ZERO ROBOTICS

SPHERES ISS CHALLENGE

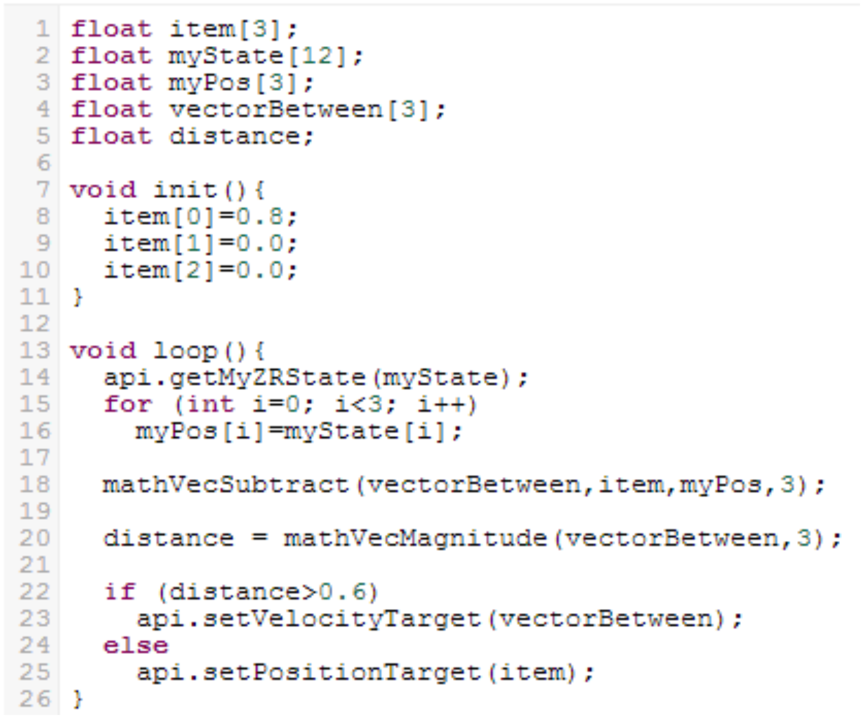
Force

setForces

- When you set a position, velocity, or attitude target, you are controlling forces in a **closed loop** system. This means that the satellite auto-adjusts its forces to meet your target.
- In addition to the closed functions we have covered so far, you can directly control force with **setForces**. This is an **open loop** control function, meaning the satellite will NOT self-adjust its forces. You need to continuously provide new input. On the bright side, this is very easy with loop(), and we are used to providing continuous input.
- setForces delivers the specified amount of force as impulses to the satellite every time the thrusters are fired. Unlike setVelocityTarget and other functions that aim for a target value, setForces has no target. You need to control the amount of force delivered with your code.

The Scenario

- In this example, we will continue our quest to move to a position target as quickly as possible.
- Open Project14c from the last tutorial and save it as Project15. It should look like this:



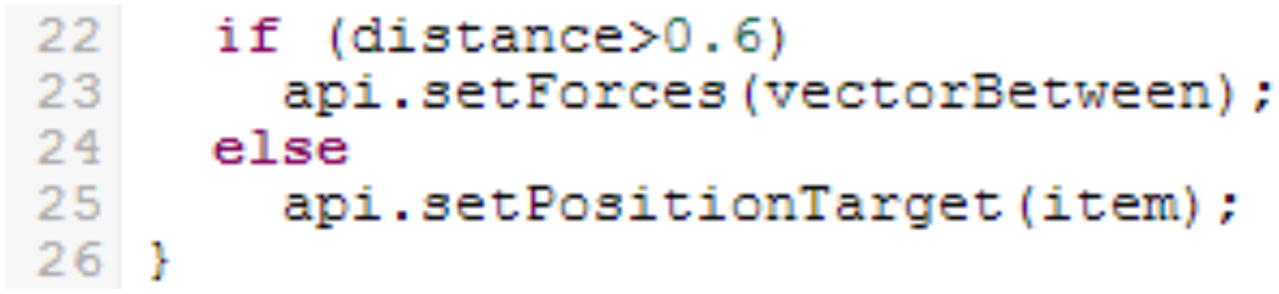
```
float item[3];
float myState[12];
float myPos[3];
float vectorBetween[3];
float distance;

void init(){
  item[0]=0.8;
  item[1]=0.0;
  item[2]=0.0;
}

void loop(){
  api.getMyZRState(myState);
  for (int i=0; i<3; i++)
    myPos[i]=myState[i];

  mathVecSubtract(vectorBetween,item,myPos,3);

  distance = mathVecMagnitude(vectorBetween,3);

  if (distance>0.6)
    api.setVelocityTarget(vectorBetween);
  else
    api.setPositionTarget(item);
}
```

Recap

- Let’s recap what the code from the setVelocityTarget tutorial does.
- Every second, we find the vector that points from our satellite to the item and store it in vectorBetween.
- vectorBetween is really a distance vector, so we find the magnitude and store it in distance.
- If distance is greater than 0.6 m, we set the velocity target to vectorBetween.
- Otherwise, we set the position target to item so we have enough time to slow down.

Variable Target

- vectorBetween varies directly with distance. As the satellite approaches the target, the components of vectorBetween approach 0.
- So, our target velocity decreases with time. We want to use this principle for force as well. Simply change setVelocityTarget to setForces.
- Compile and run.



```
  if (distance>0.6)
    api.setForces(vectorBetween);
  else
    api.setPositionTarget(item);
}
```

Results

- It takes roughly 26 seconds for the satellite to stop on the item. Even then, the satellite adjusts itself at a very low speed for the next few seconds.
- This is better than our setPositionTarget time of 28 seconds, but doesn't beat our setVelocityTarget time.
- You can improve this time quite a bit by adjusting the magnitude and conditional distance, but you may still find it easier to use setVelocityTarget.
- You can use setForces in tandem with setPositionTarget and setVelocityTarget, but be careful. Combining open loop and closed loop control functions can produce unanticipated results.