Interviewees: Steve (bottom right at beginning), Jim (bottom left)

Airplane type: Both fly Pitts S1

* Has a shoebox-sized baggage compartment
* Smaller than a car

Both pilots compete - Sportsman level (steve), Advanced level (jim)

Competition flight lasts 30-45min total (including taxiing)

Competition sequence lasts ~15min

There are 3-5 contests per summer (around May-October), but practice is year-round

Existing telemetry:

* Jim:
  + Airplane: very basic, like WW1 - airspeed, altitude, MGL avionics engine system monitor
  + Uses an app on his phone to navigate - he mounts his phone inside his cockpit, but also removes it during aerobatic flying so it doesn’t fall off during flight and hit him in the head
  + No displays or navigation or traffic awareness during aerobatic flights
  + Has ADSD and a transponder
* Steve:
  + uses AHRS unit for cross-country flying, but only as a backup if he flies into a cloud - portable unit, suction-cupped to side of cockpit; he removes it during aerobatics in case the suction cup doesn’t hold
  + In-flight camera (Contour camera) on helmet that records wherever he looks; uses it as a debriefing tool, but it doesn’t show if he flew the right shape from the ground
    - Jim also mentioned a Garmin VIRB camera (360 VR camera) - superimposes altitude, airspeed, g-force, acceleration; but doesn’t provide a view from the ground

There was a previous attempt to do something with AHRS similar to ours - they contacted IAC (international aerobatics club)

* Would have been a debrief tool
* Ran on iPhone
* Included an external box to give the pilot a real-time 3D flight log
* Provided a 3D visualization after the flight

Product did not succeed because technology was not advanced enough - GPS didn’t update quickly enough

There are many existing tools that can record a flight, but it only really works for normal flying with slow changes in direction.

* In aerobatic flight, the orientation of the plane changes too quickly.
* Aerobatic flight is judged from the ground, which doesn’t relate directly to cockpit inputs (possibly due to wind relative to ground?)

Steve’s ideal product

* Doesn’t have to interact with any technology during the flight
* After flight: download flight data to a computer, visualize the flight sequence from the judge’s position
* (No mention of real-time data)

Notes from Ken:

* Since airplane position is continuous, we can smooth the data using statistical methods. Although, this would not be in real-time
* AHRS are not very reliable for aerobatic flight because aerobatic flight violates flight models (intentionally making very sharp turns and loops, or flying backwards, e.g.)
  + Apparently existing commercial AHRS instruments rely on a sensible (non-aerobatic) flight model to capture orientation data?
* Aerobatics pilots like to show off the cockpit view - a lot of pilots have cameras
  + Jim - auto-editing video would be cool, since editing a video to post is tedious
  + Ken and Steve - get bored watching their own videos
  + Steve - will watch well-edited videos with music

Jim and Steve think it would be cool to record control inputs, but Steve thinks it would be ambitious and a secondary task. Ken (who is less experienced with aerobatic flight) would like control input to be recorded - wants to correlate control inputs to airplane outputs.

* E.g. - Ken is trying to make a Cittabria do a roll, which requires pulling back on the stick before it stalls (?), and wants to correlate airspeed, engine, and control inputs after the maneuver
* Apparently, aerobatic coaches know what the pilot’s control inputs are from watching the plane from far away
* Steve doesn’t think pilot control input would be useful, is much more interested in what the judges see and figure out how to change his input from that

3 possible main functions

* Coaching (Jim and Ken) - track control inputs and correlate it to airplane outputs, and review it after the flight
* Judging (Steve) - track only airplane outputs and visualize it from the judge’s perspective, after the flight
* Real-time Monitoring (Tomas) - Sound an alarm when the plane is about to exit the bounds (Steve also thinks this is interesting)
* 4\* (\*moonshot, maybe not a serious suggestion) - a predictive HUD (this may also be cheating in competitions)

Jim - Would buy such a thing if it was “affordable-ish” and provided a way to see the flight from the reference of the ground

\*Aerobatics coaches are ~$1000 per day

Showing off is a big component of why people fly aerobatics

Beginner aerobatics pilots often don’t know exactly how they are manipulating the controls - feedback like pointing out that they could have moved something more or saying what the exact angle of the input was would be valuable to them

* As well as correlating that to aircraft state

Idea for getting rudder pedal input - put a piece of white tape around the cable that’s attached to the pedal, and place a camera in the fuselage to track the tape’s movement (The fuselage is fairly empty). Would only need to track one cable, because as one foot moves forward the other moves backwards

Another idea - try to find a single point inside the fuselage where all the relevant cables are visible

* Benefit - the fuselage is dark, so we can provide our own consistent light source for the camera and CV
* In Jim’s plane, the rudder and elevator cables are visible from inside the fuselage behind the seat, but the ailerons are not visible

Environment requirements:

* Humans can handle ~+10g → create a box that can handle 15g (50% safety)
* Temperature - temp inside the plane is the same as outside - make the box withstand what a human could withstand - around -10C to +45C; commercial spec is -20C to +40C for operation and colder for storage.
  + Ken would go for commercial spec
* Condensation - with the pressure change, water vapor can condense even inside a case

Installation should be easy

Stuff can be mounted to the tubes in the cockpit. The majority (but not all) aerobatic planes have internal tubes (the frame of the aircraft?) exposed. This is spaceframe construction.

* Velcro or tape will not be secure enough

Apps are easy to use.