

Specks in Flight

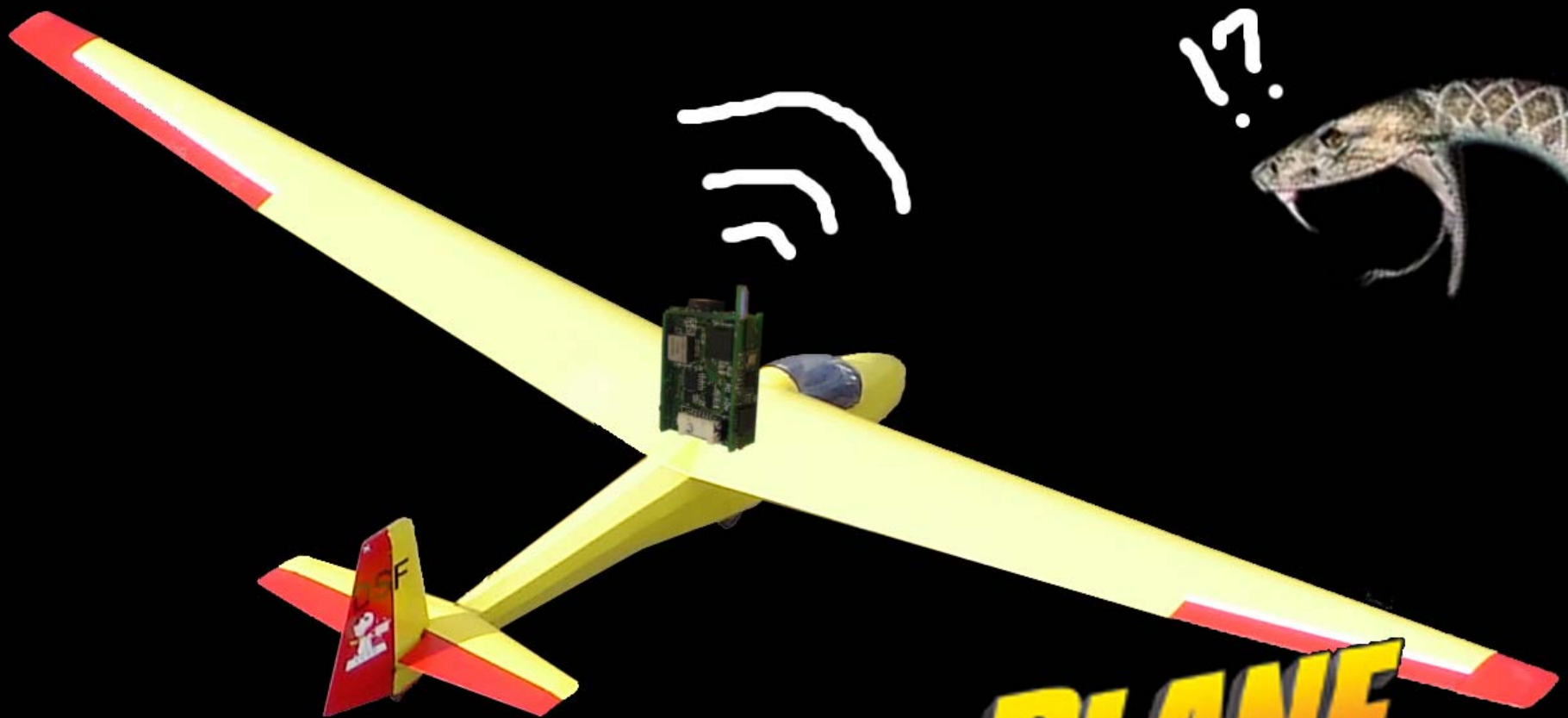
Andrew Bates & Martin Ling

University of Edinburgh

c.a.bates@sms.ed.ac.uk

m.j.ling@ed.ac.uk





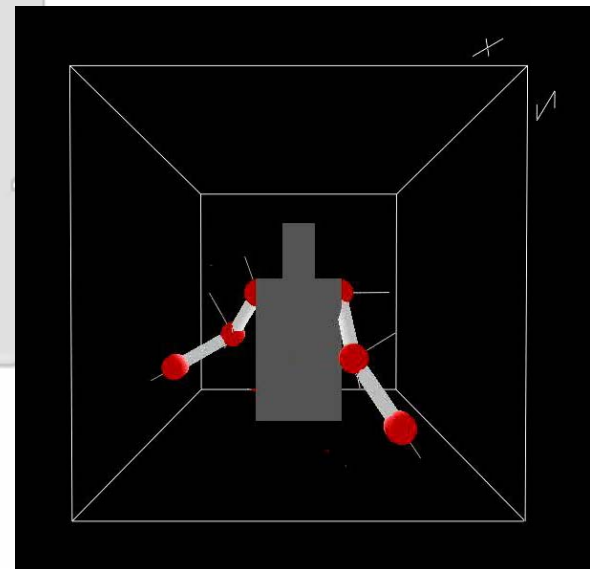
SPECKS ON A PLANE

NEW LINE CINEMA PRESENTS A MUTUAL FILM COMPANY PRODUCTION A DAVID R. ELLIS FILM
SAMUEL L. JACKSON "SNAKES ON A PLANE" JULIANNA MARGULIES NATHAN PHILLIPS BOBBY CANNANALE FLEX ALEXANDER TODD LOUSO SUNNY MABREY
KEAN THOMPSON ELSA PATAKY DAVID KOECHNER MUSIC BY TREVOR RABIN ASSOCIATE PRODUCERS JEFF KATZ TAVNY ELLIS HEATHER MEEHAN EDITOR HOWARD E. SMITH, A.C.E. PRODUCTION DESIGNER JAYMES HINKLE
DIRECTOR OF PHOTOGRAPHY ADAM GREENBERG, A.S.C. EXECUTIVE PRODUCERS JUSTIS GREENE STOKELY CHAFFIN EXECUTIVE PRODUCERS TOBY EMMERICH GEORGE MAUD PRODUCED BY GARY LEVINSON AND DON GRANGER AND CRAIG BERENSON
STORY BY DAVID DALESSANDRO AND JOHN HEFFERNAN SCREENPLAY BY JOHN HEFFERNAN AND SEBASTIAN GUTIERREZ DIRECTED BY DAVID R. ELLIS

JUSTIS GREENE ASSOCIATES DECEMBER

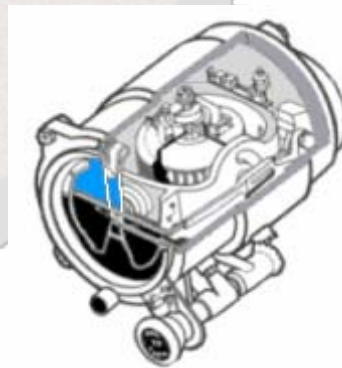
Background

- Interested in potential of Orient2 devices developed by Alex Young.
- Originally intended for motion tracking of human body.
 - Constraints on possible motions.
 - No constant accelerations.
 - Acceleration can be low-pass filtered to maintain estimate of 'down'.
- Other types of motion have different constraints.



Flying

- Aircraft undergo continuous accelerations when maneuvering.
 - Can't use acceleration to estimate 'down'.
 - Magnetic north remains a good reference.
 - Gyros provide offset estimate from last known level flight.
 - Basis of turn/slip and artificial horizon instruments for blind flight.



Motivation

- Attitude sensing based on accelerometers / magnetometers / gyros is common.
- Ongoing estimate usually based on a Kalman filter.
 - Computationally expensive.
- Orient2 using a simpler approach.
- We were curious how well the Orient2 platform would perform in flight.
- We had an aircraft lying around...

Experimental platform

- Schleicher ASK13 two-seat glider

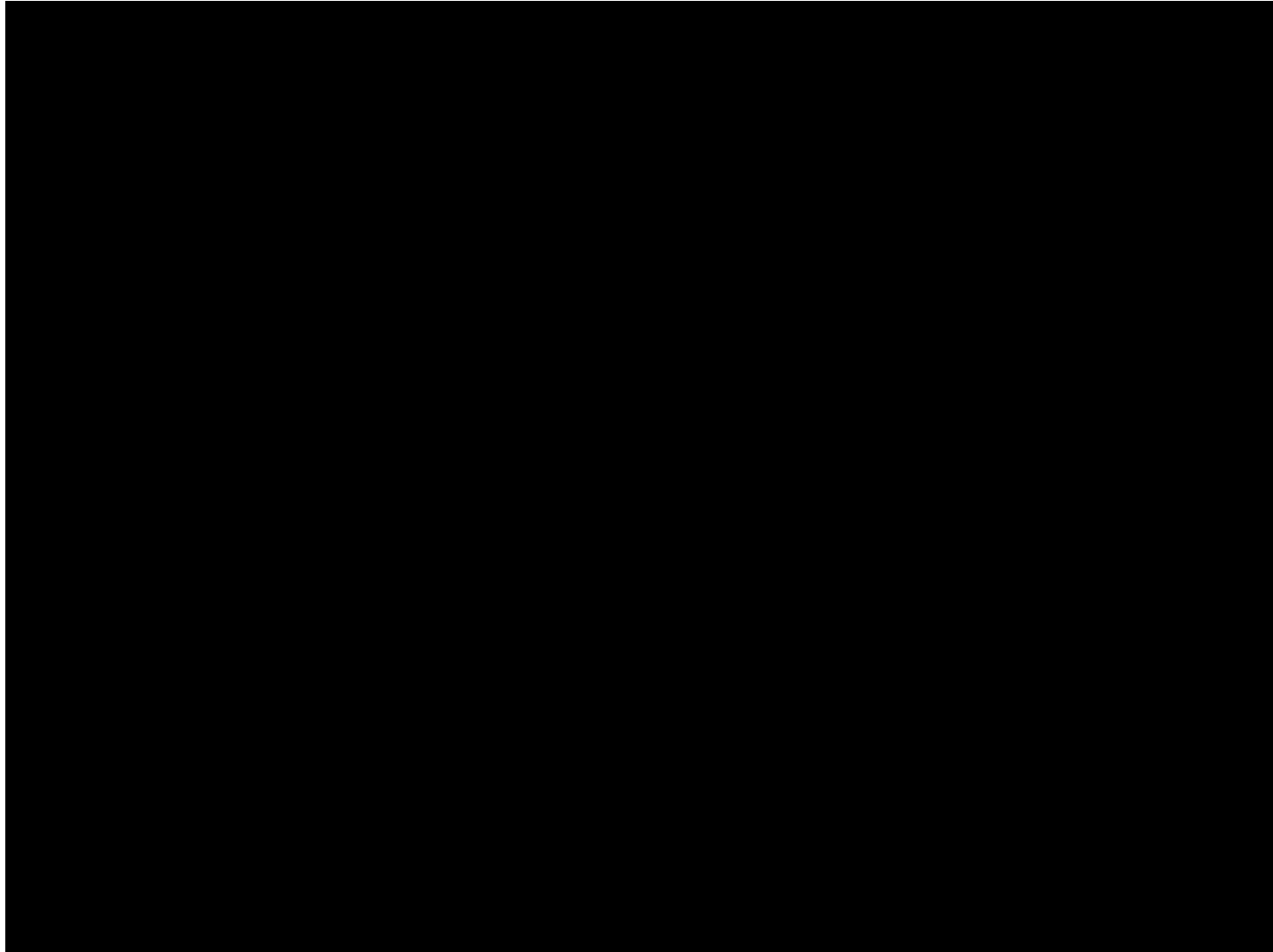


Experimental platform

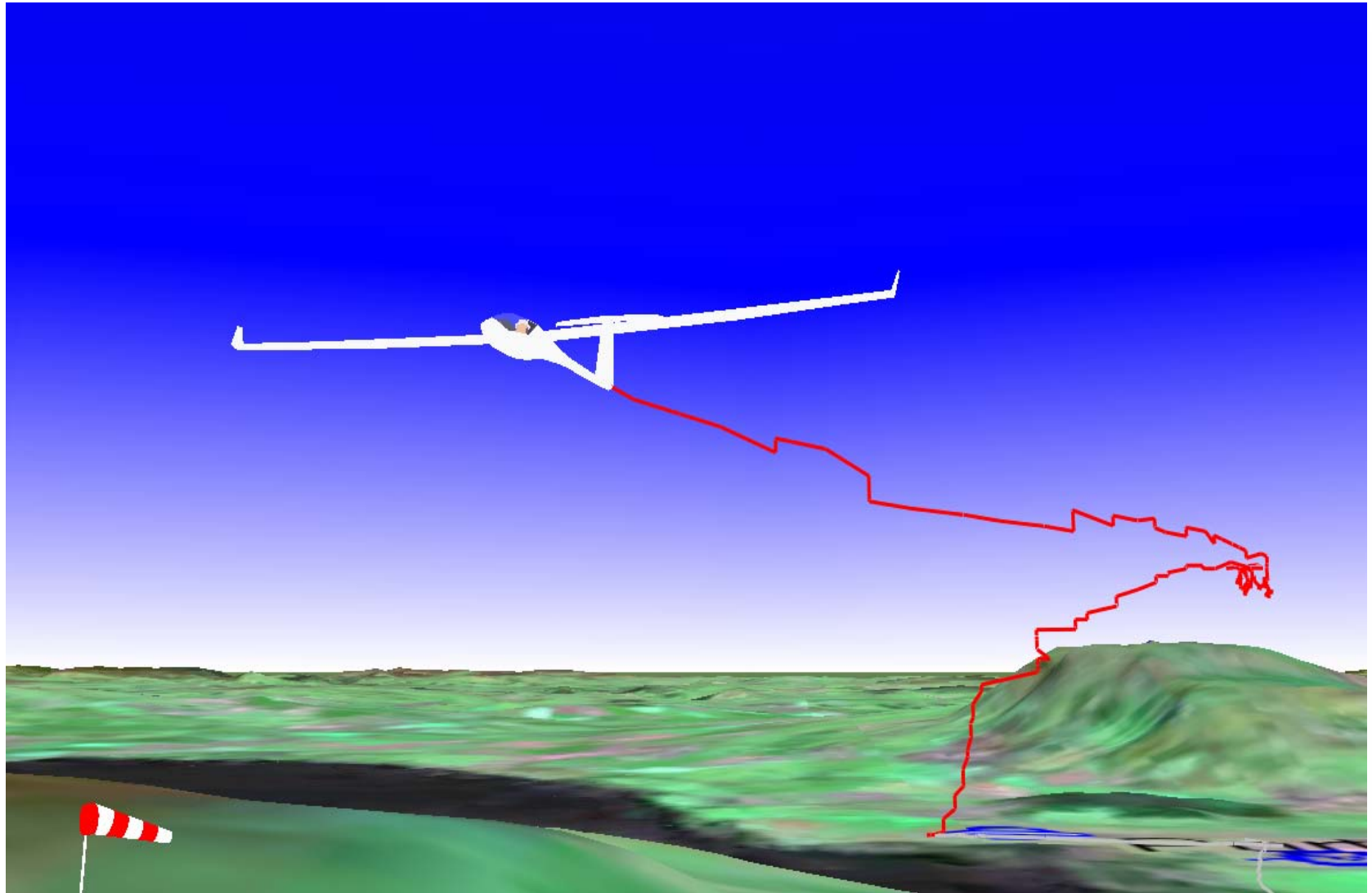
- Orient2 device
- 2 x video cameras
- Garmin GPS72
- EW Avionics flight recorder
- Laptop
- Us



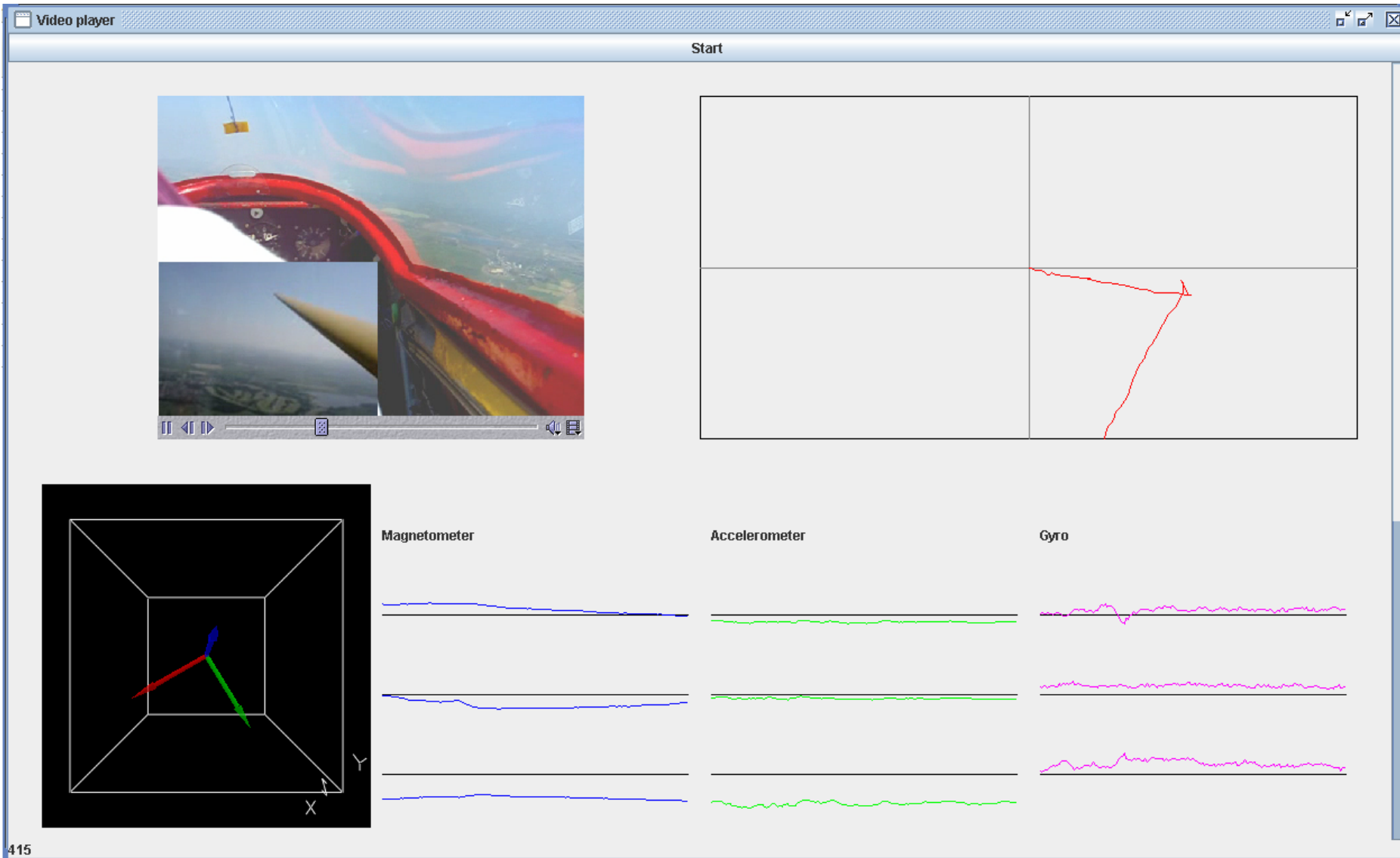
Flight



Flight trace



Combined visualisation



Results

- Pitch and roll seem roughly correct in isolation.
- Problems with magnetometer data affect yaw and combined motions.
 - Steel framed fuselage provides magnetic offset.
 - Device was not properly calibrated for position in aircraft.
 - Hard to find correct offsets after the fact.

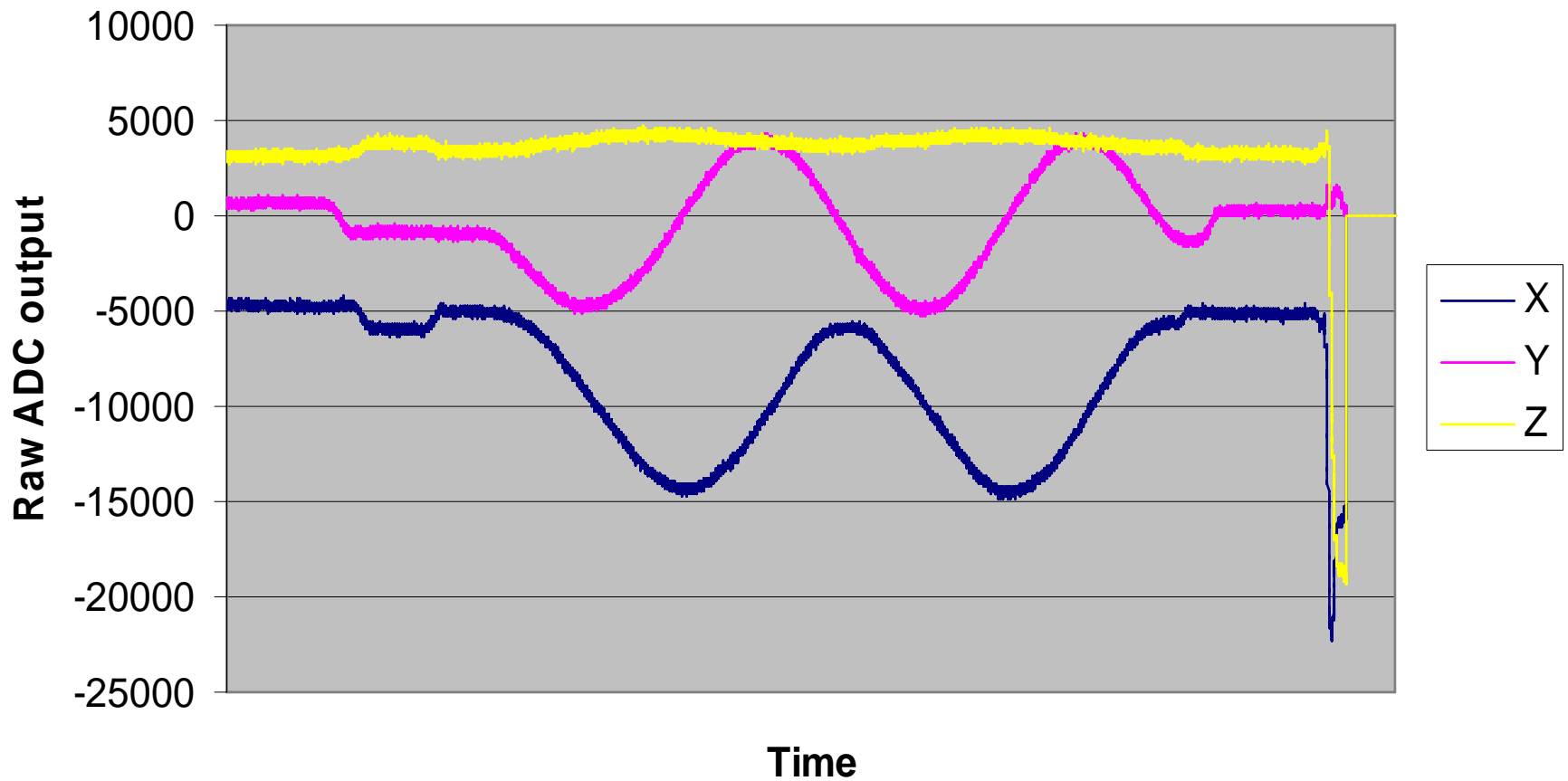
Second attempt

- This time with a single-seat SZD-30 Pirat.
- Internal logging to flash memory on new Orient2 devices.
- Sensor mounted on outside of fuselage.
- Pre-flight ground rotation for calibration of X and Y magnetometers.



Rotation data

Magnetometer data during ground rotation



Flight



Results

- Oops.
 - Miscalculated available runtime on internal flash memory.
 - Got data for first half of flight only, missing loops.
 - Flight recorder works better when turned on.
 - Can't cross-reference heading to GPS.
- Otherwise preliminary results from available data look good.

Future work

- Gather more data.
- Provide quantitative measurements of attitude estimation errors.
- Use to refine and adapt estimation algorithms.
- Test on models with feedback to controls.