Project: Building a Controller

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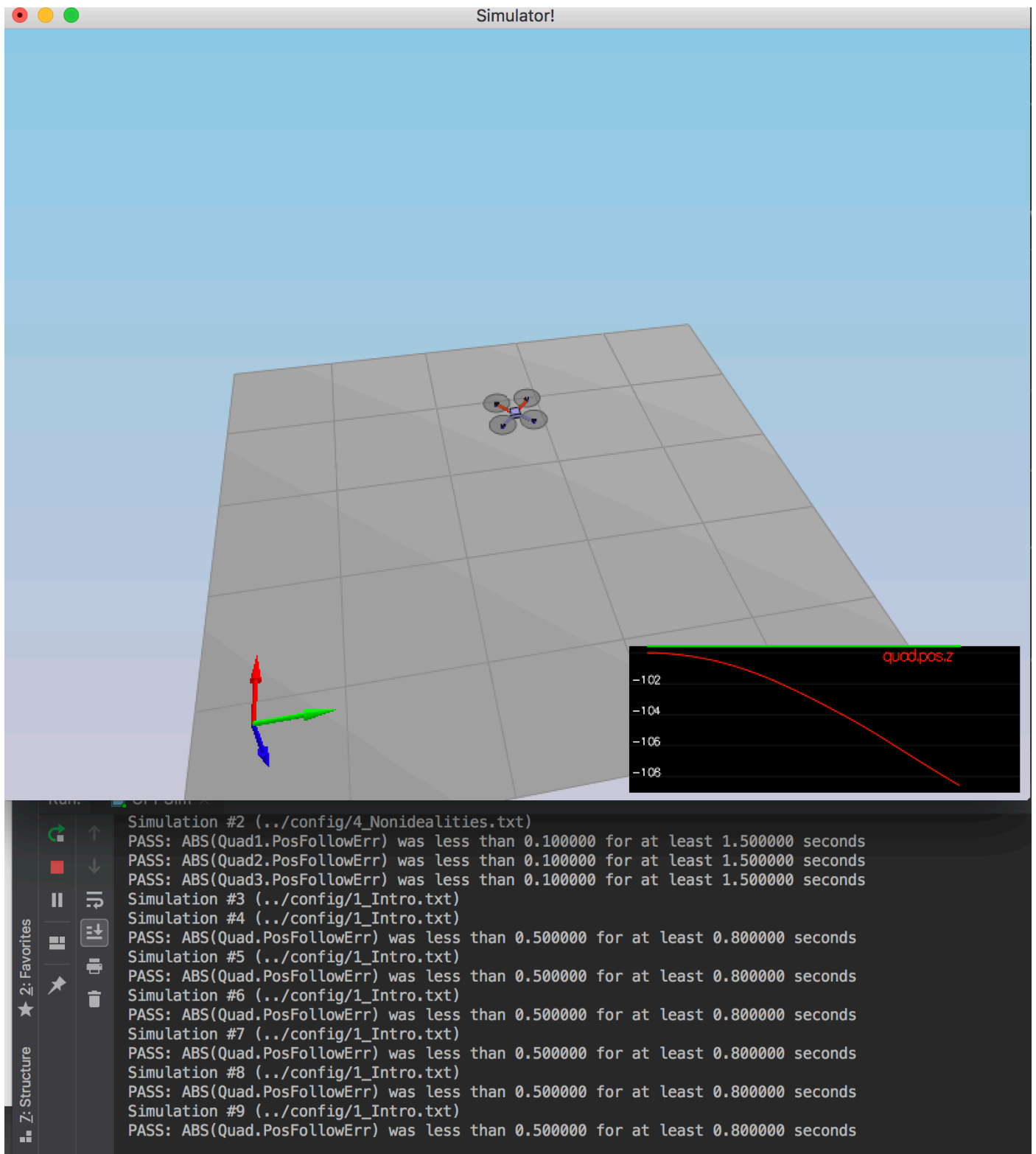

Writeup / README

1. Provide a Writeup / README that includes all the rubric points and how you addressed each one. You can submit your writeup as markdown or pdf.

You're reading it! Below I describe how I addressed each rubric point and where in my code each point is handled.

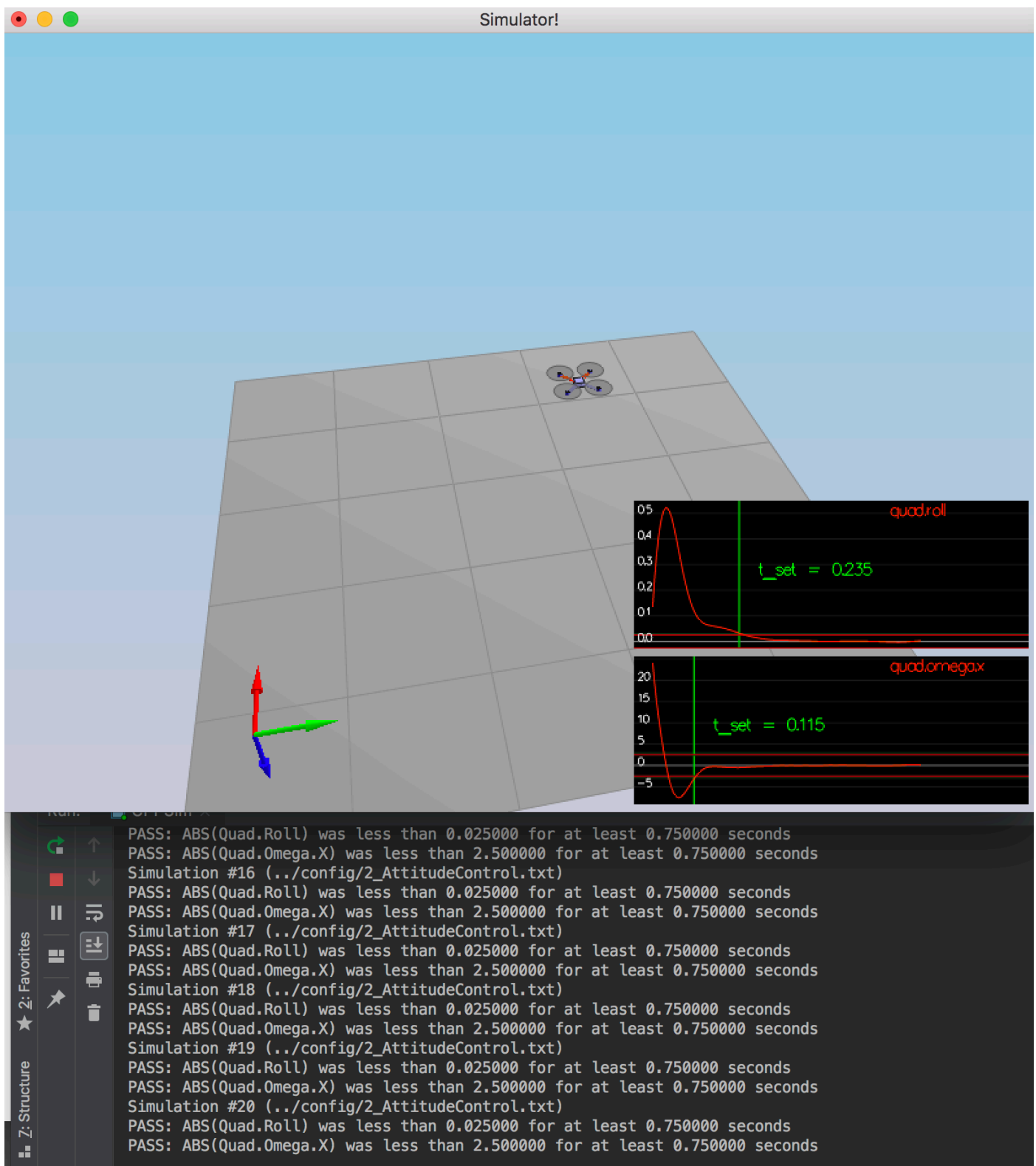### Implement Controller

1. Testing it Out (scenario 1)

The mass parameter was set to `0.5` which made the vehicle more balanced in all following scenarious.

Simulator!

quad.pos.z

-102
-104
-106
-108

Simulation #2 (../config/4_Nonidealities.txt)
PASS: ABS(Quad1.PosFollowErr) was less than 0.100000 for at least 1.500000 seconds
PASS: ABS(Quad2.PosFollowErr) was less than 0.100000 for at least 1.500000 seconds
PASS: ABS(Quad3.PosFollowErr) was less than 0.100000 for at least 1.500000 seconds
Simulation #3 (../config/1_Intro.txt)
Simulation #4 (../config/1_Intro.txt)
PASS: ABS(Quad.PosFollowErr) was less than 0.500000 for at least 0.800000 seconds
Simulation #5 (../config/1_Intro.txt)
PASS: ABS(Quad.PosFollowErr) was less than 0.500000 for at least 0.800000 seconds
Simulation #6 (../config/1_Intro.txt)
PASS: ABS(Quad.PosFollowErr) was less than 0.500000 for at least 0.800000 seconds
Simulation #7 (../config/1_Intro.txt)
PASS: ABS(Quad.PosFollowErr) was less than 0.500000 for at least 0.800000 seconds
Simulation #8 (../config/1_Intro.txt)
PASS: ABS(Quad.PosFollowErr) was less than 0.500000 for at least 0.800000 seconds
Simulation #9 (../config/1_Intro.txt)
PASS: ABS(Quad.PosFollowErr) was less than 0.500000 for at least 0.800000 seconds

2. Body rate and roll/pitch control (scenario 2)

Implemented functions `GenerateMotorCommands()`, `BodyRateControl()` (p controller) and `RollPitchControl()` (p controller). Tuned `kpPQR` and `kpBank`.

The metric PASS.

```
PASS: ABS(Quad.Roll) was less than 0.025000 for at least 0.750000 seconds
PASS: ABS(Quad.Omega.X) was less than 2.500000 for at least 0.750000 seconds
Simulation #16 (../config/2_AttitudeControl.txt)
PASS: ABS(Quad.Roll) was less than 0.025000 for at least 0.750000 seconds
PASS: ABS(Quad.Omega.X) was less than 2.500000 for at least 0.750000 seconds
Simulation #17 (../config/2_AttitudeControl.txt)
PASS: ABS(Quad.Roll) was less than 0.025000 for at least 0.750000 seconds
PASS: ABS(Quad.Omega.X) was less than 2.500000 for at least 0.750000 seconds
Simulation #18 (../config/2_AttitudeControl.txt)
PASS: ABS(Quad.Roll) was less than 0.025000 for at least 0.750000 seconds
PASS: ABS(Quad.Omega.X) was less than 2.500000 for at least 0.750000 seconds
Simulation #19 (../config/2_AttitudeControl.txt)
PASS: ABS(Quad.Roll) was less than 0.025000 for at least 0.750000 seconds
PASS: ABS(Quad.Omega.X) was less than 2.500000 for at least 0.750000 seconds
Simulation #20 (../config/2_AttitudeControl.txt)
PASS: ABS(Quad.Roll) was less than 0.025000 for at least 0.750000 seconds
PASS: ABS(Quad.Omega.X) was less than 2.500000 for at least 0.750000 seconds
```

3. Position/velocity and yaw angle control (scenario 3)
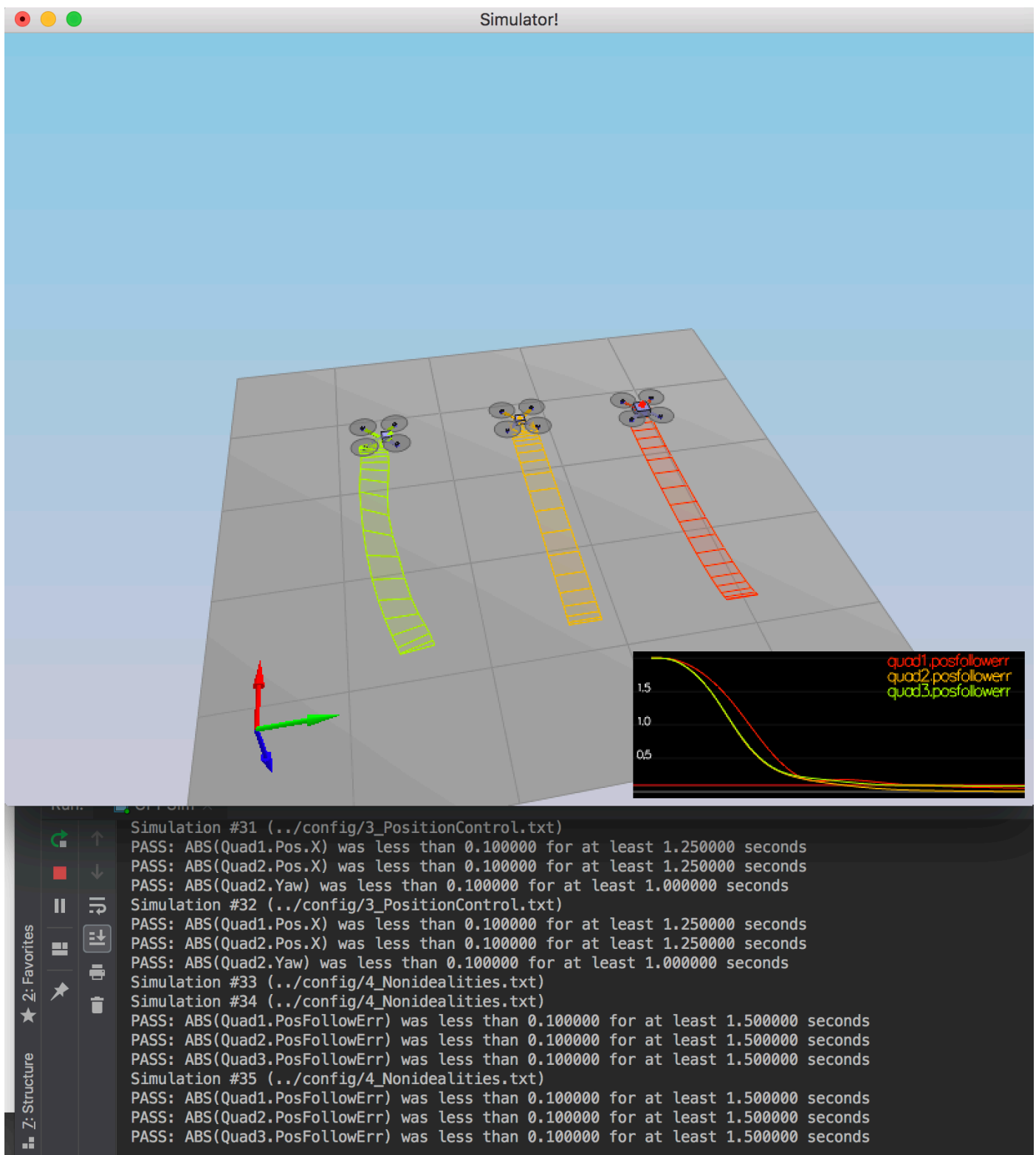
Implemented functions `LateralPositionControl()`, `AltitudeControl()` (PD-controller) and `YawControl()`. Tuned parameters `kpPosXY`, `kpPosZ`, `kpVelXY`, `kpVelZ`, `kpYaw` and `kpPQR`

The metrics PASS.
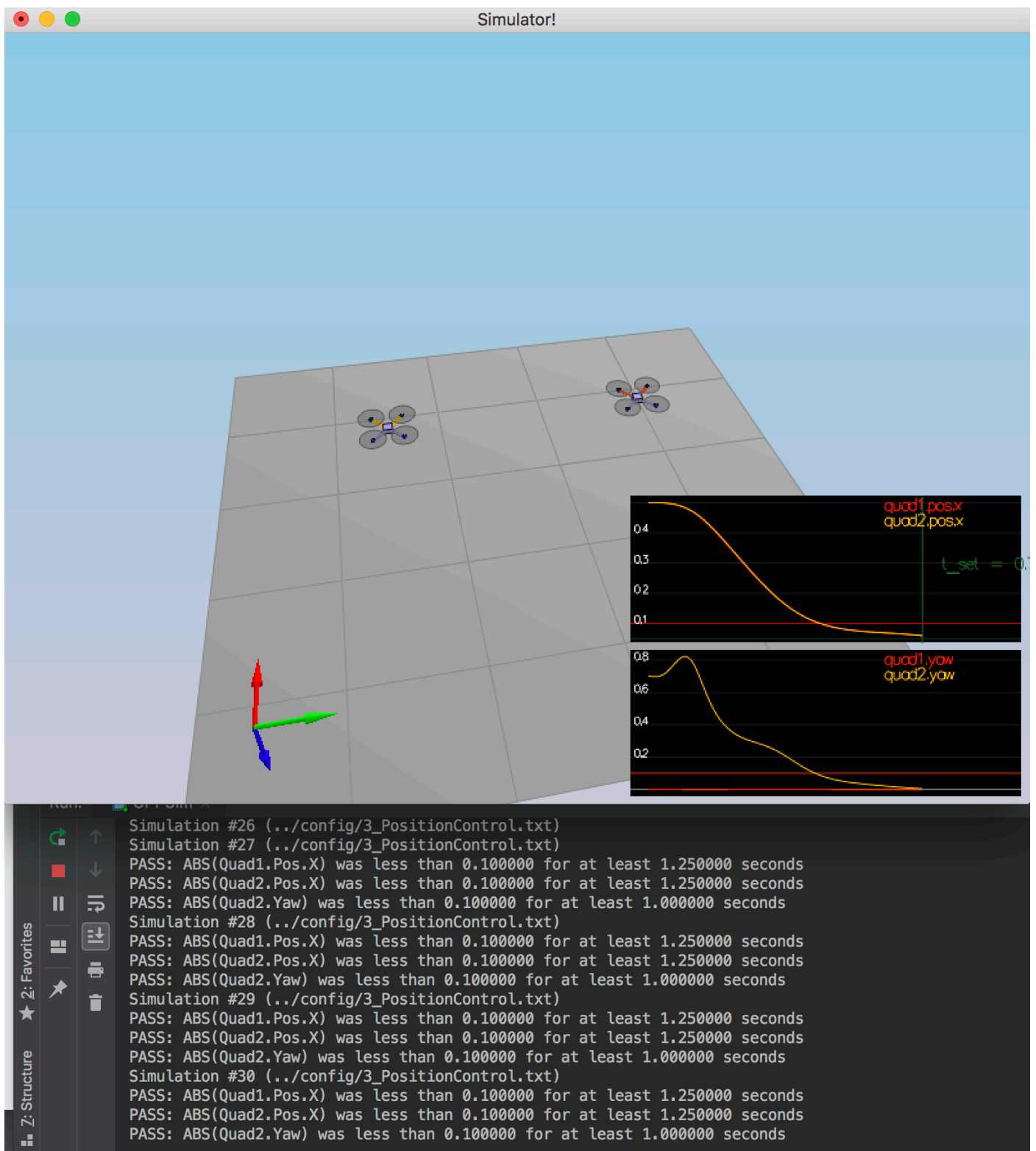
4. Non-idealities and robustness (scenario 4)

Implemented `AltitudeControl()`. All three quads are able to successfully move one meter forward.

```
                    Simulator!

Simulation #31 (../config/3_PositionControl.txt)
PASS: ABS(Quad1.Pos.X) was less than 0.100000 for at least 1.250000 seconds
PASS: ABS(Quad2.Pos.X) was less than 0.100000 for at least 1.250000 seconds
PASS: ABS(Quad2.Yaw) was less than 0.100000 for at least 1.000000 seconds
Simulation #32 (../config/3_PositionControl.txt)
PASS: ABS(Quad1.Pos.X) was less than 0.100000 for at least 1.250000 seconds
PASS: ABS(Quad2.Pos.X) was less than 0.100000 for at least 1.250000 seconds
PASS: ABS(Quad2.Yaw) was less than 0.100000 for at least 1.000000 seconds
Simulation #33 (../config/4_Nonidealities.txt)
Simulation #34 (../config/4_Nonidealities.txt)
PASS: ABS(Quad1.PosFollowErr) was less than 0.100000 for at least 1.500000 seconds
PASS: ABS(Quad2.PosFollowErr) was less than 0.100000 for at least 1.500000 seconds
PASS: ABS(Quad3.PosFollowErr) was less than 0.100000 for at least 1.500000 seconds
Simulation #35 (../config/4_Nonidealities.txt)
PASS: ABS(Quad1.PosFollowErr) was less than 0.100000 for at least 1.500000 seconds
PASS: ABS(Quad2.PosFollowErr) was less than 0.100000 for at least 1.500000 seconds
PASS: ABS(Quad3.PosFollowErr) was less than 0.100000 for at least 1.500000 seconds
```

5. Tracking trajectories

Got a partial failure here. The yellow drone follows the trajectory although not precisely. The red one completely loses its path and flies away. Since this scenario does not appear to be grated and all the previous ones were successful, I've decided to not spend a lot of time on this.
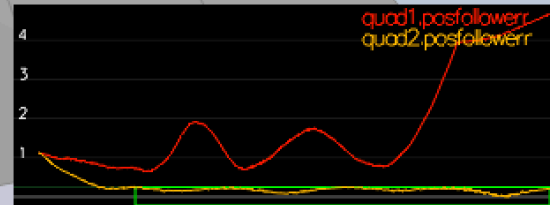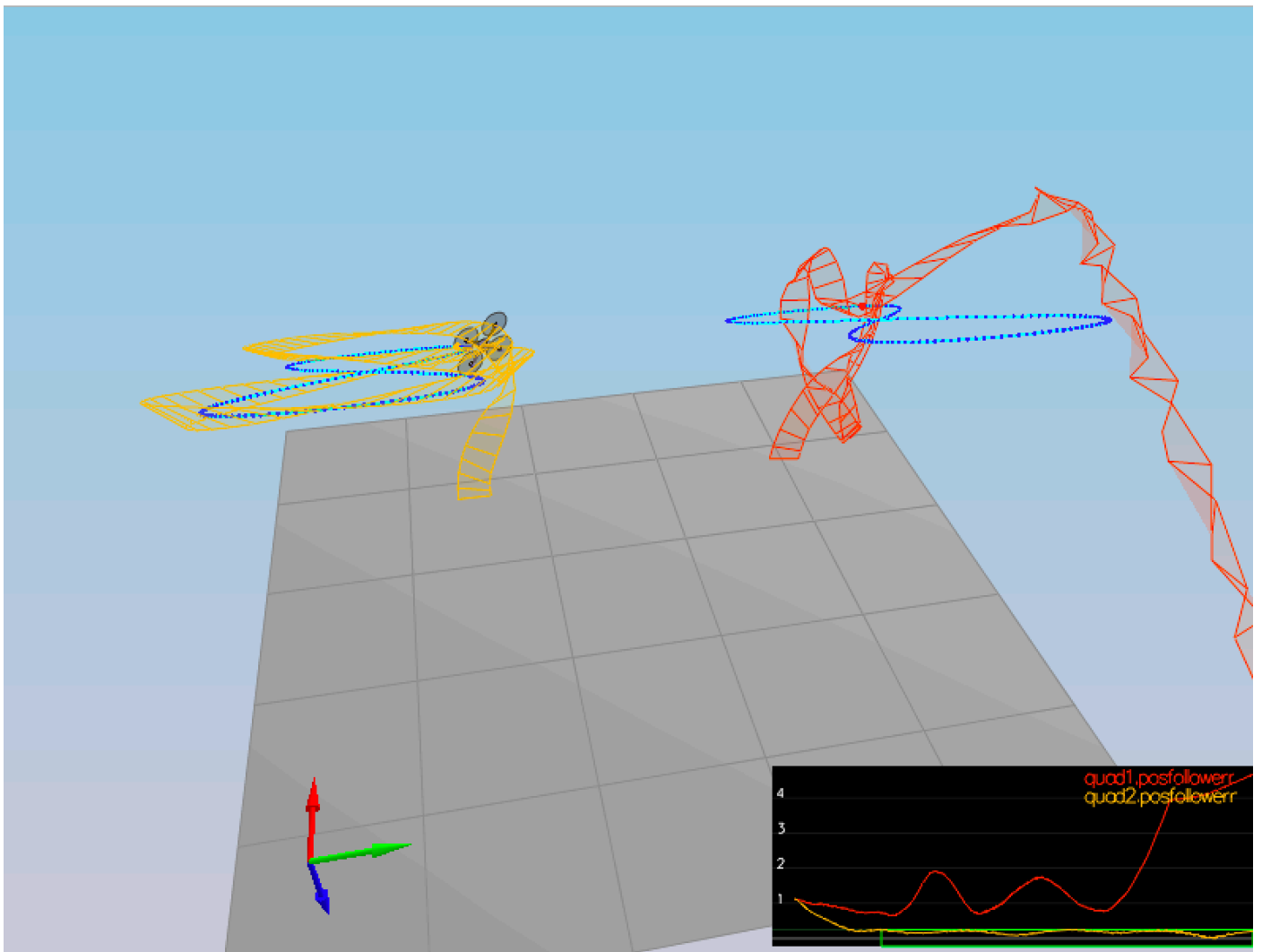
quad1.posfollowerr
quad2.posfollowerr

FAIL: ABS(Quad2.PosFollowErr) was less than 0.250000 for 0.000000 seconds, which was less than 3.00
Simulation #590 (../config/5_TrajectoryFollow.txt)
FAIL: ABS(Quad2.PosFollowErr) was less than 0.250000 for 0.000000 seconds, which was less than 3.00
Simulation #591 (../config/5_TrajectoryFollow.txt)
FAIL: ABS(Quad2.PosFollowErr) was less than 0.250000 for 0.000000 seconds, which was less than 3.00
Simulation #592 (../config/5_TrajectoryFollow.txt)
FAIL: ABS(Quad2.PosFollowErr) was less than 0.250000 for 0.000000 seconds, which was less than 3.00
Simulation #593 (../config/5_TrajectoryFollow.txt)
FAIL: ABS(Quad2.PosFollowErr) was less than 0.250000 for 0.000000 seconds, which was less than 3.00
Simulation #594 (../config/5_TrajectoryFollow.txt)
FAIL: ABS(Quad2.PosFollowErr) was less than 0.250000 for 0.000000 seconds, which was less than 3.00
Simulation #595 (../config/5_TrajectoryFollow.txt)
FAIL: ABS(Quad2.PosFollowErr) was less than 0.250000 for 0.000000 seconds, which was less than 3.00
Simulation #596 (../config/5_TrajectoryFollow.txt)
FAIL: ABS(Quad2.PosFollowErr) was less than 0.250000 for 0.000000 seconds, which was less than 3.00
Simulation #597 (../config/5_TrajectoryFollow.txt)
FAIL: ABS(Quad2.PosFollowErr) was less than 0.250000 for 0.000000 seconds, which was less than 3.00