Planning for Student Projects in AAE520

- 8 week effort, about 80 hours work per student
- Instructor will suggest some possible topics, with the assistance of other interested faculty.
- Student-initiated topics are encouraged.
- Propose topic for approval by instructor (write up the concept, no more than a paragraph or two, let's discuss it, then write up a short proposal for approval – see schedule)
- Developing your own experiment is very different from operating an experimental apparatus developed by others. It's like the difference between driving a car and building one.
- Designing and building an expt apparatus is somewhat like designing and building an air vehicle.
- Negotiate a plan for what is feasible within the course. Good experiments usually take a lot of time and money. Avoid overly ambitious goals.
- The budget for expenses for the projects remains fairly limited.

Project Teams for AAE520

- Form a small group interested in the same topic, usually 2-4 people. May be different from your group for the 3 preplanned labs
- Group may meet at times that are different than for preplanned labs. Times are flexible, depending on group members and equipment availability.
- Plan ahead! What project elements have long lead times? In what cases do you need to wait for others to do things?
- The work is initiated, planned, carried out, and reported by the student groups. Your instructors serve as advisors or coaches. If you never ask us questions, we worry about whether you are making efficient progress. If you are always asking us questions about simpler things, we worry about your ability to work independently. Find a reasonable middle ground – do what you can on your own and then get help if you get stuck. The ball is yours to carry!

Facilities Available for Student Projects

- Small low-speed wind tunnels: Chicago Blower (12x18-in.), High Contraction (18-in. dia. with balance), etc.
- Subsonic tunnel in Armstrong with balance (beware conflicts)
- Boeing 4x6 ft. subsonic tunnel with balance
- 2-inch supersonic tunnel, at Mach 0.6, 2.0, 2.5 or 3.6
- small supersonic jet (Mach 1.6, 4, or possibly 6)
- water tunnel with LDV etc.
- Mach-6 Ludwieg Tube can be operated only by people who are already trained as part of my research group.
- Others (such as drop tower, etc.)
- Can use facilities in other depts with approval
- Avoid conflicts with research, 333L, 334L

Instrumentation Available for Student Projects

- Hot wires
- Pitot measurements, multihole probes
- Pressure measurements
- Flow visualization
- LDV apparatus
- Digital oscilloscopes, other electronics
- etc., etc.
- Models are <u>not trivial</u> to build! If you want to measure the flow past a model, think about a feasible way to build one. Use of the 5-axis CNC as in the DBT course is possible but not easy. It usually takes one student's contribution for the rest of the semester to make a good 3D subsonic model.

Ideas for Student Projects, Low Speed

- Forces and moments on models (in the Boeing tunnel?). Or, use one of the other tunnels, like the high contraction tunnel or the Chicago blower tunnel.
- Continuations of the wake or water-tunnel preplanned labs.
- Realign the LDV and improve the system.
- Measure something with the LDV and traverse. We have an airfoil with a winglet and a cylinder.
- Build a smaller cylinder for the water tunnel and perform experiments at the same Reynolds number as the wake experiment in air, but with different instrumentation and with water.
- Fluid-structure interaction with vibration of thin tensioned wire cylinders, in wake tunnel
- Low Reynolds Number aerodynamics in high contraction tunnel (or in Armstrong?)

Ideas for Student Projects, High Speed

- Pulsed LED light source ← this has been done!! ☺
- Schlieren in 3-inch shock tube (compare with pressure)
- Achieving Mach 6 in the small jet with- and without condensation
- Running the small jet at low Reynolds numbers to calibrate hot wires (jet recently upgraded).
- Airfoil expt in 2-inch blowdown tunnel, using windows with clearance holes for mounting models.
- How low can you run the stagnation pressure and still get supersonic flow in the 2-inch tunnel?
- A new measurement for the 2-inch supersonic blowdown tunnel? Careful characterization of another nozzle?
- Pitot-pressure profiles in the nozzles of the 2-inch blowdown tunnel.

Ideas for Student Projects, Propulsion-Related

The following are some old ideas. Contact Propulsion faculty if you are interested in this area.

- Trapped vortex combustors in Mach 2.5 tunnel, probably unreacting (cf. Heister)
- Gas/Gas mixing problems relative to a propane/air torch (Heister)
- Fluidic injectors (Heister and Collicott?)
- Schlieren measurements in ‘cap-shock’ of over-expanded nozzle for Anderson’s thrust-optimized nozzle (Anderson)
- Talk to other faculty members (Collicott, Sullivan, Bane, Heister, Anderson, Qiao, Pourpoint)

Planning and Troubleshooting Experiments

- Plan your experiments carefully and study your apparatus and instrumentation. You must master it.
- Anything that can go wrong, will. Expect multiple iterations while developing, mastering, and debugging your apparatus. Schedule for this.
- Troubleshooting is like a more sophisticated version of troubleshooting your car or PC.
- Study how each component of your experiment works. Test each component as much as possible.
- Don't assume anything. Suspect that everything is flawed until checked. Check everything. Use things like symmetry properties to check that the experiment is really working as you suppose. Invent new checks.