NEW GRADUATE STUDENT ORIENTATION

Aerospace Engineering and Engineering Mechanics (ASE/EM)

Fall 2014
Prof. Mark Turner
Director of Graduate Studies
Aug. 2014
Agenda

- People
- Procedures
- Financial Aid
- Registration
- MS Program Requirements
- PhD Requirements and Qualifying Exam
- Faculty
People

Department Head - Prof. Paul Orkwis

Contact best by email to arrange appointment or ask question

Director of Graduate Studies

Prof. Mark G. Turner
Director of Graduate Studies
730 Rhodes Hall
556-3222
Mark.turner@uc.edu

CEAS

Ms. Julie Muenchen
Graduate Coordinator for Engineering
CEAS Office of Graduate Studies
665 Baldwin Hall
556-0635
Julie.Muenchen@uc.edu

ASE/EM

Ms. Shelly Tipton
ASE/EM Administrator
745 Baldwin Hall
556-3548
Shelly.tipton@uc.edu
Notes for All Students

• **Grad student mailboxes** are in 745 Baldwin

• **Email/internet access** – Establish account at Office of College Computing (OCC), 636 ERC. Notify Ms. Muenchen and Ms. Tipton of your e-mail address and sign up on-line for listserv.

• **Desks** assigned to GA/RA only. Assignments will be e-mailed ASAP. Obtain office key via Ms. Tipton.

• **Program of Study** – Develop with advisor. Turn in first one by December 1 – Forms & degree requirements are on-line. Update as required. (Probably frequently! Annually at a minimum.)

• **Permanent Advisor** – Talk to faculty and choose as soon as you can. Notify Ms. Tipton and Ms. Muenchen by submitting form.

• **Complete** tax forms on-line if on Assistantship support (now or later). Help: Ms. Leva Wilson (ASE/EM Bus. Mgr), 745A Baldwin, 556-9101.
Note on Choosing Advisor

• Graduate Director will be your temporary advisor until you select your permanent advisor.
• Choice of “permanent” advisor is up to the student, but…
  – RA support is tied directly to professor’s research grant, hence changing advisors means you lose that support.
  – GA support is not tied to an advisor unless it is supplemented (example: ½ and ½ GA/RA).
• Suggestion: Talk to the faculty in your interest area, find the research you want to do, and be honest about your interests with all involved.
• Check School and faculty websites for a quick idea of faculty activity … but be aware that some are notoriously out of date! Talking to them is better!
International Students

• **Check in** first with the UC International Services Office (One Edwards Center, room 3134)

• **Sign in** with Ms. Muenchen in 665 Baldwin Hall
  – Submit final transcript listing your degree.
  – **Notify** Ms. Muenchen of your social security and student ID numbers (**update** if they change).

• **Take** Oral English Proficiency Test (OEPT). Must take 2 times per year until passed. Courses in English as a Second Language are offered by UC International.
  – Pass of OEPT **required** to work as lab GA or teach recitation
Financial Aid/GA’s/RA’s

- **GA** = Graduate Assistant: Department support, Department teaching or grading assignment (expect e-mail on assignments by 2nd week) and research assignment

- **RA** = Research Assistant: Grant-based support that involves a research assignment from a professor

- **GA** and **RA** must fill out and turn in (to Department) report every semester of their activities to maintain aid
  - Must be signed by both departmental supervisor and research supervisor (may be the same professor)
  - Ms. Tipton will send reminders near end of each quarter
Financial Aid (cont’d)

• See Ms. Wilson or Ms. Tipton to begin assistantship payment and for help with any problems – all GA/RA pay issues are handled at the School level.
  – Note: UGS (tuition waiver) issues are handled at the College level with Ms. Muenchen
• Paychecks can be directly deposited (sign up) or paper check by snail mail to local addresses on pay-days, starting mid to late Sept.
• Financial aid for next year must be requested in February even for those with multi-year appt’s. E-mail reminders will be sent in January.
• Annual Review must be turned in by March for any financial aid consideration (GA/RA/UGS) next year. Forms will be e-mailed mid-Winter quarter.
Financial Aid (cont’d)

• Most students receive UGS tuition scholarship.
  – Does not include student fees/health insurance/ITIE fees
  – Requires $2,200 payment per semester from student
  – Comes from School allocation of real funds, i.e., it is a limited resource, so:
    • Available a MAXIMUM of 3 semesters for MS
    • Available a MAXIMUM of 4 semesters for Ph.D. with MS
    • Available a MAXIMUM of 7 semesters for Ph.D.
  – Must maintain full-time student status
  – Will be suspended if student is not following Program of Study (or none submitted) or is deficient in GPA or does not submit report (GA/RA) of annual reviews.
Financial Aid (cont’d)

• Department GA support
  – Mostly for 1st year students, sometimes 2nd year
  – Minimum. $850.00/bi-weekly, only a few in Summer semester
  – Department commitment of about 16-18 hours per week
  – Research commitment of 2 - 4 hours per week

• Research assistantship (RA) support
  – Grant-based research, 20 hrs/wk, professor supervises
  – Typically 12-month appointments (depends on grant)
  – Stipend varies (min. $850.00/bi-weekly through each semester depending on grant specs)

• ½ and ½ support
  – Mix of School and research commitment
Financial Aid (cont’d)

• Maintaining Support
  – All MS students receiving aid must do MS thesis
  – GPA > 3.0 at all times
  – Make progress in your research and reliably perform your Department duties
  – File semester progress reports and annual report on time with signatures!
  – Request aid for next year in February by deadline
  – Keep your Program of Study up to date!
Registration

- Must register for at least 15 credits each semester (except Summer) to be a full-time student
- Must register for at least 1 credit every semester (except Summer) – new College rule
- EGFD courses offered by AsE and MINE count as AsE courses (do NOT count as “outside School”)
- Course requirements are on Department website.
- Meet with your advisor before registering!!!!
  - Fill out a first-cut Program of Study at this time.
- Audit/UG/ESL courses do not count toward degree.
  - UG/ESL do count toward registration requirement
  - Audit classes do not count toward anything
Example Course Loads

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>4 academic classes*</td>
<td>12 cr</td>
</tr>
<tr>
<td>Research (under advisor)</td>
<td>2 - 6 cr</td>
</tr>
<tr>
<td>School Seminar</td>
<td>1 cr</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>15 - 18 credits</strong></td>
</tr>
</tbody>
</table>

Typical Full-Time Student (non GA or TA)

*May include ESL or UG classes

Talk with your advisor to define a program that is right for you!

Only a certain number of research credits can be used.
General Degree Requirements

• See Department website for course requirements for each major area (Fluids/Propulsion, Solids/Structures, Dynamics & Control)

• Technical Electives
  – AsE/EM classes– automatic approval
  – Other areas – Need Graduate Committee permission (by petition)

• Out-of-Department credits (other than Math) are limited:
  – 6 for MS, 9 beyond MS or 15 maximum for PhD
  – EGFD credits are inside Department

• Graduation
  – Degree requests MUST be submitted on-line at beginning of graduating semester by the deadline, else no degree that semester
  – Register for at least 1 credit in year of graduation
  – Complete revised final Plan of Study in last semester
  – Complete thesis/mini-thesis requirements (defense, document, signatures)
## Master of Science in Aerospace Engineering
### Any Major Area

<table>
<thead>
<tr>
<th>Major Option</th>
<th>Thesis</th>
<th>Non-Thesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major Option</td>
<td>9 cr. hrs.</td>
<td>12 cr. hrs.</td>
</tr>
<tr>
<td>Mathematics</td>
<td>3 cr. hrs.</td>
<td>6 cr. hrs.</td>
</tr>
<tr>
<td>Technical Electives</td>
<td>6 cr. hrs.</td>
<td>9 cr. hrs.</td>
</tr>
<tr>
<td>M. S. Thesis Research</td>
<td>12 cr. hrs.</td>
<td>--N/A--</td>
</tr>
<tr>
<td>Mini-Thesis Research</td>
<td>--N/A--</td>
<td>3 cr. hrs.</td>
</tr>
<tr>
<td>AsE &amp; EM Graduate Seminar</td>
<td>2* cr. hrs.</td>
<td>2* cr. hrs.</td>
</tr>
<tr>
<td>Total</td>
<td>32 cr. hrs.</td>
<td>32 cr. hrs.</td>
</tr>
</tbody>
</table>
# Master of Science in Engineering Mechanics

## Any Major Area

<table>
<thead>
<tr>
<th></th>
<th>Thesis</th>
<th>Non-Thesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dynamics &amp; Controls, Fluids &amp;</td>
<td>9 cr. hrs., with at least 3 cr. hrs. in each</td>
<td>12 cr. hrs., with at least 3 cr. hrs. in each</td>
</tr>
<tr>
<td>Propulsion, and Structures &amp;</td>
<td>area</td>
<td>area</td>
</tr>
<tr>
<td>Solids</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mathematics</td>
<td>3 cr. hrs.</td>
<td>6 cr. hrs.</td>
</tr>
<tr>
<td>Technical Electives</td>
<td>6 cr. hrs.</td>
<td>9 cr. hrs.</td>
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<td>--N/A--</td>
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</tr>
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<td>AsE &amp; EM Graduate Seminar</td>
<td>2* cr. hrs.</td>
<td>2* cr. hr.s</td>
</tr>
<tr>
<td>Total</td>
<td>32 cr. hrs.</td>
<td>32 cr. hrs.</td>
</tr>
</tbody>
</table>
Ph.D. Program Requirements – AE and EM Degree (semester credits)  
Minimum course requirements

**beyond a bachelor’s degree**

**DOCTOR OF PHILOSOPHY IN AEROSPACE ENGINEERING OR ENGINEERING MECHANICS AFTER B.S.**

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major Option</td>
<td>18 cr. hrs. with at least 9 cr. hrs. in 7000 level or above courses</td>
</tr>
<tr>
<td>Technical Electives</td>
<td>6 cr. hrs.</td>
</tr>
<tr>
<td>Mathematics</td>
<td>6 cr. hrs.</td>
</tr>
<tr>
<td>Ph.D. Research</td>
<td>58 cr. hrs. with at least 48 cr. hrs. in Ph.D. Dissertation Research</td>
</tr>
<tr>
<td>Seminar</td>
<td>2 cr. hrs.</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>90 cr. hrs.</td>
</tr>
</tbody>
</table>
DOCTOR OF PHILOSOPHY IN AEROSPACE ENGINEERING OR ENGINEERING MECHANICS
AFTER M.S.

<table>
<thead>
<tr>
<th>Major Option</th>
<th>9 cr. hrs. with at least 6 cr. hrs. in 7000 level or above courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical Electives</td>
<td>6 cr. hrs.</td>
</tr>
<tr>
<td>Mathematics</td>
<td>3 cr. hrs.</td>
</tr>
<tr>
<td>Ph.D. Research</td>
<td>46 cr. hrs. with at least 38 cr. hrs in Ph.D. Dissertation Research</td>
</tr>
<tr>
<td>Seminar</td>
<td>2 cr. hrs.</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>66 cr. hrs.</td>
</tr>
</tbody>
</table>
Major Requirements

**Dynamics and Controls**
20-AEEM-6003 Analytical Dynamics
20-AEEM-6015 Modern Control
and a 3-credit-hour courses at the 6000 level or higher in the Dynamics & Controls area.

**Fluid Dynamics and Propulsion Systems**
(Three out of Four Listed Courses)
20-AEEM-6011 Combustion
20-AEEM-6041 Compressible Flow and Thermodynamics
20-AEEM-8030 Advanced Propulsion
20-EGFD- 7041 Visc. Flow and Heat Transfer

**Solids and Structural Mechanics**
20-AEEM-6001 Advanced Strength of Materials
20-AEEM-7052 Finite Element Method
and a 3-credit-hour courses at the 6000 level or higher in the Solids and Structural Mechanics area.
MS Specific Requirements (cont’d)

• Minimum Academic Performance
  – Dismissal if GPA < 3.0 (courses only, Pass/Fail for Research)

• Thesis Defense and Submission
  – Note early deadlines for approval (not just submission)
  – Forms from Ms. Muenchen for scheduling and passing oral defense
  – Signatures of all Committee members required
  – Submit thesis electronically to Office of Research and Advanced Studies

• Mini-Thesis Submission
  – Note early deadlines for approval (not just submission)
  – Forms from Ms. Muenchen – approval needed by 2 faculty members
  – College mini-thesis requirements are on College website
PhD Specific Requirements

- 90 credits beyond BS or 66 past MS
- 2 credits School Seminar (can be from MS studies)
- Residence requirement – 10 or more graduate credits for 2 out of 4 consecutive semesters (University rule) with 12 credits in fall semester
- Forms from Office of Research and Adv. Studies for scheduling defense, acceptance of dissertation
- Request for degree forms - online
- GPA < 3.0 means dismissal from program
ASE/EM PhD Qualifying Exam

- **Objective:**
  - understanding of engineering concepts and ability to apply these concepts in research and design
  - ability to critically analyze an engineering problem
  - ability to organize and communicate a body of knowledge
  - ability to answer questions related to a defined body of knowledge
- Must have GPA 3.0 overall and 3.0 in major area
- Faculty member must sign as potential dissertation advisor – does **not** guarantee financial support
- EM students must choose a major area
- Can be given throughout the year
- **Two Parts:**
  - submission of a research paper
  - Oral Exam based on presenting of the research paper
- **Exam Committee:** 3 department faculty in the student’s major area

New Process
PhD Qual. Exam – Research Paper

• prepared in accordance with the best practices for preparing peer reviewed journal papers and will be evaluated based on:
  – Interest. The paper has to address a topic of significant importance to the fields of aerospace engineering or engineering mechanics
  – Novelty. The paper must present original methods or results which are not available in the open literature
  – Validity. The paper must be accurate and free from errors

• Exam Committee members will vote on the quality of the work based on the three criteria above. A consensus vote is required to pass. Students failing the evaluation will be given the possibility of resubmitting the research paper for a second and final time within six months subject to the time limitations of Section V.E.1.

• If paper accepted for journal, student is first author, and work done at UC, the review may not be needed
PhD Qual. Exam - Oral

• Student will present an uninterrupted seminar open to all faculty and students of twenty (20) minutes in length.

• Presentation based on best practices for preparing presentations for conferences and seminars. Besides the clarity and conciseness of the presentation, the exam will establish the student’s ability to respond to questions aimed at assessing:
  – Critical thinking skills
  – Understanding of technical material and fundamental knowledge in the field
  – Ability to relate their research to the field as a whole

• The question and answer period will typically last thirty to sixty minutes and is open only to the Department faculty and any designated persons outside the faculty to whom the Department faculty present indicate no objections

• Exam Committee members will then vote
Doctoral Candidacy

• All coursework satisfactorily completed
• Qualifying exam (both parts) passed
• Dissertation proposal accepted
  – Must occur at least 1 year prior to dissertation defense
• Ph.D. time limitations: 9 years maximum
  – 5 year limit until candidacy
  – 4 year limit on candidacy until degree
Bottom Line

• Good luck!
  ◦ Work hard!
  ◦ Be responsible for your own progress!
  ◦ Have some fun!
  ◦ Keep a positive attitude!
  ◦ Achieve greatness!
  ◦ … well, at least get a degree!
Aerospace Faculty Research

These sides provide an overview of the department research and then the specific research areas of each individual.
Faculty Decision Making

Kelly Cohen  UAV Surveillance for Forest Fires and Urban First Response, Mission Planning, Intelligent Controls

Elad Kivelevitch  UAVs Optimization and Intelligent Multi-Agent Systems
Professor Educator

Kristin Y. Rozier  Formal Methods, Air Traffic Management, Unmanned Aerial Systems

Grant Schaffner  Spaceflight Exercise Countermeasures, Robotic Surgery, Exoskeleton Systems

Bruce Walker  Engine Diagnostics and Prognostics, Modeling of Engine Controls
## Faculty Modeling and Simulation

<table>
<thead>
<tr>
<th>Name</th>
<th>Research Areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shaaban Abdallah</td>
<td>Computational Fluid Dynamics (CFD) Techniques, Engine Shutdown Dynamics</td>
</tr>
<tr>
<td>Kirti Ghia</td>
<td>CFD, Tidal Energy, Flow Control</td>
</tr>
<tr>
<td>Awatof Hamed</td>
<td>CFD, Thermal Management, Blade Coating Erosion, Aeroacoustics, Flow Control</td>
</tr>
<tr>
<td></td>
<td><strong>Director CIPALMS</strong></td>
</tr>
<tr>
<td>G.R. Liu</td>
<td>Finite Element Simulation and Modeling, Solids/Fluids/Heat Transfer Multi-Physics Simulation, Mesh Free Methods, Material Crack Propagation</td>
</tr>
<tr>
<td></td>
<td><strong>Ohio Eminent Scholar</strong></td>
</tr>
<tr>
<td>Paul Orkwis</td>
<td>Large Scale CFD Analysis, Aeroacoustic Simulation, Algorithm Development, Turbomachinery Design Optimization, 3D Visualization, 3D Printing, Shock Wave/Boundary Layer Interaction, Conjugate Heat Transfer</td>
</tr>
<tr>
<td>Mark Turner</td>
<td></td>
</tr>
</tbody>
</table>

*Ohio State University*
## Faculty Experimentation and Testing

<table>
<thead>
<tr>
<th>Name</th>
<th>Research Areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peter Disimile</td>
<td>Aircraft Fire Extinction, Blast Mitigation Fire Detection</td>
</tr>
<tr>
<td>Jong-Guen Lee</td>
<td>Ohio Research Scholar</td>
</tr>
<tr>
<td>Samir Tambe</td>
<td></td>
</tr>
<tr>
<td>Ephraim Gutmark</td>
<td>Chevron Jet Noise Reduction, Pulse Detonation Engines, Afterburners, Turbine Blade Heat Transfer and Aerodynamics, Oil Drilling, Thermoacoustics, Flameless Combustion</td>
</tr>
<tr>
<td>Jie Chen</td>
<td></td>
</tr>
<tr>
<td>David Munday</td>
<td></td>
</tr>
<tr>
<td>Asif Syed</td>
<td>Acoustic Liner Testing</td>
</tr>
</tbody>
</table>
Peter Nagy

Francesco Simonetti
Ohio Research Scholar

Nondestructive Evaluation (NDE):
Ultrasonic, Electric, Magnetic,
Electromagnetic, Dielectric,
Thermoelectric. NDE Methods of
Ceramic Matrix Composites. Evaluation
of Structural Parts for Creep Damage,
Fatigue, Debonding, Cracks, Corrosion,
Erosion, Surface Tension. Detection of
Breast Cancer.
Shaaban Abdallah
shaaban.abdallah@uc.edu

**GE (Aviation, Cincinnati, OH)**
- Engine shutdown physics Core compartment cooling and ventilation at engine soakback
- New hybrid nozzle for jet engine deicing

**CFD Research**
- Mesh Free method for solutions of Navier-Stokes equations

**Turbomachinery Research**
- Multistage co-rotating propellers
- Innovative wind turbine design

**Patents**
- US patent, ”Two-Level Flow Controller,” 2009
- US Provisional patent on Navigated Catheter, 2013
- Counter-Rotating Radial, Centrifugal or Mixed-Flow Compressor, Pump or Turbine,
  University of Cincinnati, Invention Disclosure
- Back-To-Back Centrifugal Impeller,
  University of Cincinnati, Invention Disclosure
Dr. Kelly Cohen  
Kelly.Cohen@uc.edu

**Current Research Directions**  
http://most-aero.uc.edu

**Intelligent Systems and Mission Planning:**
- Battle management system for missile defense  
- Multi-agent optimal task planning for UAVs  
  - AFRL (DAGSI)

**System Identification of Rotorcraft:**
- System identification of Morphing Unmanned Rotorcraft  
  - Modus Recte, Inc.

**Surveillance for Intelligent Emergency Response Robotic Aircraft**
- Small UAV platforms for forest fire monitoring and situational awareness  
  - Marcus UAV, Inc.
- Forest fire growth prediction algorithms  
  - NSF: I-Corps Program with University of Toledo

**Intelligent Control Systems:**
- Attitude Control of a “CubeSat”  
  - Sierra Lobo ([http://www.sierralobo.com](http://www.sierralobo.com))
  - Ohio Consortium with NASA Glenn, Univ. of Toledo, Univ. of Dayton and AFIT
Research Activity

• Fuel spurt characterization due to HRAM.
• Fire Suppressant Transport
• Blast mitigation techniques.
• Hot Surface ignition & thermal management.
• Composite thermal conductivity measurements.
• Flame impingement and damage assessment.
• Turbulent flow over rectangular cavities.
• Fluid Structure Interactions.

Core facilities

• OJATS: A 9 ft² subsonic open jet can expands into a 3100 ft³ acoustic chamber at speeds up to 30kts.
• Full scale Rotorcraft Engine Nacelle Fire Simulator.
• Three wind tunnels (test sections up to 16 ft² and speeds to 130 kts).
• Blast chamber with a square 2.5” shock tube and 18” diameter blast tube.
• Fan Acoustics Test & Evaluation Bed.
• 3”x3” Thermal Conductivity Test Bed
Applied R&D Activities:
• A small independent high speed passive fire protection system for rotorcraft engine nacelles.
• Development of a high speed microprocessor based fire detection & locating system development for aircraft spaces.
• Smart fire protection system for aircraft engine nacelles and dry bays.

Rotorcraft Engine Nacelle Fire Simulator

8 GPH JP-8 Fire Initiated

A red circle highlights the ignition @ t=0 msec and extinction @ 123 msec later
DAGSI, AFRL, National Renewable Energy Laboratory (DoE)

- Development of High-Work, High-Efficiency Low-Pressure Turbine Technologies for Separated and Transitional Flows
- Flow Control for Hypersonic Inlets using Magneto-hydro-dynamics (MHD)
- Generation of Clean Energy using Hydro-Kinetic Tidal Turbine Farm
GE (Aviation, Global Research, Power)
- Reduction of commercial and military jet noise (4 joint patents)
- Developing new afterburners concepts (1 joint patent)
- Constant volume/pressure gain combustors (1 joint patent)
- New methods for boiler cleaning (1 joint patent)
- Turbine blades heat management and aerodynamics

The Boeing Company
- Shape Memory Alloys for vertical takeoff (V-22)
- Heat transfer from advanced aerodynamic airfoils
- Shock and flow separation control at high speeds (1 joint patent)

Honeywell International, Inc.
- Extension of surge margin in turbochargers

Halliburton Company
- Innovative hydrodynamics for oil drilling and production (1 joint patent)

Siemens/Alstom/ABB
- Prevention of thermoacoustic in power generation combustors (35 joint patents)

Goodrich Aerospace
- Multiple Lean-Direct Inject burners in high pressure combustors
- Low emissions, efficient and stable “Flameless” combustion (1 joint patent)
GE Aviation, Rolls Royce, BRYCOAT Inc, Expatial

- **Erosion of Turbomachinery Blades and Thermal Barrier Coatings**
  - Experimental investigation of blade and coating erosion by particle impacts at high velocities and temperatures

**GE Aviation**

- **Thermal Management**
  - Optimization of aircraft environmental control systems
  - Subsystem modeling of the Adaptive Power Thermal Management System (APTMS) for 5th Gen. military aircraft

**NASA**

- **Flow Control in Shock Wave Boundary Layer Interactions**
  - Computational simulations of bleed hole row interactions with shock/turbulent boundary layer interactions
  - Development of flow expansion physics bleed models for supersonic inlet design
Composites/Coatings Lab--Hybrid nanocomposites and coatings for protection of metals: J.O.Iroh
(irohj@ucmail.uc.edu)

Supported by
National Science Foundation: NSF-CMMI; Office of Naval Research: ONR/Jackson State University

Area of Research

• Processing and properties of high temperature polymer composites.
• Variable temperature high impact resistant composite coatings.
• Low density transparent and conductive composites and coatings.
• Synthesis and properties polymer/nanographene sheets composites.
• Processing and characterization of polymer/nanoclay coatings.
• Polymer composites for renewable energy storage systems.
• Electrochemical synthesis of composites and coatings
• Mechanical and interfacial properties of polymer composites.
GE (Aviation, Global Research, Power) and Parker Hannifin Gas Turbine Fuel Systems

- **Combustion and Spray**
  - Characterization of spray at high-pressures
  - Reacting and non-reacting aerodynamics
  - Multi-swirl cup swirler-swirler interactions
  - Advanced multi-point Lean Direct Fuel Injection
  - Cokings in fuel nozzle and fuel line
  - Combustion dynamics measurements to assist model development
  - NOx emissions from a perfectly premixed combustor
  - Fuel/air mixing measurement in micro-mixing device using acetone-PLIF
  - Development of (a) high altitude relight facility and ignition study, (b) Flame radiation emission probe (fiber-optic) for high pressure combustion chamber, and (c) Fuel vapor concentration probe using Infrared Extinction Technique

- **Fire Safety and Thermal Management**
  - FAA fire certifications and engineering tests
  - Fire resistant properties of advanced composite material
  - Spray cooling systems
Elad Kivelevitch
Elad.Kivelevitch@uc.edu

Unmanned Aerial Systems (UAS): analysis and design of UAS, multi-vehicle task assignment algorithms and control

Optimization Methods: mathematical modeling and optimization, gradient-based methods, Mixed Integer Linear Programming (MILP), heuristic and meta-heuristic methods, combinatorial optimization problems

Complex Adaptive Systems (CAS): using complex systems, e.g., swarms and economic markets, to find near-optimal solutions for large-scale, dynamic, and uncertain problems

Intelligent multi-agent systems: using multi-agent modeling and simulation to analyze the behavior of complex systems, incorporating Fuzzy Logic, Artificial Neural Networks

Min-Max combinatorial assignment of 5000 tasks to 10 UAVs
GR Lab--computation for sustainability
G. R. Liu (liugr@uc.edu)

Supported by
US Department of Defense (DTRA); US Department of Army Research Laboratory
National Science Foundation

Area of Research

- Novel theory and methodology for automation in modeling and simulation.
- Computational technology for structures under extremely conditions.
- Computational technology for crack path capturing and crystal-plasticity.
- Computational techniques for automatic shock capturing in fluids.
- Computational techniques for SWBLI problems.
- Computational techniques for complex fluid-structural problems.
- Computational biomechanics for medical applications.
- Computational techniques for energy systems.

www.ase.uc.edu/~liugr
Ongoing Research Projects

- Nondestructive creep damage assessment (Battelle/DoE)
- NDE of diffusion bonded components (Rolls-Royce Corp.)
- Nonlinear ultrasonic NDE of fatigue (Rolls-Royce Corp.)
- Thermoelectric NDE for thermal aging (EPRI)
- Magnetic field mapping for online welding monitoring (EPRI)
- Electric nondestructive monitoring of corrosion (NNL)
- Residual stress assessment by electromagnetic NDE (FAA)

Core Facilities

- **Ultrasonic NDE** (RAM-10000 high-power ultrasonic system, DPSS-532 Fabry-Perot interferometer, OFV-302 heterodyne interferometer, Brilliant 10 laser pulser, A1270 EMA electromagnetic acoustic gauge, etc.)
- **Electric NDE** (LR700 AC potential drop system, SR921 AC impedance analyzers, etc.)
- **Magnetic NDE** (SMM-701U SQUID magnetic scanner, MAG-03 magnetic scanner, RollScan300 Barkhausen noise analyzer, Magnetoscop 1.069 susceptibility meter, MP30E-S Feritscope, etc.)
- **Electromagnetic NDE** (Nortec 2000 and US-450 eddy current analyzers, etc.)
- **Dielectric NDE** (Agilent 4294A and SR720 impedance analyzers, etc.)
- **Thermoelectric NDE** (ATS-6044 and TE-300 TEP analyzers, etc.)
Gas Turbine Simulation Lab (GTSL)
Paul D. Orkwis and Mark G. Turner
Paul.Orkwis@uc.edu  mark.turner@uc.edu
http://gtsl.ase.uc.edu/

GE Aviation, AFRL, NASA, Siemens Energy, Cornerstone Research

- **Capabilities**
  - **Hardware:** 1000+ cores in parallel cluster in protected network, high memory workstations, 3D visualization, GPUs
  - **Solvers:** XDG, Tacoma, Overflow, Fine/Turbo, FDL3DI, CFX, ANSYS
  - **Post Processing:** Tecplot, NPLOT3D, Asgard, Fieldview
  - **Grid Generation:** Pointwise, Numeca Autogrid & IGG
  - **Turbomachinery Design:** meanline, axisymmetric, 3D geometry

- **Simulation Applications & Flow Physics**
  - Compressor tip flows with unsteadiness and multistage apps
  - Turbine Aero and Cooling including hub purge cavity flows that affect unsteadiness such as hot streak migration
  - Turbomachinery Design & Optimization
  - Supersonic Inlets & SWBLI, Acoustics, Heat Transfer, LES

- **CFD Development**
  - High Order Discontinuous Galerkin: 10-100 times faster!
  - Harmonic Balance
  - Optimization, Post Processing, GPUs
• **Formal Methods**
  – Formal specification, V&V of safety critical systems
  – Model checking, property-based & model-based design
  – Linear Temporal Logic satisfiability checking, specification debugging techniques and theory

• **Air Traffic Management**
  – Design-time checking of system logic and system requirements
  – Comparative analysis of functional scenarios for NextGen future separation assurance designs

• **Unmanned Aerial Systems**
  – Intelligent runtime monitoring and reasoning for real-time decision making and safety
  – Flight-certifiable system health management
  – Automated reasoning, runtime verification, fault tolerance

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**Laboratory for Temporal Logic**

starting Jan 2015

Kristin Yvonne Rozier [kristin.y.rozier@nasa.gov](mailto:kristin.y.rozier@nasa.gov)
Spaceflight Exercise Countermeasures (NASA)
- Determining muscle forces and bone stress
- Optimizing exercise prescriptions

Semi-Autonomous Robotic Surgery for Space Exploration
- Effects of communication latency on telesurgery accuracy and efficiency (NASA)
- Development of semi-autonomous methods for surgery (Summa Health System / NASA / NSF / NIH)

Blast Characterization and Protection
- Lightweight IED Blast and Momentum Bypass/Mitigation (ESI Inc., US Navy)
- Occupant Sensor Suite (ESI Inc., US Army)

Exoskeletons Systems
- Space Suit Simulator (Aurora Flight Sciences / NASA)
- Movement assistance (NSF/NIH proposal in review)
- Exercise / Extravehicular Activity (NASA)
Ongoing research projects

- Novel nondestructive inspection techniques for CMC engine components - GE Aviation
- Super-resolution ultrasonic imaging methods for the inspection of cast austenitic components – EPRI
- Guided wave tomography for corrosion and erosion monitoring in inaccessible regions – Cincinnati NDE
- Guided microwave detection of corrosion under insulation
- Ultrasound tomography for the early detection of breast cancer
- Ultrasonic measurement of surface tension

Core facilities

- Ultrasonic Microscope up to 300MHz
- 128-channel phased array system
- Microwave vector network analyzer up to 64GHz
- FLIR Infrared camera 640×512 res. -20°C to 500°C
- Laser doppler vibrometer 24MHz bandwidth

Full list available at www.ase.uc.edu/USIL/core_facilities.html
Duct Acoustics and Acoustic Liner Design

**GE Aviation**
- Acoustic characteristics of advanced high temperature materials for thermal and acoustic insulation

**Middle River Aircraft Systems (GE Aviation)**
- Development of double layer acoustic liners for aircraft engine nacelles (acoustic suppression)

**Cornerstone Research Group/NASA**
- The effects of drainage slots (in the honeycomb) on the acoustic suppression performance

**Hexcel Corporation**
- New product development based on honeycomb structures
GE Aviation

• Diagnostics and prognostics for turbofan engines based on limited sensor information
• Simulink modeling for engine control development and testing

Other ongoing research topics

• Output feedback control to achieve zero steady state error for a subset of outputs
• Trajectory tracking control using inverse system dynamics approximated by radial basis functions
• Comparison of diagnostic approaches for fault detection on jet engines
• UAV trajectory tracking control (with K. Cohen)