



Project 028 Combustion Model Development and Evaluation. Area #4

Georgia Institute of Technology, University of Connecticut

Project Lead Investigator

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University Participants

Georgia Institute of Technology

- P.I.(s): Professor Suresh Menon and Professor Wenting Sun
- FAA Award Number: 13-C-AJFE-GIT-009
- Period of Performance: 12-01-2015 to 11-30-2016
- Task(s):
 - Task 2 (Sun): Only travel funds are provided for this task
 - Task 3 (Menon): Only travel funds are provided for this task

University of Connecticut

- P.I.(s): Professor Tianfeng Lu
- FAA Award Number: 13-C-AJFE-GIT-009
- Period of Performance: 12-01-2015 to 11-30-2016
- Task(s):
 - Task 1 (Lu): Only travel funds are provided for this task

Project Funding Level

\$20K from FAA and \$20K cost share. Funds are explicitly for travel only.

Investigation Team

List the investigation team and specify the tasks for which they are responsible, their role in the team, and university affiliation. Include graduate students and post-doctoral researchers.

Task 1:

- **Title:** Reduced Kinetic Models with Fuel Sensitivity
- **Lead:** Professor Tianfeng Lu
- **Post Docs & Students:** Yang Gao
- **University Affiliation:** University of Connecticut

Task 2:

- **Title:** Network modeling and kinetics acceleration
- **Lead:** Professor Wenting Sun
- **Post Docs & Students:** Suo Yang
- **University Affiliation:** Georgia Institute of Technology



Task 3:

- **Title:** Large-Eddy simulation of the Referee rig
- **Lead:** Professor Suresh Menon
- **Post Docs & Students:** Dr. Reetesh Ranjan, Achyut Panchal
- **University Affiliation:** Georgia Institute of Technology

Project Overview

For Year 2 FAA support is primarily for travel to attend the mid-year and annual program review (May and Dec). Funds provided are not for research.

Task 1 – Reduced Kinetic Models with Fuel Sensitivity

University of Connecticut

Only travel funds are provided to attend FAA ASCENT and NJFCP program reviews and meetings to present results obtained from the NJFCP project. The Year 1 effort of the NJFCP project was funded by FAA and the Year 2 (2016) research project was funded by a NASA NRA. The FAA sub award to UCONN has been used to cover the following travel expenses:

1. FAA ASCENT program review meeting at Alexandria VA on 4/26/2016. Total cost is \$1080.48
2. NJFCP midyear review at UTRC (Hartford Connecticut) from 6/1/2016- 6/3/2016. Total cost is \$138.42
3. To present results from the NJFCP project in the 2nd International Workshop on combustion chemistry models of Real Liquid Fuels, at Arlington, VA from 6/5/2016-6/6/2016. Total cost is \$421.35
4. NJFCP year 2 review at Rolls-Royce (Indianapolis Indiana) from 12/13/2016-12/16/16. Total direct cost is \$1,053.43.

Year 2 total cash cost share from UCONN is \$6,864

Task 2 – Network modeling and kinetics acceleration

Georgia Institute of Technology

Only travel funds are provided to attend NJFCP program reviews and other relevant meetings. All research is funded by a NASA NRA. Travel details:

1. midyear review at UTRC (Hartford Connecticut) from May 31 to June 3. Total direct cost is \$1,356.3
2. year 2 review at Rolls-Royce (Indianapolis Indiana) from Dec. 12 to Dec. 16. Total direct cost is \$1,067.13
3. MACCCR fuel meeting at Argonne national lab (Chicago) from Oct. 17 to Oct. 20. Total direct cost is \$1,299.35
4. Jet fuel chemistry workshop at Washington D.C. from June. 6 to June. 7. Total direct cost is \$1,185.29

Year 2 total cash cost share from Georgia Institute of Technology is \$6,666.

Task 3 – Large-eddy simulations of the Referee rig

Georgia Institute of technology

Travel funds are provided to attend FAA ASCENT and NJFCP program reviews and meetings to present results obtained from the NJFCP project. The Year 2 (2016) research project was funded by a NASA NRA. Travel Expense includes

1. Midyear review at UTRC (Hartford Connecticut) from 6/1/2016- 6/3/2016. Total direct cost is \$1510.
2. Year 2 review at Rolls-Royce (Indianapolis Indiana) from 12/13/2016-12/16/16. Total direct cost is \$1300
3. Posters for ASCENT meeting: \$200

Year 2 total cash cost share from Georgia Institute of Technology is \$6,666



Objective(s)

The project's overall goal is to model the sensitivity of lean blow out (LBO) to various alternate fuels. The modeling effort includes three parts: (a) development of efficient reduced kinetics, (b) development of kinetics acceleration techniques and (c) LES studies of spray combustion in the Referee rig under experimental conditions. This work is continued under NASA NRA funding in 2016 but results are directly relevant for this NJFCP program.

Research Approach

All work under NASA NRA are computational in nature and are reported elsewhere.

Milestone(s)

Include a description of any and all milestones reached in this research according to previously indicated timelines.

Major Accomplishments

- New reduced and skeletal kinetics mechanisms were developed for the NJFCP three chosen fuels Cat A2, C1 and C5. These kinetics models have been implemented into LES codes
- Adaptive methods have been developed to speed up kinetics calculations in LES and DNS. These methods are currently being analyzed for relevance to full rig simulations.

Publications

Presentation:

"Model Reduction," Yang Gao, Chao Xu, Tianfeng Lu, Hai Wang, Jacqueline H. Chen, Alexei Poludnendo, Peter Hamlington, 2nd International Workshop on Combustion Chemistry Models of Real Liquid Fuels, Arlington, VA, June 06, 2016.

Publication (refereed):

Yang, S., Ranjan, R., Yang, V., Menon, S., Sun, W., ``Parallel on-the-fly Adaptive Kinetics in Direct Numerical Simulation of Turbulent Premixed Flame," Proceedings of the Combustion Institute, Vol. 36, 2016 (to appear).

Outreach Efforts

None

Awards

None

Student Involvement

Students are still in their PhD graduate programs in both Georgia Tech and UCONN.

Plans for Next Period

Work in the 3rd year is also funded by NASA NRA and not by NJFCP. Travel funds are however, authorized for two meetings in 2017.