ESTCUBE

per solem ad astra

ESTCube-1 Attitude Control

Tartu Conference on

Space Science and Technology

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Mission objectives for attitude control

- High spin rate — 360 deg/s for deploying a tether using centrifugal force
- Minimal power and mass requirements
- Align the spin axis with the Earth's polar axis
- Minimize the forces acting on the experiment tether

ESTCube-1 Attitude control design

- 3 electromagnetic coils placed along each satellite axis
- Spin controller based on attitude and magnetic field
- Simpler controller for detumbling
- Pointing controller for taking better pictures
- Using coils as often as possible

Magnetic coils

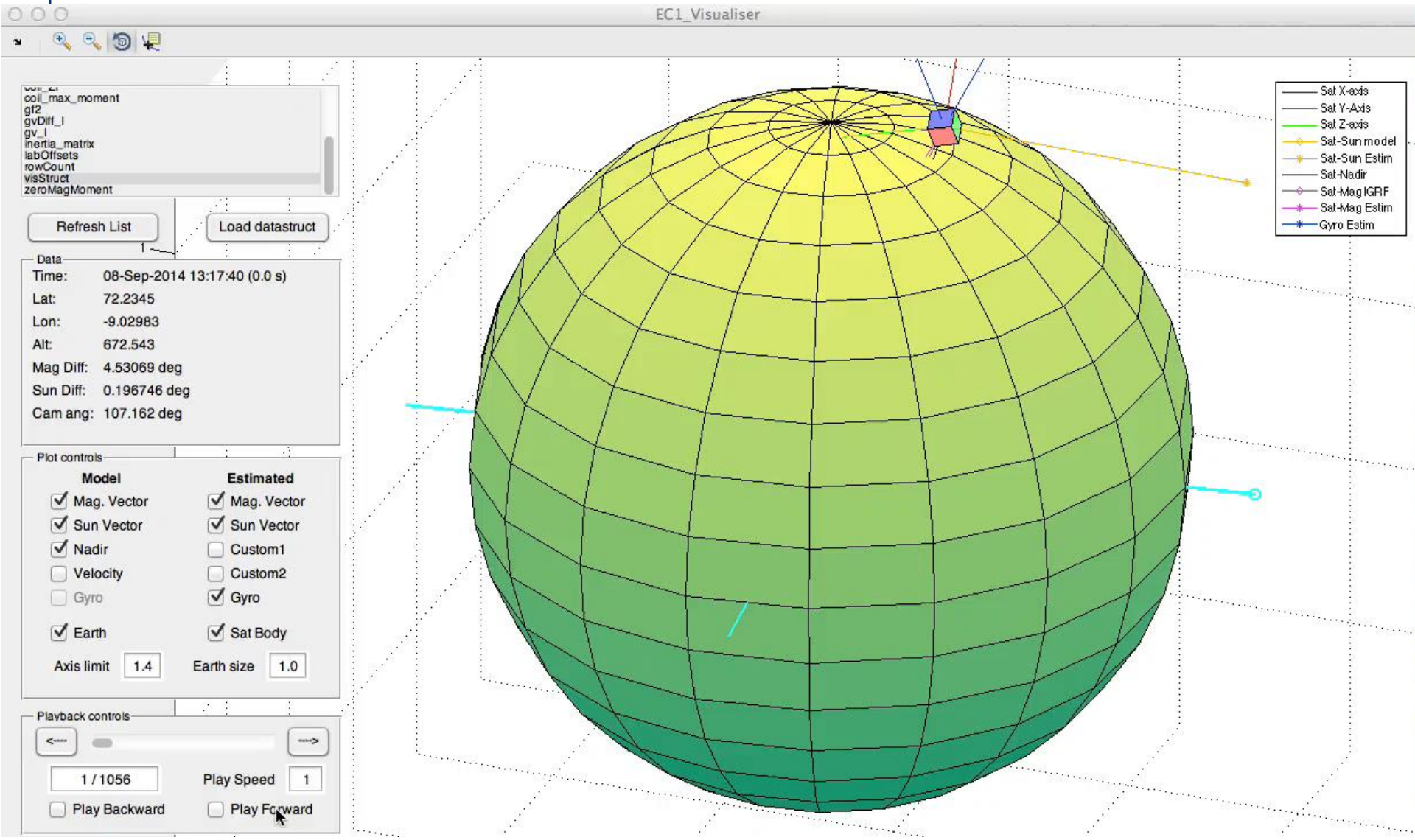
Problems encountered

- Inertia matrix uncertainty
- Timing of control has to be well thought through
- Coil output distortion
- Residual magnetic moment

Magnetic influence

- Residual magnetic moment that is of the same order that the coils can produce
- Magnetic moment direction (–x , +z) in satellite axes
- Makes pointing practically impossible and inertial alignment during spin-up very difficult

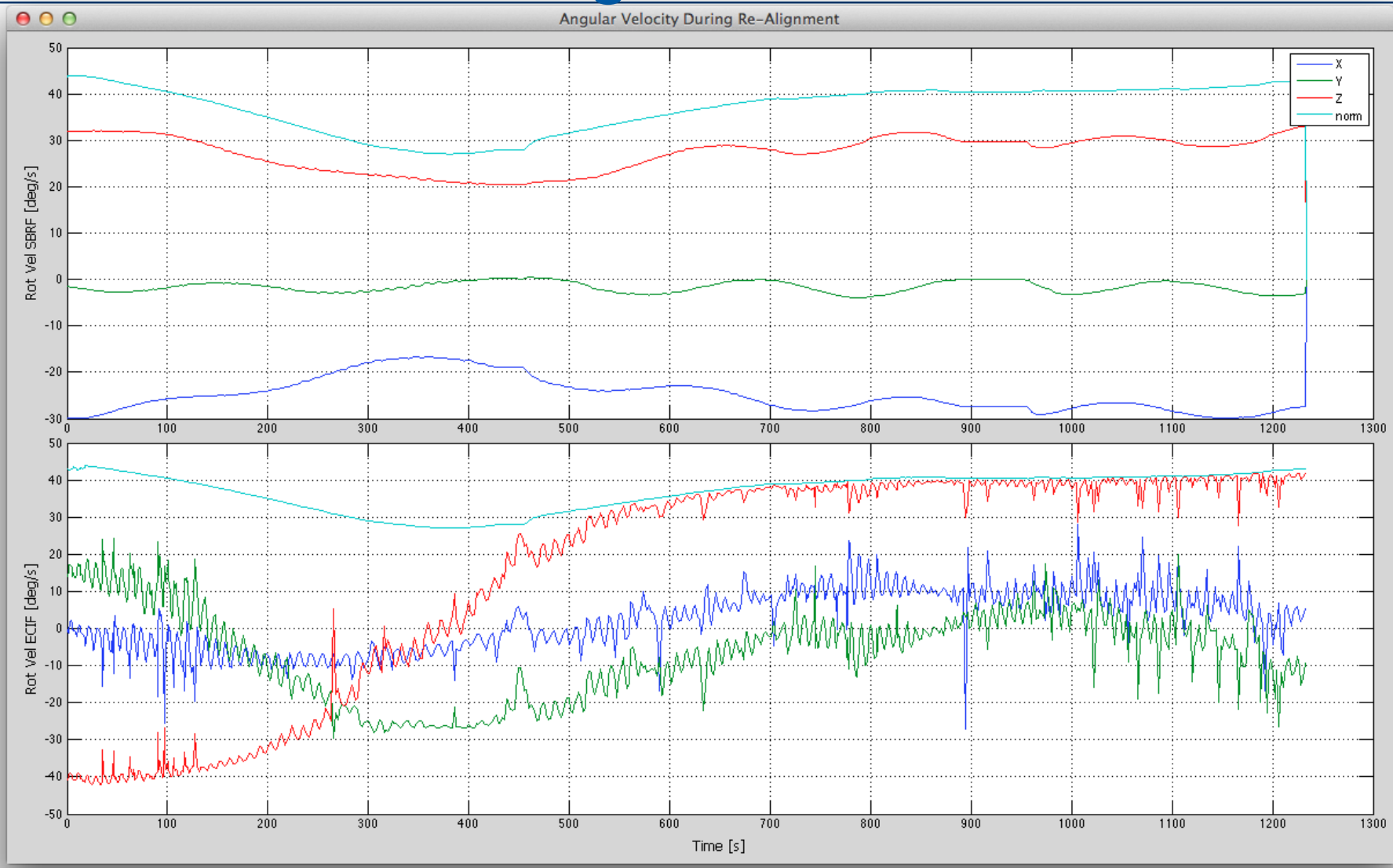
Natural behaviour of the satellite



Response to the magnetic disturbance

- Change the initially planned rotation axis to be around the residual magnetic moment vector
- Correct the coil output with a function that accounts for the magnetic disturbance
- Scrapped the plans for inertial alignment during the experiment

Realignment test



Lessons learned

- Try to be even more careful with using ferromagnetic materials
- Include other actuators to improve the overall performance of the attitude control system
- Get as accurate as possible inertia measurments for attitude controll and determination

Lessons learned 2

- **Be able to update software in orbit!!!**
- **Add a COTS accelerometer for troubleshooting**
- **Have an identical prototype on ground**

Thank you

Questions?