level. Thus, she is utilizing the largest green-grey roof available in New York State to reduce the edge effects for her study to compare the measurements with the roads, which will enable accurate measurements. She has completed her extensive literature search and now collecting data from the green roof using an above ground piping system she developed just for the study.

D. <u>Texas Southern University</u>:

i. *A Systematic Evaluation of the Impacts of traffic Condition Information on the Reduction of On-road Mobile Emissions*

a. Reviewed literature in following areas:
   - Studies on the relationship between the roadway congestion and vehicle emissions.
   - Methods of evaluating/quantifying the roadway congestion and its impacts on traffic flow/emissions.

b. Continue collecting the GPS data and accident data in some selected roadway sections.

c. Analyzed the collected field data and developed vehicle VSP distributions under various traffic congestion conditions.

ii. *Education and Outreach Activities*

a. Successfully organized the summer transportation academy at TSU June 2013 for two sessions of high school students (primarily minority).

b. Initiated a transportation club in MacGregor Elementary School (The Club) in Houston for grades 3 through 5. Most of them are minority students.

c. Prepared curriculum, list of reference books, for the transportation club for grades 3 through 5.

d. Provided scholarships to support graduate students for their studies in transportation. All are U.S. citizens.

e. Supported student travel to present research papers or to attend academic conferences, including:
   - The 2013 Transportation Research Board Annual Meeting, Washington DC, January 12-16, 2013;
   - 2013 Emerging Researchers National (ERN) Conference in STEM by National Science Foundation, February 28 to March 1, 2013, Washington, DC;
   - The 26th International Chinese Transportation Professional Association (ICTPA) Annual Meeting, Tampa, FL, May 24-26, 2013.

iii. ***Develop an Integrated Data Management System at the Microscopic, Mesoscopic, and Macroscopic Levels to Assess the Environmental Impacts of Transportation System***
Tested part of the database for sample use of emission estimation for different purposes.

iv. ***Use the Driving Simulator to Synthesize the Related Vehicle Specific Power (VSP) for Emission and Fuel Consumption Estimations***
This research is to validate the feasibility of a driving simulator's in vehicle emission estimations, especially for the simulation of vehicle specific power (VSP). In accordance with VSP and vehicle activity data, the operating mode bins distributions can be calculated which are directly related to emission rates. By analyzing real-world and simulated vehicle activity data, it was found that the operating mode bins distributions from real-world roadway and from the simulator tests are different. To make full use of the driving simulator data for emission estimation, a fuzzy logic based Table Look-Up Scheme was identified to calibrate the Operating Mode distributions from the simulator. The modeling results show that the calibration errors of estimated emissions can be reduced to about 50% of the total, while the validation error of overall emissions is less than 2%.
These results imply that the operation data (e.g. speed, acceleration, VSP) from a driving simulator can be used for vehicle emission estimation if these data are well calibrated through the proposed Fuzzy Table Look-up Scheme.

v. ***Develop Multi-scale Energy and Emission Models for Arterial Traffic Systems***
   a. Through simulation, we have learned that vehicles that run on one-way or two-way urban street networks often generate totally different emissions. The analysis shows that the two-way street network produces lower emissions, thus can better improve the air quality during non-peak hours. However, such improvement will be less during peak hours. In addition, emissions from the two-way street network may eventually exceed those from the one-way street network when the traffic demand increases to a certain level.
   b. The traffic operations at different weaving areas on freeways also generate different level of emissions. This highly relies on the design of on and off ramps. Some types of design would result in higher emissions. It is recommended considering emissions when designing freeway weaving areas.

vi. ***Improve the Environment for a Livable Community: Advance the AERIS Program by Developing and Testing Eco-traffic Signal System Control Applications***
Simulated and tested the V2I system in driving simulator for more and safer scenarios.

E. <u>Virginia Tech</u>:

i. ***Develop Eco-adaptive Cruise Control Systems***
Nothing to report this time

ii. ***Develop Green Cooperative Adaptive Control Systems in the Vicinity of Signalized Intersections***
   a. Developed and tested the logic in an agent-based simulation framework.
   b. Conducted a survey of user acceptance of technology.
   c. Integrated the software with microscopic traffic simulation software.

iii. ***Develop Dynamic Eco-routing Systems***
Studied the evolution of driver route choice behavior.

iv. ***Develop Multi-scale Energy and Emission Models***
Began a framework for modeling transit vehicle fuel consumption and emission levels.

2. PRODUCTS:

A. University of Idaho:

i. ***Developing and Testing Eco-Traffic Signal System Applications***

a. Abdel-Rahim, A., *"Modeling Fuel Consumption and Emissions at Signalized Intersection Approaches: A Synthesis of Data Sources and Analysis Tools,"* Transportation Research Forum, March 21-23, 2013, Annapolis, MD.

b. Thesis titled *Development of an Evaluation Method for Eco-driving Skills* by Amanda Battles, 4/30/13.

ii. ***In situ Transesterification of Microalgal Oil to Produce Algal Biodiesel***

a. A manuscript titled *Characterization of Microalgae for the Purpose of Biofuel Production*, resulted from a research prior to this study, was accepted in June 2013 and is currently in press for publication in the Transaction of ASABE (vol. 56, Issue 3).

b. A technical presentation on preliminary study of in situ transesterification of microalgal oil to produce algal biodiesel was accepted and is to be presented orally at the 2013 International Annual Conference of the ASABE in Kansas City, July 23, 2013.

iii. ***Security and Survivability of Real-Time Communication Architecture for Connected-Vehicle Eco-Traffic Signal System Applications***

We are preparing for a submission to TRB due end of July.

iv. ***Developing Active Learning Materials for the Introductory Transportation Engineering Course***

a. Completion of several interim reports on student learning during spring 2013 and assessment of other available transportation textbooks.

b. Completion of draft chapter on signalized intersection operations; used chapter during spring 2013 in introductory transportation course.

c. Thesis titled *Evidence-based Approach to Curriculum Development for the Signalized Intersection Module of the Introductory Transportation Engineering Course* completed by Maria Tribelhorn 5/10/13.

d. Completed and tested set of ranking tasks to study misconceptions in student learning on signalized intersection operations.

e. Completed several versions of final draft chapter.

v. ***Calibration of Multi-Scale Energy and Emissions Models***

a. A white paper documenting alternative methods for measuring fuel consumption and emissions.

b. Vehicle emission field-data collection tool.

vi. ***Pyrolysis Bio-Oil Upgrading to Renewable Fuels***

a. A poster was presented at the 55th Idaho Academy of Science (IAS) Annual Meeting and Symposium at Idaho State University on March 22, 2013, Pocatello, ID.

b. A presentation about "Characterization of Bio-oil Produced by Woody Biomass Fast Pyrolysis" was given at the Western Forestry Graduate Research Symposium at Oregon State University on April 12, 2013.

vii. ***Progress in Catalytic Ignition Fabrication, Modeling and Infrastructure***

a. Results this period primarily include the updates to the flowbench, the setup of a dynamometer-equipped engine for student training, relocating all of the equipment in the Small Engine Laboratory to the Vehicle Research Laboratory, and purchase (with outside funds) of a research-grade emissions analyzer.

b. A technique for obtaining the temperature coefficient of thermal resistance for catalysts used in alternative transportation fuel combustion is complete and ready for application to nanosprings catalyst assemblies.
c. A presentation about the measurement technique for α(T) was made at the 8th US Meeting of the US Sections of the Combustion Institute. A technical paper on the same topic was accepted for presentation at a peer-reviewed conference, and will be published by the American Society of Mechanical Engineers.

viii. ***Design Improvements and Performance Validation of a Competitive Hybrid FSAE Vehicle***
Three Theses –
a. *Hybrid Vehicle Mathematical Modeling & Drive Cycle Simulation*, Samuel Wos, 1/30/13;
b. *Small Engine Inertia Balancing for Hybrid Application,* Tyler Flowers, 2/8/13;
c. *Computational Optimization of Laminate Composites for the Prediction of Performance Metrics Using Finite Element Simulation, Christopher Eacker, 5/3/13.*

ix. ***Curriculum Development for K-12 Sustainable Transportation Education***
The instructor's guide for this summer program was completed. It is an 80 page document with all the content for the camp. Each chapter provides material for each day (i.e. 10 chapters). Course material for each day including power point presentations and student activity handouts were completed.

B. Old Dominion University:

i. ***New Strategies for the Emergency Vehicle Routing to Reduce Response Time Using Vehicle-to-Vehicle Communications***
a. C.A. Jordan, M. Cetin, and R.M. Robinson, "Clearing Paths for Emergency Vehicles Using Vehicle-to-Vehicle Communication" Presented at t*he 92nd Annual meeting of the Transportation Research Board*, Washington, D.C., January 13-17, 2013.
b. A new paper is being prepared for submission to the 93rd Annual Meeting of the Transportation Research Board.

ii. ***Real-time Prediction of Queues at Signalized Intersections to Support Eco-driving Applications***
A paper is being prepared for submission to the *93rd Annual Meeting of the Transportation Research Board.*

iii. ***Exploring Image-based Classification to Detect Vehicle Make and Model***
a. We made substantial progress on this project. The program produced three modules. The first module is a UNIX script tool used to automate the capture and categorization of sample traffic video to form a standard input database. The second module is a MATLAB implementation of an adaptive mixture of Gaussians algorithm to perform segmentation of vehicles from a background scene and to identify and label detected vehicles from this segmented data. To improve the detection of vehicles in challenging scenarios (rain/snow weather conditions, dense traffic), this tool has been extended using methods that resolve vehicle occlusion by analyzing morphological properties of segmented vehicle blobs, and track features within these blobs over time. The third module performs classification of the detected vehicles, using an implementation of a support vector machine classifier, in order to determine the class of vehicle (sedan, passenger truck/SUV, motorcycle, bus, small commercial truck, large commercial truck). A supporting software tool for this third module presents a graphical user interface to assist in labeling the class and quality of the segmentation so that a ground truth database can be built and tested. Additionally, a subset of these tools has been used to test a super-resolution algorithm, which synthetically improves the resolution of the input video.

b. Yousef, A., Iftekharuddin, K., Karim, M., Toward aerosols LiDAR scattering plots clustering and analysis. Proc. SPIE 8718, Advanced Environmental, Chemical, and Biological Sensing Technologies X, 87180F (May 31, 2013), DOI:10.1117/12.2015807.
c. Yousef, A. H., Flora, J., Iftekharuddin, K. Highway traffic segmentation and classification using super-resolution and Gaussian mixture model In: Optics and Photonics for Information Processing VII X in SPIE *Optics and Photonics Conference*, August 2013. (To be Published, August 2013).
d. The following demo has been developed and posted on the web for this project: http://ww2.eng.odu.edu/visionlab/research/ITS.php.

iv. ***A Study on the Impact of Parameter Uncertainty on the Emission-based Ranking of Transportation Projects***

We are preparing a manuscript for submission to the TRB Annual Meeting in 2014.

v. ***Reducing Energy Use and Emissions through Innovative Community Designs: Methodology and Application***

a. X. Wang, A. Khattak, Y., Zhang, "Is Smart Growth Associated with Reductions in CO_2 Emissions?" Presented at the 92nd Annual meeting of the Transportation Research Board, Washington, D.C., January 13-17, 2013. Also accepted for publication in the Transportation Research Record.
b. We have a drafted an online survey and we are working on conference papers for the TRB 2014 annual meeting.

vi. ***Optimize Freight Routes and Modes to Minimize Environmental Impacts***

Nothing to report at this time

C. <u>Syracuse University</u>:

i. **Dr. Sam Salem**, PI of the TranLIVE projects at Syracuse University, taught a Graduate Level Course on "Sustainable Development and Infrastructure Management" in Spring 2013. He attended the Transportation Research Board 92nd Annual Meeting held on January, 2013 at Washington, DC. He is a member of the Transportation Sustainability committee and the Construction Management committee and a friend with the Asset Management committee.

ii. **Dr. Cliff Davidson** (Co-PI) organized a workshop on "Sustainable Engineering" and presented on "User Cost Analysis and Life Cycle Assessment" in June 2013. The workshop was highly informative and was relevant to the issues related to the TranLIVE projects.

iii. **Jeff Chen** and **Sudipta Ghorai** completed the five hours ITS Deployment Analysis System (IDAS) web-based training provided by the National Highway Institute.

iv. **Jeff Chen, Sudipta Ghorai** and **Sharareh Pirzadeh** presented their TranLIVE research at the poster session of the Nunan Lecture and Research Day organized by Syracuse University on April 5, 2013 at Sheraton Syracuse University Hotel and Conference Center. Their respective poster topics were "TranLIVE LCA", "Accelerated Bridge Construction Decision Making Framework" and "Life Cycle Assessment of Pavement and Bridges."

D. <u>Texas Southern University</u>:

i. ***A Systematic Evaluation of the Impacts of Traffic Condition Information on the Reduction of On-road Mobile Emissions***

Nothing to report at this time

ii. ***Education and Outreach Activities***

a. A series of education programs are in production, covering all ages of students (K-12 through college). These include the summer transportation academy for high school students and the transportation club for primary school students.

b. One academic paper was presented at TRB 2013 conference on education efforts to minority high school students to promote their interests in transportation:
   - Godazi. K., R. Goodwin, F. Qiao, A. Miller (2013). Exposing Minority Students to Transportation and STEM-related Careers through Summer Education Programs. Presented at the 92nd Annual Meeting of Transportation Research Board (TRB) Annual Meeting, Washington, DC. January 13-17, 2013.

iii. ***Develop an Integrated Data Management System at the Microscopic, Mesoscopic, and Macroscopic Levels to Assess the Environmental Impacts of the Transportation System***

a. Wang, J., L. Yu, and F. Qiao (2013). Micro Traffic Simulation Approach to the Evaluation of Vehicle Emission on One-way vs. Two-way Streets: A Case Study in Houston Downtown. Presented at the 92nd Transportation Research Board Annual Meeting, Transportation Research Board of the National Academies, Washington, DC, Jan 2013.
b. Qiao, F., J. Jia, and L. Yu (2013), A RFID Based Smart Warning System at Signalized Intersections, Presented at and published in the proceedings of The XIII World Conference on Transport Research (WCTR), July 15-18, 2013, Rio de Janeiro, Brazil.
c. Qiao F., Y. Qiao, F. Tao, and L. Yu (2013), Developing a Wireless Warning System to Enhance the Worker Safety in Work Zone Area, Accepted for presentation and publication in the proceedings of The XIII World Conference on Transport Research (WCTR), July 15-18, 2013, Rio de Janeiro, Brazil.
d. Qiao, F., L. Hill, X. Wang, and L. Yu: GPS Based Emission Estimation at Airport Terminals for Passengers -Picking-Up Vehicles (paper # 26-163), Presented and published in the 26th Annual Conference of the International Chinese Transportation Professionals Association (ICTPA), Tampa, FL, May 24-26, 2013.

iv. ***Use the Driving Simulator to Synthesize the Related Vehicle Specific Power (VSP) for Emission and Fuel Consumption Estimations***

Ziyue Li, Fengxiang Qiao, and Lei Yu. Using a Driving Simulator for Vehicle Specific Power (VSP) Simulation in Vehicle Emissions Analyses - A Feasibility Study. Presented at the 2013 Emerging Researchers National (ERN) Conference in STEM, Feb. 28 – March 1, 2013. Washington, DC.

v. ***Develop Multi-scale Energy and Emission Models for Arterial Traffic Systems***

a. Wang, J., L. Yu, and F. Qiao (2013). Micro Traffic Simulation Approach to the Evaluation of Vehicle Emission on One-way vs. Two-way Streets: A Case Study in Houston Downtown. Presented at the 92nd Transportation Research Board Annual Meeting, Washington, DC, Jan 2013.
b. Wang, J. (2013). Impacts of Roadway Network Design on Emissions. Presentation in the consortium seminar organized by UTC TranLIVE. Summer workshop in webinar.

vi. ***Improve the Environment for a Livable Community: Advance the AERIS Program by Developing and Testing Eco-traffic Signal System Control Applications***

a. Qiao, F., X. Wang, L. Yu, and J. Jia (2013). Using RFID to Improve Drivers Awareness of STOP Sign at Unsignalized Intersections. Presented at the 92nd Transportation Research Board Annual Meeting, Transportation Research Board of the National Academies, Washington, DC, Jan 2013.
b. Jing Jia, Fengxiang Qiao, and Lei Yu (2013). A prototype of an advanced traffic warning system in safety improvement and emission reduction, Presented at the Emerging Researchers National Conference by National Science Foundation, February 28–March 2, 2013, in Washington, D.C.
c. Fengxiang Qiao, Jing Jia, Lei Yu, Dong Zhai (2013), A Short Range Vehicle-to-Infrastructure System at Work Zones and Intersections, paper #1027. Accepted for presentation and publication at the 20th ITS World Congress, October 14-18, 2013, in Tokyo.

d. Ziyue Li, Fengxiang Qiao, and Lei Yu, A Calibration Algorithm for Vehicle Emission Estimation Using a Driving Simulator. Paper #1030. Accepted for presentation and publication at the 20th ITS World Congress, October 14-18, 2013, in Tokyo.
e. Qing Li, Fengxiang Qiao, Xiaobing Wang, and Lei Yu, Impacts of P2V Wireless Communication on Safety and Environment in Work Zones through Driving Simulator Tests (paper # 26-179). Presented and published in the 26th Annual Conference of the International Chinese Transportation Professionals Association (ICTPA), Tampa, FL, May 24-26, 2013.

E. <u>Virginia Tech</u>:

i. *Develop Eco-adaptive Cruise Control Systems*

a. Saerens, B., Rakha, H., Ahn, K., and Van den Bulck, E. (2013), "Assessment of Alternative Polynomial Fuel Consumption Models for use in ITS Applications," *Journal of Intelligent Transportation Systems: Technology, Planning, and Operations*, DOI:10.1080/15472450.2013.764801.
b. Saerens B., Rakha H., Diehl M., Van den Bulck E. (2013), "Eco-Cruise Control for Passenger Vehicles: Methodology," *Transportation Research Part D: Transport and Environment,* Vol. 19, pp. 20-27.
c. Ahn K., Rakha H., and Park S. (In press), "ECO-Drive Application: Algorithmic Development and Preliminary Testing," *Transportation Research Record: Journal of the Transportation Research Board*.

ii. *Develop Green Cooperative Adaptive Control Systems in the Vicinity of Signalized Intersections*

a. Kamalanathsharma R. and Rakha H. (In press), "Leveraging Connected Vehicle Technology and Telematics to Enhance Vehicle Fuel Efficiency in the Vicinity of Signalized Intersections," *Journal of Intelligent Transportation Systems: Technology, Planning, and Operations*.
b. Kamalanathsharma R. and Rakha H. (2013), "Fuel-Optimal Vehicle Throttle Control: Model Logic and Preliminary Testing," 20th ITS World Congress, Tokyo, Japan, October 14-18 [Paper: 4136].
c. Kamalanathsharma R., Zohdy I., and Rakha H. (2013), "Public Perception on Increased Use of Technology in Automobiles: Survey Findings," 20th ITS World Congress, Tokyo, Japan, October 14-18 [Paper: 4112].

iii. *Develop Dynamic Eco-routing Systems*

a. Tawfik A. and Rakha H. (2013), "A Latent Class Choice Model of Heterogeneous Drivers Route Choice Behavior Based on a Real-World Experiment," Transportation Research Board 92nd Annual Meeting, Washington DC, January 13-16.
b. Tawfik A. and Rakha H. (In press), "A Latent Class Choice Model of Heterogeneous Drivers Route Choice Behavior Based on a Real-World Experiment," *Transportation Research Record: Journal of the Transportation Research Board*.
c. Tawfik A. and Rakha H. (2013), "Hierarchical Route Choice Model of Heterogeneous Driver Behavior based on Field Observations," Submitted to *Journal of Choice Modelling*.
d. Ahn K. and Rakha H. (2013), "Network-wide Impacts of Eco-routing Strategies: A Large-scale Case Study," Submitted to *Transportation Research Part D: Transport and Environment*.

iv. *Develop Multi-scale Energy and Emission Models*

a. Saerens, B., Rakha, H., Ahn, K., and Van den Bulck, E. (2013), "Assessment of Alternative Polynomial Fuel Consumption Models for use in ITS Applications," *Journal of Intelligent*

Transportation Systems: Technology, Planning, and Operations
DOI:10.1080/15472450.2013.764801.

b. Park S., Rakha H., and Ahn K. (2013), "Virginia Tech Comprehensive Power-based Fuel Consumption Model (VT-CPFM): Model Validation and Calibration Considerations," Presented at the 92nd Transportation Research Board Annual Meeting, Washington DC, January 14-17, CD-ROM [Paper # 13-0461].
c. Du J., Rakha H., and Sangster J. (In press), "Can Electricity Powered Vehicles Serve Traveler Needs?" *International Journal of Transportation Science and Technology*.
d. Faris W., Rakha H.A., Kafafy R., Idres M., and Elmoselhy S. (In press), "Diesel Powertrain Intake Manifold Analytical Model," *International Journal of Vehicle Systems Modelling and Testing*.
e. Faris W., Rakha H.A., Kafafy R., Idres M., and Elmoselhy S. (In press), "Analytical Modelling of Diesel Powertrain Fuel Consumption Rate, Efficiency, Power, Torque, and Mean Effective Pressure," *International Review on Modelling and Simulations (IREMOS).*
f. Faris W., Rakha H.A., Kafafy R., Idres M., and Elmoselhy S. (In press), "Supercharged Diesel Powertrain Intake Manifold Analytical Model," *International Review on Modelling and Simulations (IREMOS)*.
g. Rakha H. (2012), "Transportation Sustainability: What can ITS Offer?" ITS World Congress, Vienna, Austria, Oct. 22-26. (Session SIS06 Emerging ITS Strategies and Sustainability - Tuesday 11:00 - 12:30).
h. Rakha H. (2012), "Case Study Evaluation of the Environmental Impacts of Adaptive Traffic Signal Control and Transit Signal Priority," ITS World Congress, Vienna, Austria, Oct. 22-26. (Session SIS35 - Demonstrating the environmental contributions from demand responsive traffic control - Wednesday 16:00 - 17:30).

3. <u>PARTICIPANTS & OTHER COLLABORATING ORGANIZATIONS</u>:

A. <u>University of Idaho:</u>

UI has been working with the Idaho Transportation Department and Econolite Controls and has held various meetings to collaborate on projects and hold trainings.

i. ***Developing and Testing Eco-Traffic Signal System Applications***
Nothing to report at this time

ii. ***In situ Transesterification of Microalgal Oil to Produce Algal Biodiesel***
Nothing to report at this time

iii. ***Security and Survivability of Real-Time Communication Architecture for Connected-Vehicle Eco-Traffic Signal System Applications***
Nothing to report at this time

iv. ***Developing Active Learning Materials for the Introductory Transportation Engineering Course***
Nothing to report at this time

v. ***Calibration of Multi-Scale Energy and Emissions Models***
Nothing to report at this time

vi. ***Pyrolysis Bio-Oil Upgrading to Renewable Fuels***
Nothing to report at this time

vii. ***Progress in Catalytic Ignition Fabrication, Modeling and Infrastructure***
Funding for the renovated Vehicle Research Building was obtained from a Federal Transit Administration 5309 grant approximately $400,000.

Funding for research-quality emissions analysis, flow metering, and precision infrared temperature measurement was obtained from a Murdock Trust equipment grant for $292,000.

viii. ***Design Improvements and Performance Validation of a Competitive Hybrid FSAE Vehicle***
Financial support has come from alumni donations. In-kind support has come from Nelson Metals Inc., Janicki Industries, and DATAQ Instruments. Further support has come in the form of discounts from Fastenal, Aurora Bearing Company, and Cartesian Tube Profiling.

ix. ***Curriculum Development for K-12 Sustainable Transportation Education***
Nothing to report at this time

B. Old Dominion University:

Dr. Khattak worked collaboratively with University of Aveiro, Portugal (J. Bandeira, T. Almeida, & M. Coelho) on a research paper that is related to the TranLIVE theme of his *Reducing energy use and emissions through innovative community designs: methodology and application* project.

C. Syracuse University:

Nothing to report at this time

D. Texas Southern University:

i. ***A Systematic Evaluation of the Impacts of traffic Condition Information on the Reduction of On-road Mobile Emissions***
   a. A visiting scholar from Shandong Jiatong University in China, Dr. Liyan Qin.
   b. Shandong province office of education provided funding support for the exchange visitor, Dr. Liyan Qin from Shandong Jiatong University in China.
   c. Dr. Xumei Chen from Beijing Jiatong University in China - Beijing Jiatong University in China provided funding support for Dr. Yi Qi's travel to Beijing Jiatong University for giving a presentation on the results of this project on January 3, 2013.

ii. ***Education and Outreach Activities***
   a. The MacGregor Elementary School in the Houston Independent School District collaborated with TSU to implement TSU's Transportation and Environmental Club curriculum. MacGregor Elementary provided 18 students for the club, snacks for the students, science lab, a science coordinator, two parent volunteers, two field trip chaperons, and equipment (i.e. computers, printers, projector, smart board, educational software, GPS devices, scissors, etc.).
   b. METRO financially supported the Transportation and Environmental Club at MacGregor Elementary (The Club) by providing each student, chaperone, TSU coordinator, and MacGregor science coordinator with Q-Cards (pre-paid cards) to travel to the Metro Rail Operating Center. METRO's Community Education Department provided a free tour of their operating center. The students were able to access the command center and see real-time operation of the rail system throughout Houston.
   c. METRO's Community Education Department provided a rail safety awareness program for the students, where the students learned dangers of crossing the rail lines incorrectly. In addition, the students were made aware of the signaling and sounds put in place by the rail system for recognition for pedestrians.

iii. ***Develop an Integrated Data Management System at the Microscopic, Mesoscopic, and Macroscopic Levels to Assess the Environmental Impacts of Transportation System***
Exchanged ideas and potential collaborative work with researchers at Virginia Tech, University of Idaho, University of Texas at El Paso, etc.

iv. ***Use the Driving Simulator to Synthesize the Related Vehicle Specific Power (VSP) for Emission and Fuel Consumption Estimations***
Nothing to report at this time

v. ***Develop Multi-scale Energy and Emission Models for Arterial Traffic Systems***
Conducted collaborative research with National Science Foundation (NSF) CREST center on complex network at TSU.

vi. ***Improve the Environment for a Livable Community: Advance the AERIS Program by Developing and Testing Eco-traffic Signal System Control Applications***
Conducted collaborative research with National Science Foundation (NSF) CREST center on complex network, especially its subcenter on wireless communications at TSU.

E. Virginia Tech:

i. ***Develop Eco-adaptive Cruise Control Systems***
The research team collaborated with researchers from KULeuven.

ii. ***Develop Green Cooperative Adaptive Control Systems in the Vicinity of Signalized Intersections***
Nothing to report at this time

iii. ***Develop Dynamic Eco-routing Systems***
Nothing to report at this time

iv. ***Develop Multi-scale Energy and Emission Models***
The research team collaborated with researchers from KULeuven and the International Islamic University of Malaysia (IIUM).

4. IMPACT:

A. University of Idaho:

i. ***Developing and Testing Eco-Traffic Signal System Applications***
This work focuses on modeling the fuel consumption and vehicle emissions of arterial system operations and the development and testing of eco-signal timing plans for small and medium size cities. One graduate student and two undergraduate students who were involved in the project in the spring 2013 semester have joined different transportation agencies as summer interns. One undergraduate student who has been working on the project will be joining the transportation engineering graduate program at the University of Idaho.

ii. ***In situ Transesterification of Microalgal Oil to Produce Algal Biodiesel***
Nothing to report at this time

iii. ***Security and Survivability of Real-Time Communication Architecture for Connected-Vehicle Eco-Traffic Signal System Applications***
Nothing to report at this time

iv. ***Developing Active Learning Materials for the Introductory Transportation Engineering Course***
When this project is completed the curriculum materials will be distributed to transportation educators who are a part of the National Transportation Curriculum Project.

v. ***Calibration of Multi-Scale Energy and Emissions Models***
a. Vehicle emission and fuel consumption data that can be used to calibrate and validate multi-scale energy and emission models.
b. Vehicle emission field data collection tool that facilitates the collection of emissions data in the field for different vehicle types and under different speed and acceleration profiles.

vi. ***Pyrolysis Bio-Oil Upgrading to Renewable Fuels***
The main impact is the improvement of the efficiency of bio-fuels production to reduce the reliance on fossil fuels largely used in the transportation sector.

vii. ***Progress in Catalytic Ignition Fabrication, Modeling and Infrastructure***
Graduate student, undergraduate student and high-school intern education are key components of this project. The new facility has been used extensively for both graduate and undergraduate research. The Clean Snowmobile Challenge and the Formula Hybrid teams have each performed engine calibration and fuel/emissions measurement in the new facility leading to more competitive vehicle platforms.

viii. ***Design Improvements and Performance Validation of a Competitive Hybrid FSAE Vehicle***
a. Education: It provides an opportunity for young engineers to investigate, design, and experiment with hybrid automotive technologies. Having this experience gives team members an advantage when entering industry.
b. Technology Advancement: Samuel Wos and Tyler Flowers both completed their theses based on research done with regards to the Formula Hybrid program. The thesis "Hybrid Vehicle Mathematical Modeling & Drive Cycle Simulation" by Samuel Wos, created a useful resource for the Formula Hybrid program. The modeling simulation provided an in-house way to analyze various designs and predict vehicle performance. Current graduate student work includes vehicle testing to validate and improve the mathematical model. PhD research is also being done using the Formula Hybrid program. In particular, it is conducted towards management of energy and distribution of torque (power) which is an essential element in the implementation of HEVs, where each power source must be used according to driver demand and the specific features of the driving situation.

ix. ***Curriculum Development for K-12 Sustainable Transportation Education***
The preparation activities that have been done so far have established an effective network of collaboration between TranLIVE and TRIO Upward Bound. We hope that this partnership will continue for many years to come as we seek opportunities to introduce high school students to the transportation field.

B. <u>Old Dominion University</u>:

i. ***New Strategies for the Emergency Vehicle Routing to Reduce Response Time Using Vehicle-to-Vehicle Communications***
Nothing to report at this time

ii. ***Real-time Prediction of Queues at Signalized Intersections to Support Eco-driving Applications***
Nothing to report at this time

iii. ***Exploring Image-based Classification to Detect Vehicle Make and Model***
The impact of this of the research being conducted is to develop an automated technique that is efficient, fast and accurate to extract a set of attributes that will be used in the EPA's MOVES software to estimate the vehicle emission on the street and highways.
The program also educates one graduate student in Intelligent Transportation System research. It is also expected that one MS thesis will be generated from this research. We have already produced a few publications through partial funding of this project.

iv. ***A Study on the Impact of Parameter Uncertainty on the Emission-based Ranking of Transportation Projects***
This research is complementing existing literature by providing valuable insights into the impact of capacity, demand and uncertainty on the ranking of capacity expansion projects.

v. ***Reducing Energy Use and Emissions through Innovative Community Designs: Methodology and Application***
This project is contributing to the overall UTC mission by training a post-doc and several graduate students who are working on energy and emissions issues. The research will generate modeling and simulation tools and products that can be used in energy and emissions reduction.

vi. ***Optimize Freight Routes and Modes to Minimize Environmental Impacts***
Nothing to report at this time

C. Syracuse University:

i. The course "Sustainable Development and Asset Management" raised graduate students' awareness on Sustainability of Infrastructure Systems, especially Transportation Systems.

ii. The IDAS training from Nation Highway Institute is helping the students to evaluate the collected data and develop various ITS models.

D. Texas Southern University:

i. ***A Systematic Evaluation of the Impacts of traffic Condition Information on the Reduction of On-road Mobile Emissions***
Nothing to report at this time

ii. ***Education and Outreach Activities***
a. The education program has brought awareness to students, teachers, community organizers, organizations and families about the impact of transportation on the environment. These groups have come to understand that their personal decisions regarding transportation impact the quality of their environment.
b. The students learned new transportation and environmental concepts and terms; the students made a connection to how goods, services, and people are transported efficiently through various modes and networks of transportation infrastructure.
c. "The Club" provided an opportunity for students and parents to ride the METRO rail who had never done so. They communicated they would consider taking public transportation in the future.
d. The Club allowed the students to compete for awards. The competition required students and parents to collaborate to build an efficient wind powered vehicle from recycled materials. The first place winner said he had never won anything in his life. In addition, a father and son commented that they had never worked on any project together before.

iii. ***Develop an Integrated Data Management System at the Microscopic, Mesoscopic, and Macroscopic Levels to Assess the Environmental Impacts of Transportation System***
Nothing to report at this time

iv. ***Use the Driving Simulator to Synthesize the Related Vehicle Specific Power (VSP) for Emission and Fuel Consumption Estimations***
Nothing to report at this time

v. **Develop Multi-scale Energy and Emission Models for Arterial Traffic Systems**
The developed simulation test beds can be different kinds of course projects for graduate students in the studies on simulation, vehicle emission estimations, and roadway design.

vi. ***Improve the Environment for a Livable Community: Advance the AERIS Program by Developing and Testing Eco-traffic Signal System Control Applications***
a. The simulation of the V2I communication system in a driving simulator provides a test platform for safer tests with more scenarios designed.
b. The developed system and the simulation in a driving simulator are good teaching materials for students to understand the effects and components of V2I and ITS.

E. Virginia Tech:

i. ***Develop Eco-adaptive Cruise Control Systems***
   a. Research: Development of an eco-cruise control and eco-drive system.
   b. Technology Transfer: Publication of results at various conferences.

ii. ***Develop Green Cooperative Adaptive Control Systems in the Vicinity of Signalized Intersections***
   a. Education: The funding of a graduate student assistantship.
   b. Research: Development of an eco-cruise control in the vicinity of traffic signalized intersections.
   c. Technology Transfer: Publication of results at various conferences.

iii. ***Develop Dynamic Eco-routing Systems***
   a. Education: The funding of a graduate student assistantship.
   b. Research: Development of an eco-routing system.
   c. Technology Transfer: Publication of results at various conferences.

iv. ***Develop Multi-scale Energy and Emission Models***
   a. Education: The funding of a graduate student assistantship.
   b. Research: Development of an eco-cruise control and eco-drive system.
   c. Technology Transfer: Publication of results at various conferences.

5. CHANGES/PROBLEMS

A. University of Idaho:

i. ***Developing and Testing Eco-Traffic Signal System Applications***
Nothing to report at this time

ii. ***In situ Transesterification of Microalgal Oil to Produce Algal Biodiesel***
Nothing to report at this time

iii. ***Security and Survivability of Real-Time Communication Architecture for Connected-Vehicle Eco-Traffic Signal System Applications***
Nothing to report at this time

iv. ***Developing Active Learning Materials for the Introductory Transportation Engineering Course***
Nothing to report at this time

v. ***Calibration of Multi-Scale Energy and Emissions Models***
Nothing to report at this time

vi. ***Pyrolysis Bio-Oil Upgrading to Renewable Fuels***
Our preliminary hydrogenation studies show that the bio-oil and model compounds were not fully hydrogenated using the catalysts as received and therefore continuing studies will focus on using the activated catalysts. Further studies will investigate longer reaction times and a 2-stage hydrogenation reaction to enhance yields.

vii. ***Progress in Catalytic Ignition Fabrication, Modeling and Infrastructure***
Moving the facility to a new location has taken significant time away from our alternative fuels research. Funds to hire graduate research assistants have been limited so most of the work is being done by interns, staff, and/or work study students.

viii. ***Design Improvements and Performance Validation of a Competitive Hybrid FSAE Vehicle***
The vehicle experienced some component failures preventing the team from competing in the 2013 Formula Hybrid SAE competition. Upon initial high voltage testing, the isolation circuitry protecting the battery management system failed, damaging the control module. The wiring has been corrected and once the new components arrive full testing will resume.

ix. ***Curriculum Development for K-12 Sustainable Transportation Education***
Nothing to report at this time

B. Old Dominion University:

i. ***New Strategies for the Emergency Vehicle Routing to Reduce Response Time Using Vehicle-to-Vehicle Communications***
Nothing to report at this time

ii. ***Real-time Prediction of Queues at Signalized Intersections to Support Eco-driving Applications***
Nothing to report at this time

iii. ***Exploring Image-based Classification to Detect Vehicle Make and Model***
One important consideration for the future requirement is the classification of vehicles by their make and model which requires the availability of a high resolution camera that streams directly from the provider (i.e. VDOT). It appears the high resolution camera streams are only available through a fee-based system. Unavailability of this high resolution camera streams may impede the ability to classify vehicles by their make and model.

iv. ***A Study on the Impact of Parameter Uncertainty on the Emission-based Ranking of Transportation Projects***
Nothing to report at this time

v. ***Reducing Energy Use and Emissions through Innovative Community Designs: Methodology and Application***
Nothing to report at this time

vi. ***Optimize Freight Routes and Modes to Minimize Environmental Impacts***
Nothing to report at this time

C. Syracuse University:
Nothing to report at this time

D. Texas Southern University:
Nothing to report at this time

E. Virginia Tech:
Nothing to report at this time

6. SPECIAL REPORTING REQUIREMENTS

Financials will be sent by the University of Idaho's Office of Sponsored Programs as needed.

Completed by:
University of Idaho: Karen R. Den Braven
Old Dominion University: Asad Khattak
Syracuse University: O. Sam Salem
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