

## Sensors and Control for Mechatronics Systems

### Tutorial 8

#### Question 1 : Linearizing a nonlinear system

For the following systems,

1.1 : Calculate the equilibria for given constant inputs

1.2 : Linearize the system around each equilibrium point

1.3 : Comment on the stability of each equilibrium point

i)

$$u_1 = 0 \text{ and } u_2 = 1$$

$$\begin{aligned}x_1(k+1) &= x_1(k)^3 - u_1(k) \\x_2(k+1) &= 2x_1(k) + 3x_2(k) - u_2(k)\end{aligned}$$

ii)

$$u_1 = 3 \text{ and } u_2 = 1$$

$$\begin{aligned}x_1(k+1) &= 2x_1(k)^2 - u_1(k) \\x_2(k+1) &= \left(\frac{1}{2}\right) x_2(k)^2 - \left(\frac{1}{2}\right) x_2(k) + u_2(k)\end{aligned}$$

iii)

$$u_1 = 0 \text{ and } u_2 = 2$$

$$\begin{aligned}x_1(k+1) &= x_1(k)^2 + x_1(k) - u_1(k) \\x_2(k+1) &= \sin(x_1(k)) + x_2(k)^2 - u_2(k)\end{aligned}$$