Prof. Steven Collicott, School of Aeronautics and Astronautics, Purdue University

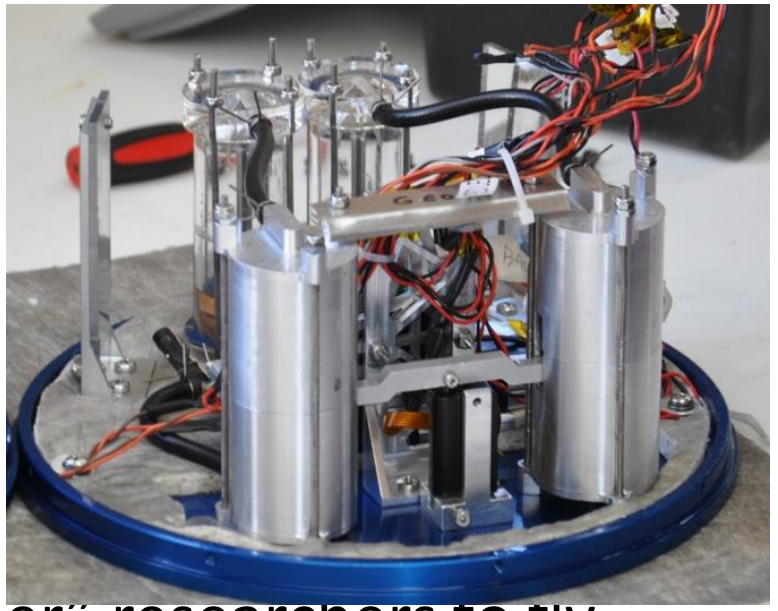
- 25 years as a Purdue engineering professor.
- I work with one foot in fluids physics in weightlessness, one foot in applied zero-g fluid dynamics in the commercial satellite industry.
- First zero-g fluids experiences: 1981, Lockheed Missiles and Space Co.
- First parabolic flight payload: 1996
- First on-orbit thermal-fluids based propellant gauging: 1998
- First Purdue drop tower experiment: 1999, 0.8 seconds, which led the to Vane Gap payloads of Capillary Flow Experiments (CFE) in ISS.
- First fluids-based lifetime extension for a commercial satellite, 2004
- First sub-orbital payload launch: 2009 with Armadillo Aerospace
- First time PI on ISS experiment: Nov. 2012 (cancelled, 2014)
- Chair, Sub-orbital Applications Researchers Group of Commercial Spaceflight Federation, 2013 to date. SARG member since 2009.
- CASIS Science and Technology Advisory Panel, serving 2013 to date.

Activities

Space-related Consulting History:

- 1998-date: Lockheed-Martin, now YSPM, LLC,:
  - Modeling liquid propellant positioning in geosynchronous communications satellites for:
    - The best propellant gauging method available for this type of satellite mission
    - Variations in mass properties of the spacecraft throughout the mission
    - Propellant rebalancing and lifetime extension in older, multi-tank satellites
    - Many happy customers!
- 2005: Designed the Vane-Gap geometries for CFE experiments in ISS.
- 2009: Liquid propellant slosh natural frequency prediction, in support of a LEO science mission.
- 2014-date: Program planning for industrial manufacturing test in ISS
  - Collaborate on SBIR proposal writing and scheduling.
  - If funded, lead scheduling of the program based on necessary reviews

Activities



Zero-g Fluids Research

- 1996-date: 34 parabolic flight payloads
- 1998-2008: Purdue 0.8 second Drop Tower
- 2006-2007: Aided in Vane-Gap operations in ISS
- 2009: Chosen by Blue Origin as one of three “Pathfinder” researchers to fly payloads during Blue’s flight test program (soon...)
- 2009-date: Armadillo, Blue Origin, Masten Space Systems, XCOR, Exos, UpAerospace commercial sub-orbital rocket payloads built, launched, and being built.
- 2012: “Fluids Education” experiment proposal selected by NASA for ISS. A joint science and education effort with Prof. Kizito at NCA&T. NASA cancelled several such efforts just before our Phase-2 safety review.

Comments for Today

I often seek satellite industry collaboration on orbital and sub-orbital experiments. Buy-in by this industry is rare. This is likely because:

1) From contract to launch of a $200M satellite is approximately 24 months. So the pace of industry far exceeds the pace of access to ISS. They regularly build, test, and launch a profitable satellite in 2 years. (LM, Boeing, SSL schedule data)
2) I get the impression annually that industry does not trust NASA to follow through on plans. Industry fears investing time and money only to have plans change, delaying or cancelling their efforts. Couples into #1 too. But industry does understand launch delays as industry also has launch delays.
3) Program Managers, VPs, etc. are expected to deliver profits quickly. An ISS payload is, to date, a very slow process. Thus, ISS experimentation is counter-productive for those in a company who have the authority to commit company funding.
4) Insurance companies impact innovation in commercial communications spacecraft. Heritage hardware that “works well” is far lower risk than a new idea which “should be better”.
5) Current satellite manufacturing profits are weak due to a global over-supply of satellite manufacturing and export control restrictions on US companies.

Possible Conclusions for Today

Thus, the most important items to attract industry to current and future orbital experiment opportunities are:

1) Cost effectiveness is key
   - This is no different than for any other item in their product
   - Difficult to put a price on this as there is so little experience to compare with.
   - I find that I can get some small money now and then for some ground-based testing from some companies
2) Schedule is key
   - More rapid and more frequent access to orbit
   - CASIS is working to be quicker, I wish that they would advertise their “rapid” successes more to attract more participants.
3) Dependable management of orbital access is key
   - These companies are experienced in international commercial launch provider markets, they would adapt quickly to commercial access to orbit for research.
4) New, cheap, commercial sub-orbital can be an entry for industry into experimentation in space.