```
clear; clc; close all;
%% ================ PARAMETERS ================
dt = 0.01;
T  = 20;
t  = 0:dt:T;
% gains
kp_azimuth   = 1;
kp_elevation = 1;
%% ================ INITIAL STATES ================
sphereAzimuth   = 0;
sphereElevation = 0;
azimuthErrorArray   = zeros(size(t));
elevationErrorArray = zeros(size(t));
sphereAzimuthArray   = zeros(size(t));
sphereElevationArray = zeros(size(t));
flashAzimuthArray   = zeros(size(t));
flashElevationArray = zeros(size(t));
%% ================ FLASHLIGHT SETUP
================
newTargetTime = 0;
flashAzimuth = 0;
flashElevation = 0;
%% ================ SIMULATION LOOP ================
for k = 1:length(t)
  % ---- Every 4 seconds choose new random direction
----
  if t(k) > newTargetTime

      flashAzimuth = rand*2*pi - pi;   % -π to π

      % Random elevation between -30° and +30°
      flashElevation = (rand*60 - 30) * pi/180;

      newTargetTime = t(k) + 4;
  end
```

```
  flashAzimuthArray(k)   = flashAzimuth;
  flashElevationArray(k) = flashElevation;
  % ---- Wrapped azimuth error ----
  azimuthError = atan2( sin(flashAzimuth -
sphereAzimuth), ...
                        cos(flashAzimuth -
sphereAzimuth) );
  % ---- Elevation error ----
  elevationError = flashElevation - sphereElevation;
  azimuthErrorArray(k)   = azimuthError;
  elevationErrorArray(k) = elevationError;
  % ---- P Controllers ----
  sphereAzimuth   = sphereAzimuth   + kp_azimuth   *
azimuthError   * dt;
  sphereElevation = sphereElevation + kp_elevation *
elevationError * dt;
  sphereAzimuthArray(k)   = sphereAzimuth;
  sphereElevationArray(k) = sphereElevation;
end
%% ================ PLOTS ================
figure;
subplot(3,2,1)
plot(t, flashAzimuthArray,'LineWidth',2)
ylabel('Flashlight Azimuth (rad)')
title('Flashlight Random Azimuth')
grid on
subplot(3,2,3)
plot(t, azimuthErrorArray,'LineWidth',2)
ylabel('Azimuth Error (rad)')
title('Azimuth Error')
grid on
subplot(3,2,5)
plot(t, sphereAzimuthArray,'LineWidth',2)
ylabel('Sphere Azimuth (rad)')
xlabel('Time (s)')
```

```
title('Sphere Azimuth Response')
grid on
subplot(3,2,2)
plot(t, flashElevationArray,'LineWidth',2)
ylabel('Flashlight Elevation (rad)')
title('Flashlight Random Elevation')
grid on
subplot(3,2,4)
plot(t, elevationErrorArray,'LineWidth',2)
ylabel('Elevation Error (rad)')
title('Elevation Error')
grid on
subplot(3,2,6)
plot(t, sphereElevationArray,'LineWidth',2)
ylabel('Sphere Elevation (rad)')
xlabel('Time (s)')
title('Sphere Elevation Response')
grid on
```