

التحكم بالروبوت - معادلات الحركة (لاغرانج)

اكتب برنامج بلغة MATLAB لإيجاد الصيغة المصفوفاتية D, H, G لمعادلات الحركة المشتقة من تابع لاغرانج الآتي:

$$\mathcal{L} = \frac{3}{2}\dot{\theta}_1 + (\dot{\theta}_1 + \dot{\theta}_2)^2 + \cos(\theta_2)(\dot{\theta}_1^2 + \dot{\theta}_1\dot{\theta}_2) - 20\sin(\theta_1) - 10\sin(\theta_1 + \theta_2)$$

```
clear; clc;
```

```
% Define symbolic variables
```

```
syms th1(t) th2(t)
dth1 = diff(th1,t);
dth2 = diff(th2,t);
```

```
% Lagrangian
```

```
L = 1.5*dth1^2 + (dth1 + dth2)^2 + cos(th2)*(dth1^2 + dth1*dth2) -
20*sin(th1) - 10*sin(th1 + th2)
```

```
% Equations of motion
```

```
Taw = simplify(functionalDerivative(-L, [th1, th2]))
```

```
% Substitute derivatives
```

```
syms dth1 dth2 d2th1 d2th2
oldt={'diff(th1(t), t)', 'diff(th2(t), t)', 'diff(th1(t), t,
t)', 'diff(th2(t), t, t)'};
newt={dth1 dth2 d2th1 d2th2};
Taws=subs(Taw,oldt,newt);
```

```
% Mass matrix (D)
```

```
D = equationsToMatrix(Taws, [d2th1; d2th2])
```

```
% Coriolis/centrifugal (H) and gravity (G) terms
```

```
HG = Taws - D*[d2th1; d2th2];
G = simplify(subs(HG, {dth1,dth2}, {0, 0}))
H=simplify(HG-G)
```