Team Meeting 1/20/20

Project: CH4-LOx Liquid Biprop with Non-Pyro Ignition + Restart

Meeting Objectives

- Decide Measurables/Goals
- Assign subsystem responsible engineers (leads)
- Assign subteam members
- Discuss propellant sourcing/availability
- Decide top-level parameters
    - Thrust
    - Chamber pressure

Measurables/Goals

Ideas:

- HS camera view into chamber to observe initial ignition process?
    - High-speed cameras are probably available through Ames
    - Maybe Cantwell's lab, but those are likely still in use
    - 1200fps camera probably available, 10kfps also but harder to access
    - Need to get clever with optics layout to prevent camera damage
        - Rishav: sapphire sight-glass in chamber wall?
- ~~Accelerometer~~ pressure transducer/load cell measurements for start smoothness?
    - Test stand & plumbing rigidity/resonances becomes a problem
- C* efficiency?
- ~~L* measurement/approximation?~~
- Chamber pressure measurement?
    - Pressure transducers in injector face, feed system, nozzle exit if possible

We will do:

- HS camera view into chamber
    - If we want to watch ignition propagation, we need at least 3 lines of sight into chamber along axis
    - Sight glass in chamber wall near injector
    - Sealing will be an issue - ablator all the way to glass
    - Sapphire glass is $$$, as is porting side of chamber
        - Germanium glass? IR transparency
    - If we want ignition sensor, we just need a 300nm light filter with optical sensor
    - Mirror downstream of exhaust, looking up chamber
        - Long sight line - focus?

        - Do we want this at all? Let's just focus on making a good rocket engine rather than studying combustion
            - We'll make the best rocket engine we can, and measure what we can without making it a frankenstein research engine 
- Thrust
    - Sparkfun has 200kg Load cells for $60
- Pressure
    - Pressure transducers implemented in the injector, do not weld anything to the chamber wall.
    - Measure pressure at the nozzle throat and/or exit such that we can deduce the thrust from the pressure difference.
    - Strain gauge on chamber? Temperature of wall important
- Temperature
    - Temperature transducers are inexpensive, easy to mount.
- C* efficiency

Top-Level System Definition

- Thrust
    -
- Chamber Pressure
    - Greg:
        - Typ. ~1000 psi (70bar) for Ox-CH4, to minimize ionization (improve Isp)
        - 500 psi (35 bar) would be good range for our engine, might be doable with autogenous press
- 24 bar chamber pressure (~350 psia)
    - Quick CEA study with LNG/Ox at 24 bar gives approx. worst-case chamber temperatures around 2800-3000K, similar range to RP-1/Ox combo from last liquid biprop engine
    - Hardware design (sealing, wall thicknesses, materials) become increasingly difficult as Pc increases, so 24 bar is good medium
    - Still gets us ~2800-3000 m/s Ue if nozzle is ideally expanded
    - Used by last year's team, can reference their plumbing
- Sourcing
    - Rishav will contact Praxair person he worked with for combustion research to ask about LNG dewar availability
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Subsystem Organization

- Responsible Engineer Job Description
    - Take responsibility for subsystem
        - Report overall progress at meetings
    - Arrange regular subteam meetings
    - Delegate subsystem tasks

        - Lit. review
        - Design
        - Analysis
        - Manufacturing/Sourcing
        - Build/Integration

To-Do

- Rough design for CoDR
    - Hand calcs. and sketches only at this stage, don't spend too much time on CAD or simulations until our basic concept is refined