Sistemes Dinàmics (Seminari 1) 15/10/20

$$x' = y$$
$$y' = -x + \mu(1-x^2)y$$

$\mu = 0$ Centre

$\mu \neq 0$ No centre

$\mu \neq 0$ $\rho=2$ és una òp. manté per pertorbació. μ petit

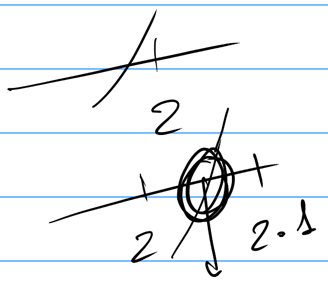
Continuació d'una solució

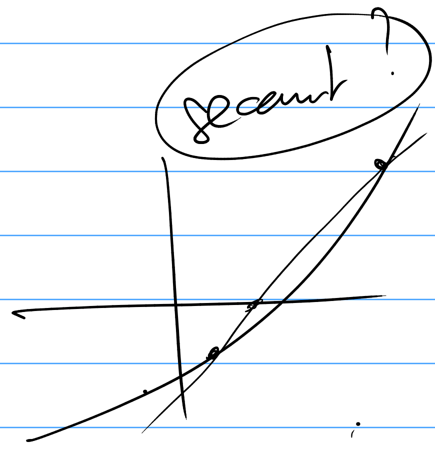
$\mu = 0$ $\Pi(2) = 2$

$\mu \neq 0$ $\Pi(2^*) = 2^*$?

$f(\rho) = \Pi(\rho) - \rho = 0$ Numèricament

$f(2) > 0$? < 0

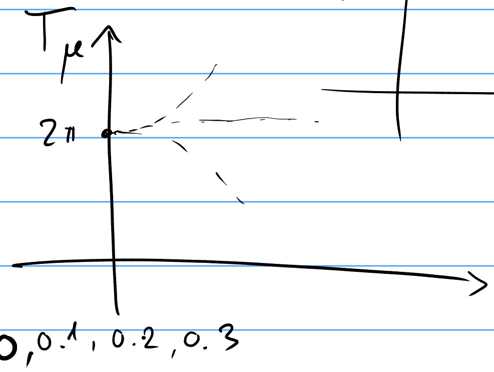


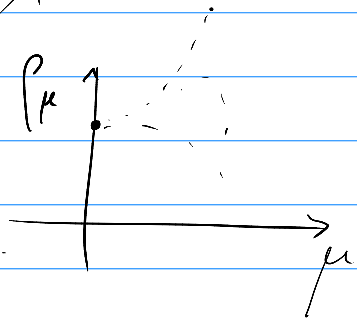


$\rho_0 = 2 \xrightarrow{\mu=0.2} 2.00041$

$T_0 = 2\pi \longrightarrow 6.2988$

$$\boxed{\mu \longrightarrow (\rho_\mu, T_\mu)} \quad (e)$$

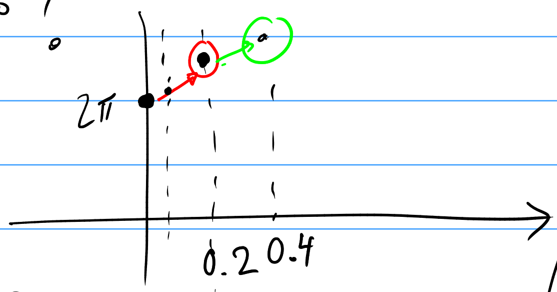




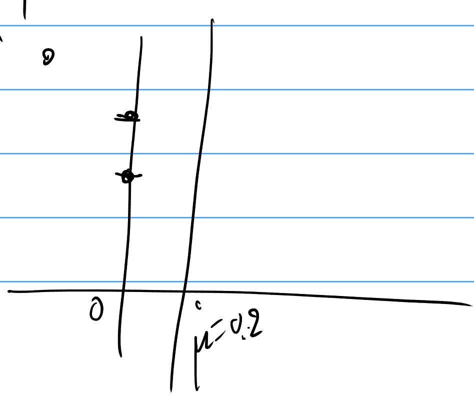
0, 0.1, 0.2, 0.3

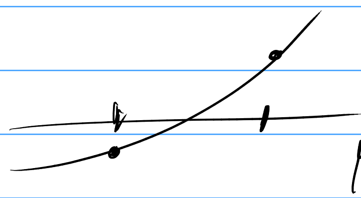
0, 0.01, 0.02, 0.03, ...

Continuació ?



Newton?



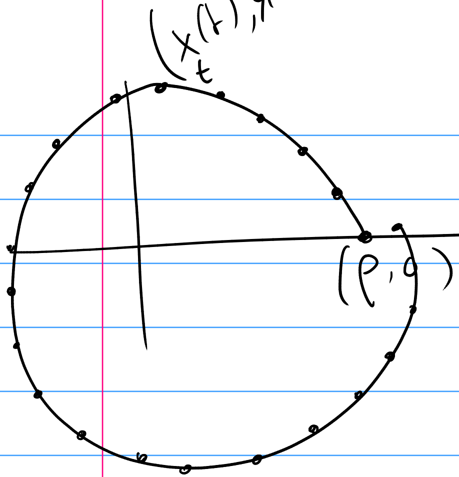


2 2.1

μ=0.2 2.00041

μ=0.4 2.00081

μ=0.6



$x(t)$

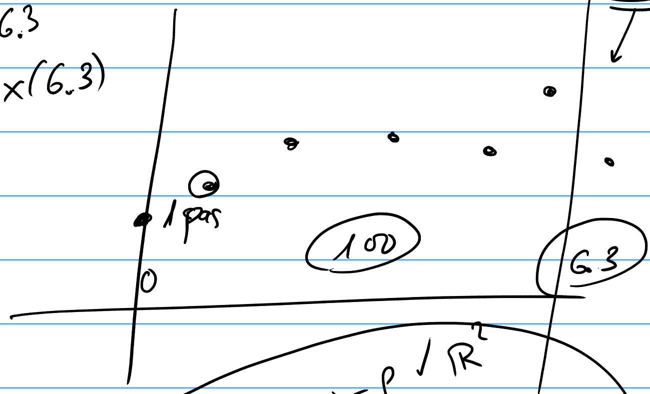
$t \sim 6.3$

$x(6.3)$

ode ?

n pas — ode

1 pas — rk45



$x_1(0) = \rho$ ✓ $\mathbb{R}^2$

$y_1(0) = 0$

$x_2(0) = 1$ ✓ $\mathbb{R}^4$

$y_2(0) = 0$

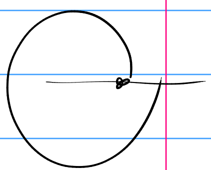
$x_3(0) = 0$ ✗

$y_3(0) = 1$

Newton $X(t)$

$X(t)$

μ



$x_\rho(t)$

$(\rho, 0)$ $y_\rho(t)$

$(0, \rho)$

$$\begin{cases} x_1' = y_1 \\ y_1' = -x_1 - \mu(x_1^2 - 1)\, y_1 \end{cases}$$

$$\begin{pmatrix} x_2' \\ y_2' \end{pmatrix} = \begin{pmatrix} 0 & 1 \\ -1-\mu(2x_1)y_1 & -\mu(x_1^2-1) \end{pmatrix} \begin{pmatrix} x_2 \\ y_2 \end{pmatrix}$$

$$\begin{pmatrix} x_3' \\ y_3' \end{pmatrix} = \begin{pmatrix} 0 & 1 \\ -1-\mu(2x_1)y_1 & -\mu(x_1^2-1) \end{pmatrix} \begin{pmatrix} x_3 \\ y_3 \end{pmatrix}$$

$x(t)$ $y(t)$

$\frac{\partial}{\partial \rho} x(t)$, $\frac{\partial}{\partial \rho} y(t)$

1 dim $r' = f(r, \theta)$

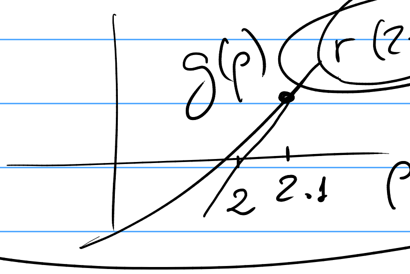
$\theta = 2\pi$

$r(\theta)$

$\frac{d r(\theta)}{d\rho}$

$g(\rho)$ $r(2\pi) - \rho$

$g'(\rho) = r_\rho(\cdot) - 1$



?

Newton ?

$\mathbb{R}^2$

r_ρ

1 dim

$$S' = Df\big|_{sol} S$$