high torque high power high acceleration servo system

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high torque high power high acceleration servo system:

Abstract

In this project a high torque high power high accelerated servo system will be designed.

Table of Contents

Chapter 1. Introduction

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The requirements are given as follows:
@azimuth
the load is turned 90° in 100ms
@elevation
the load is turned 60° in 100ms
@azimuth & @elevation
the load is turned 60° in azimuth and the load is turned 30° in elevation
at the same time

%% input parameters
deltaposdeg = 90; %% [degree]
period = 0.2; %% [seconds] T   45° --> -45° 0.1s
inertiaazimuth = 1.6; %% [kg.m^2] motor inertia is not included
inertiaelevation = 0.5; %% [kg.m^2] motor inertia is not included
azimuthloadmass = 50; %% [kg]
elevationloadmass = 25; %% [kg]

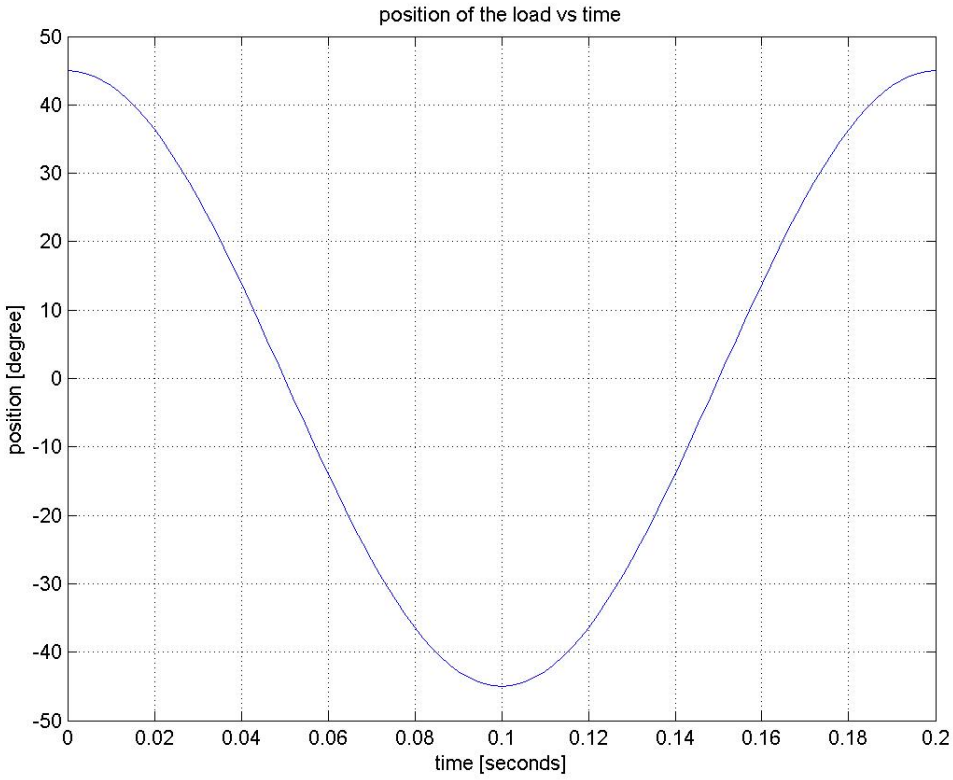
input parameters are given above.
estimated azimuth load inertia 1.6000kg.m^2
estimated elevation load inertia 0.5000kg.m^2
```

Chapter 2. Basic Calculations @Azimuth

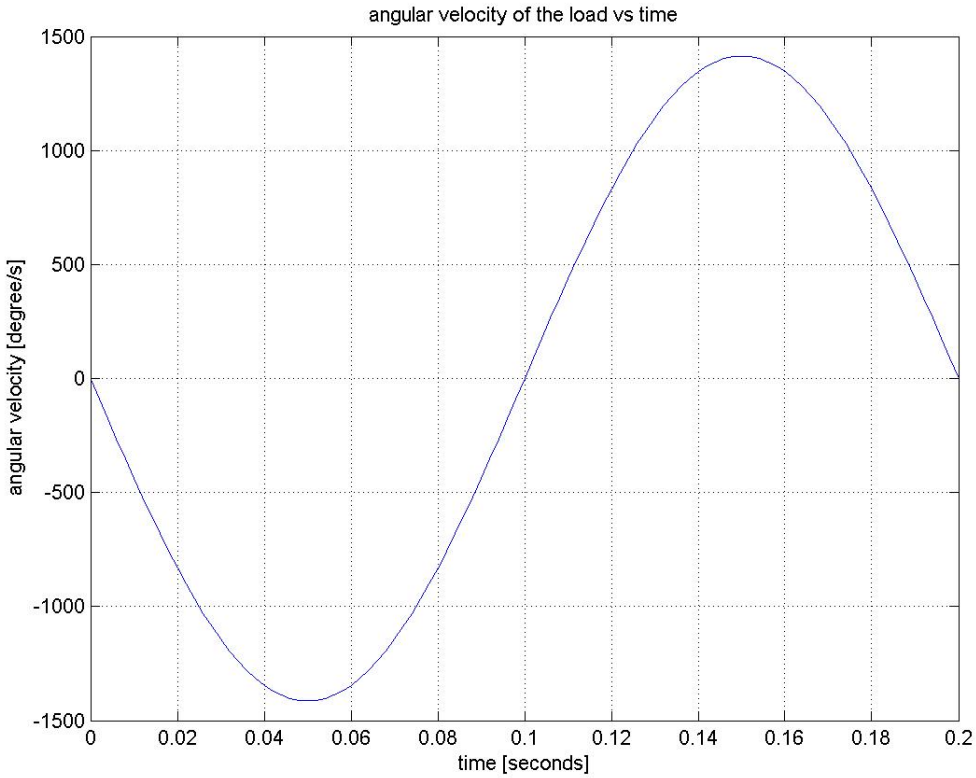
basic calculations are given below

```
%% velocity, acc, power, torque calculations
%% assume sinusoidal profiles
%% theta = A*cos(wt)   --> position
%% angvel = -A*w*sin(wt) --> angular velocity dtheta/dt
%% angacc = -A*w^2*cos(wt) --> angular acceleration dangvel/dt
%% desired requirement : 90° --> 100ms
deltaposdeg = 90; %% [degree]
deltaposrad = deltaposdeg*2*pi / 360; %% [rad]  2*A
period = 0.2; %% [seconds] T
angfreg = 2*pi/period; %% [rad/s]  w = 2pi/T
maxangvelrads = (deltaposrad/2) * angfreg; %% [rad/s]
maxangveldegs = maxangvelrads * 360 / (2*pi); %% [deg/s]
maxangvelrpm = maxangvelrads * 60 / (2*pi); %% [rpm]
maxangaccrads2 = (deltaposrad/2) * angfreg^2; %% [rad/s^2]
maxangaccdegs2 = maxangaccrads2 * 360 / (2*pi); %% [deg/s^2]
%% torque = inertia * acc
%% power = torque * angvel
inertiaazimuth = 1.6; %% [kg.m^2]
maxtorqueazimuth = inertiaazimuth * maxangaccrads2; %% [Nm]
%% plot the assumed profiles
tres = period / 100; %% [seconds]
t = 0:tres:period;
posdegarr = deltaposdeg/2 * cos(angfreg*t);
figure;
plot(t,posdegarr);
grid;
title('position of the load vs time')
xlabel('time [seconds]');
ylabel('position [degree]');
saveas(gcf, 'position_load', 'jpg')
angveldegsarr = -1*maxangveldegs * sin(angfreg*t);
figure;
plot(t,angveldegsarr);
grid;
title('angular velocity of the load vs time')
xlabel('time [seconds]');
ylabel('angular velocity [degree/s]');
saveas(gcf, 'velocity_load', 'jpg')
angaccdegs2arr = -1*maxangaccdegs2 * cos(angfreg*t);
figure;
plot(t,angaccdegs2arr);
grid;
title('angular acceleration of the load vs time')
xlabel('time [seconds]');
ylabel('angular acceleration [degree/s^2]');
saveas(gcf, 'acceleration_load', 'jpg')
```

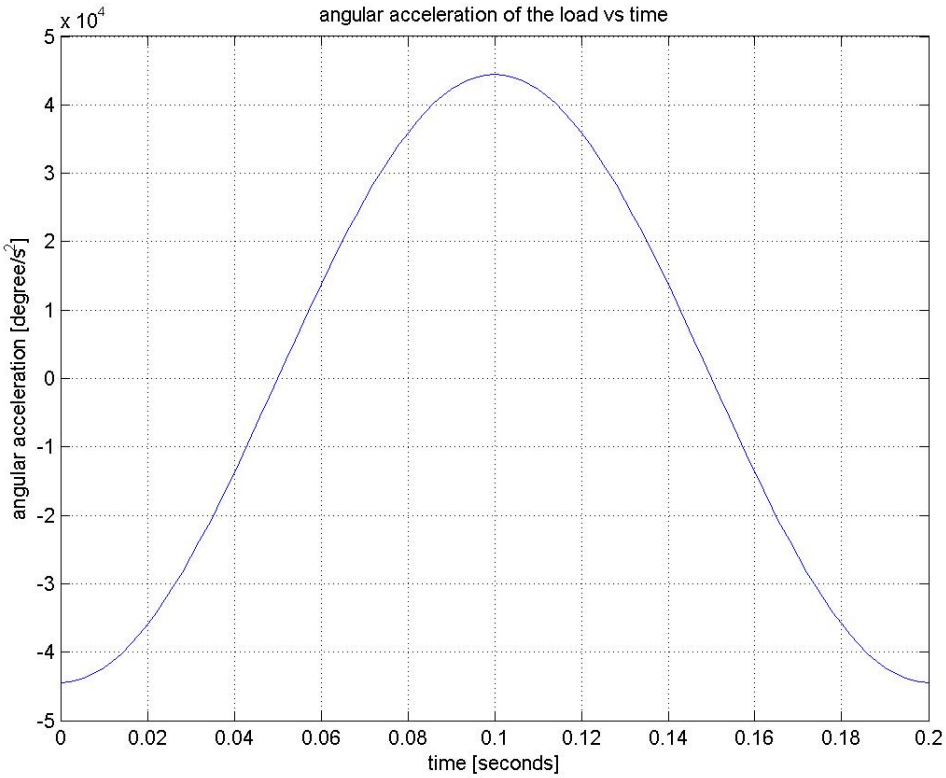
```
angaccrads2arr = -1*maxangaccrads2 * cos(angfreg*t);
torqueazimutharr = inertiaazimuth * angaccrads2arr;
figure;
plot(t,torqueazimutharr);
grid;
title('requirred torque of the load vs time')
xlabel('time [seconds]');
ylabel('torque [Nm]');
saveas(gcf, 'torque_load', 'jpg')
angvelradsarr = -1*maxangvelrads * sin(angfreg*t);
powerazimutharr = torqueazimutharr .* angvelradsarr;
maxpowerazimuth = max(powerazimutharr); %% [watt]
figure;
plot(t,powerazimutharr);
grid;
title('requirred power of the load vs time')
xlabel('time [seconds]');
ylabel('power [Watt]');
saveas(gcf, 'power_load', 'jpg')
```



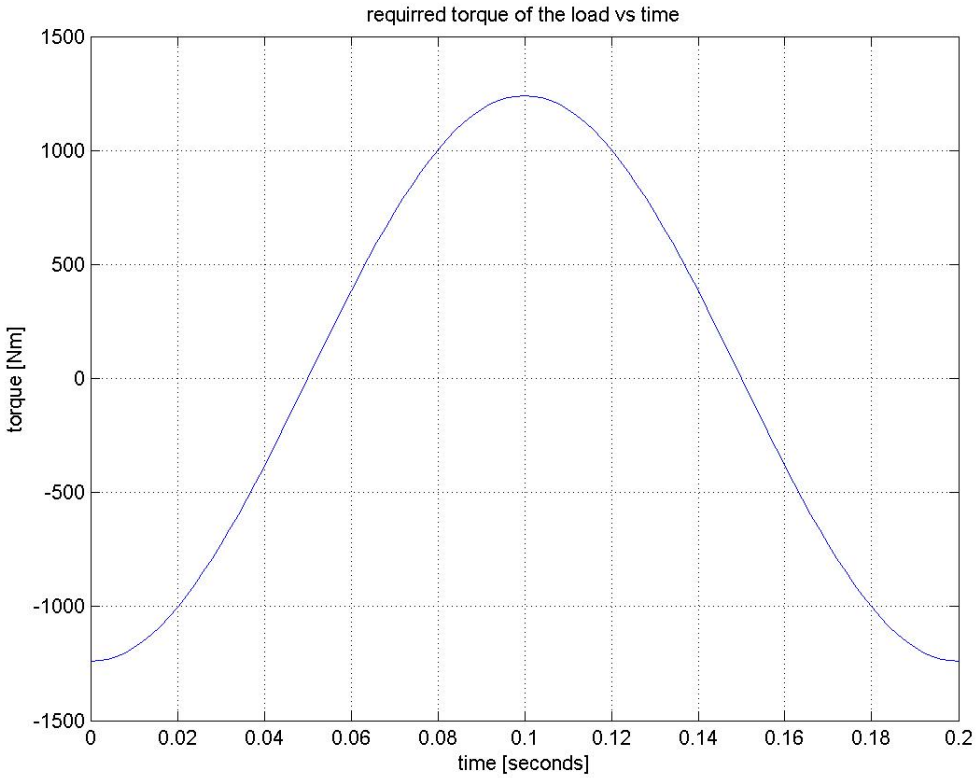

```
position of the load, delta position is 90°
period is 0.2000 second
```



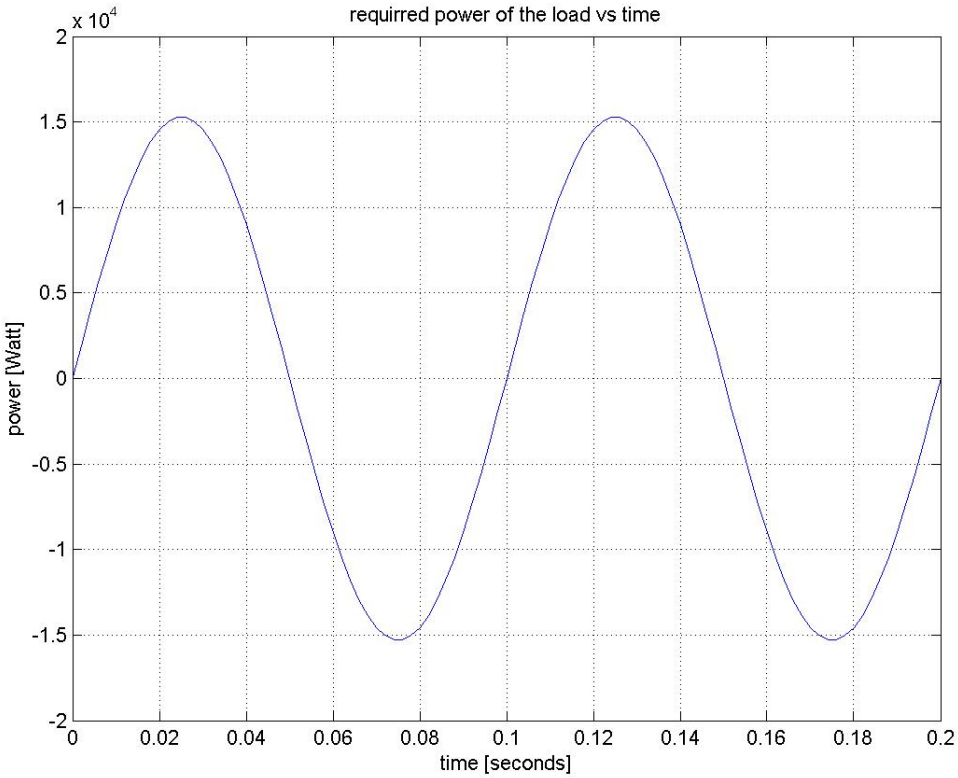

```
angular velocity of the load in degree/s
maximum angular velocity of the load is
1.4137e+03 deg/s
235.6194 rpm
```




```
acceleration of the load in degree/s^2
maximum acceleration 4.4413e+04 deg/s^2
```




```
desired torque in Nm
maximum desired torque is 1.2403e+03 Nm
```




```
desired power in Watt
maximum desired power 1.5271e+04 Watt
```

Chapter 3. Conclusion

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