|  |
| --- |
|  |
| System Diagram |

Question4

**Provide a description of this state machine with an associated state machine diagram**

|  |
| --- |
| State Machine Diagram |
|  |
| The drone would take off, and transit to hover mode once it arrives at desired state, then hover for n second, follow the desired trajectory, descend back to the ground |
| Sample trajectory and actual following |
|  |

Question5

**Plot the error response of the system with respect to the desired position, orientation, and linear and angular velocities**

|  |
| --- |
| desired trajectory and actual following |
|  |
|  |
| error in positions |
|  |
| error in velocities |
|  |
| error in rotational angles |
|  |
| error in angular velocities |
|  |

**What are the rise (90%) and settling (10%) times associated with the position and linear velocities? What is the steady-state value? What is the maximum percent overshoot? How do these values (position and heading) change given different gain values?**

|  |  |
| --- | --- |
| ctrl.Kp = [17 17 20]';ctrl.Kv = [6.6 6.6 9]';  ctrl.Kr = [190 198 80]';ctrl.Kw = [30 30 17.88]'; | |
|  | Position |
| rise time(s) | 6.370000 |
| settle time(s) | 7.350000 |
| steady state value | 0.100000 |
| overshoot (%) | 0.025003 |
| ctrl.Kp = [17 17 40]';ctrl.Kv = [6.6 6.6 9]';  ctrl.Kr = [190 198 80]';ctrl.Kw = [30 30 17.88]'; | |
|  | Position |
| rise time(s) | 6.370000 |
| settle time(s) | 7.350000 |
| steady state value | 0.100000 |
| overshoot (%) | 0.028947 |
| ctrl.Kp = [17 17 20]';ctrl.Kv = [6.6 6.6 20]';  ctrl.Kr = [190 198 80]';ctrl.Kw = [30 30 17.88]'; | |
|  | Position |
| rise time(s) | 6.360000 |
| settle time(s) | 7.350000 |
| steady state value | 0.099905 |
| overshoot (%) | 0.103024 |
| The performance barely changes with respect to gains, only very slight increase in overshoot | |

\*since the starting and ending state of velocity are both zero, it does not make sense to generate the above performance indexes; also, since it has no heading goal, it does not make sense to generate its performance either.

**Now provide a waypoint at the same position but with heading of 15 deg. Plot the error response of the system with respect to the desired position, orientation, and linear and angular velocities**

|  |
| --- |
| desired trajectory and actual following |
|  |
|  |
| error in positions |
|  |
| error in velocities |
|  |
| error in rotational angles |
|  |
| error in angular velocities |
|  |

**What are the rise (90%) and settling (10%) times associated with the position and linear velocities? What is the steady-state value? What is the maximum percent overshoot? How do these values (position and heading) change given different gain values?**

|  |  |  |
| --- | --- | --- |
| ctrl.Kp = [17 17 20]';ctrl.Kv = [6.6 6.6 9]';  ctrl.Kr = [190 198 80]';ctrl.Kw = [30 30 17.88]'; | | |
|  | Position | Rotational Angles |
| rise time(s) | 6.370000 | 5.040000 |
| settle time(s) | 7.350000 | 10.010000 |
| steady state value | 0.100000 | 0.261839 |
| overshoot (%) | 0.023879 | 0.021324 |
| ctrl.Kp = [17 17 20]';ctrl.Kv = [6.6 6.6 9]';  ctrl.Kr = [190 198 160]';ctrl.Kw = [30 30 17.88]'; | | |
|  | Position | Rotational Angles |
| rise time(s) | 6.370000 | 5.050000 |
| settle time(s) | 7.350000 | 10.010000 |
| steady state value | 0.100030 | 0.261809 |
| overshoot (%) | 0.024925 | 0.005741 |
| ctrl.Kp = [17 17 20]';ctrl.Kv = [6.6 6.6 20]';  ctrl.Kr = [190 198 80]';ctrl.Kw = [30 30 35]'; | | |
|  | Position | Rotational Angles |
| rise time(s) | 6.370000 | 5.040000 |
| settle time(s) | 7.350000 | 10.010000 |
| steady state value | 0.099905 | 0.261874 |
| overshoot (%) | 0.024484 | 0.034142 |
| The performance barely changes with respect to gains | | |