Uncontrolled 1D BB-8

Governing equations and simulation

Setup problem

In[1]:=
```
params = <|i → 10, m → 3, l → 1, g → 9.81|>
```
Out[1]=
```
⟨|i → 10, m → 3, l → 1, g → 9.81|⟩
```

In[2]:=
```
(* Define force magnitudes *)
Fg = m g;
Fn = fn[t];
Ff = drive[t];
```

In[5]:=
```
(* Define equations of motion *)
eq1 = m (-l θ'[t]^2) == Fn - Fg Cos[θ[t]]
eq2 = m l θ''[t] == -Ff + Fg Sin[θ[t]]
eq3 = Ff l == i ω'[t]
```
Out[5]=
```
-l m θ'[t]^2 == -g m Cos[θ[t]] + fn[t]
```
Out[6]=
```
l m θ''[t] == -drive[t] + g m Sin[θ[t]]
```
Out[7]=
```
l drive[t] == i ω'[t]
```

In[8]:=
```
(* Initial Conditions *)
initial = {θ[0] == .1, θ'[0] == 0, ω[0] == 0};
```

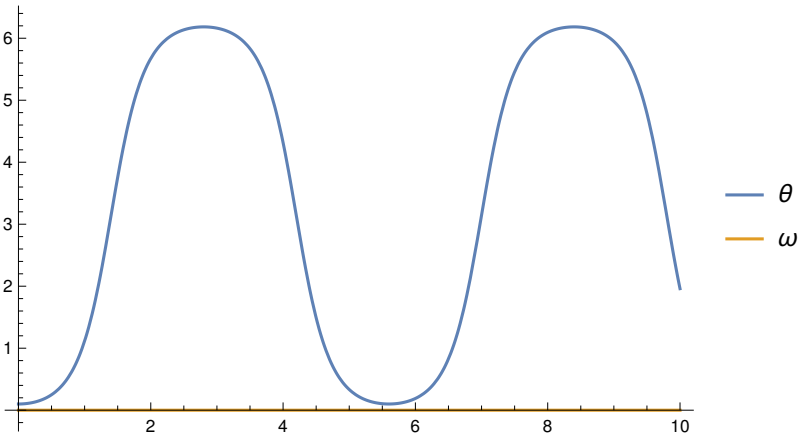
In[9]:=
```
(* Drive equation *)
driveeq = drive[t] == 0
```
Out[9]=
```
drive[t] == 0
```

Solve problem

In[10]:=
```
Dynamic[
 sol = NDSolveValue[{eq1, eq2, eq3, driveeq, initial} /. params, {θ[t], ω[t]}, {t, 0, 10}]]
```
Out[10]=
```
{InterpolatingFunction[ ⊞ Domain: {{0., 10.}} Output: scalar ][t],
 InterpolatingFunction[ ⊞ Domain: {{0., 10.}} Output: scalar ][t]}
```

In[11]:=
```
Dynamic@
 Plot[Evaluate@sol, {t, 0, 10}, PlotLegends → {θ, ω, "normal force"}, PlotRange → All]
```

Out[11]=




```
sol[[1]] /. t → 10
```

```
1.96058
```