Sciences Industrielles de l'Ingénieur
Informatique

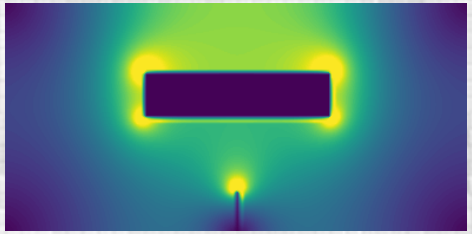
$$\begin{cases}\dfrac{d^2x_1(t)}{dt^2}=\dfrac{F_1}{m_1}\\ \dfrac{d^2x_2(t)}{dt^2}=\dfrac{F_2}{m_2}\\ \vdots\\ \dfrac{d^2x_n(t)}{dt^2}=\dfrac{F_n}{m_n}\end{cases}$$

$$\begin{cases}\dfrac{dH(t)}{dt}=aH(t)-bA(t)H(t)\\ \dfrac{dA(t)}{dt}=-cA(t)+dA(t)H(t)\end{cases}$$

$$\begin{cases}\dfrac{d^2x(t)}{dt^2}=-\dfrac{\beta}{m}\dfrac{dx(t)}{dt}\sqrt{\dfrac{dx(t)}{dt}^2+\dfrac{dy(t)}{dt}^2}\\ \dfrac{d^2y(t)}{dt^2}=-g-\dfrac{\beta}{m}\dfrac{dy(t)}{dt}\sqrt{\dfrac{dx(t)}{dt}^2+\dfrac{dy(t)}{dt}^2}\end{cases}$$

$$\begin{cases}\dfrac{di(t)}{dt}=\dfrac{u(t)-k_e\omega(t)-Ri(t)}{L}\\ \dfrac{d\omega(t)}{dt}=\dfrac{k_ci(t)-f\omega(t)-c_r(t)}{J}\\ \dfrac{du(t)}{dt}=-K_pK_{capt}\dfrac{d\,\omega(t)}{dt}+K_i\left(U_c-K_{capt}\,\omega(t)\right)\end{cases}$$

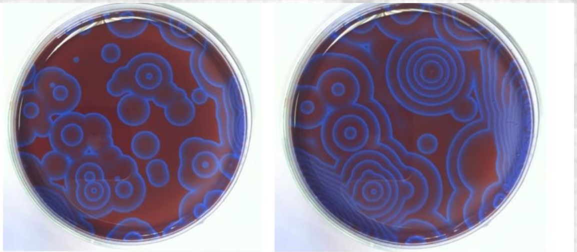
$$\begin{cases}\dfrac{dS(t)}{dt}=-p_IS(t)C(t)\\ \dfrac{dI(t)}{dt}=p_I[S(t)C(t)-S(t-T_i)C(t-T_i)]\\ \dfrac{dC(t)}{dt}=p_IS(t-T_i)C(t-T_i)-(p_R+p_D)C(t)\\ \dfrac{dR(t)}{dt}=p_RC(t)\\ \dfrac{dD(t)}{dt}=p_DC(t)\\ \dfrac{dV(t)}{dt}=0\end{cases}$$



$$\frac{\partial^2(y(t,x))}{\partial t^2}=c^2\frac{\partial^2(y(t,x))}{\partial x^2}$$

$$m\frac{d\overrightarrow{V(t)}}{dt}=\overrightarrow{f_f}+\overrightarrow{f_g}$$

$$\lambda\Delta T+q=\rho c\frac{dT}{dt}$$

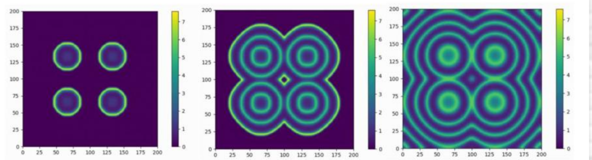


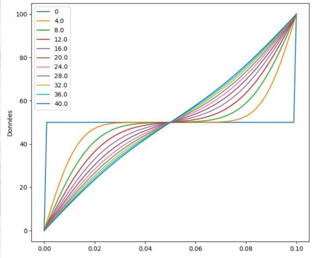
Simulation numérique
Méthode d'Euler

$$\frac{\partial^2T(x,y)}{\partial x^2}+\frac{\partial^2T(x,y)}{\partial y^2}=0$$

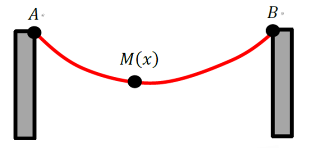
$$\begin{cases}\dfrac{dx(t)}{dt}=\sigma(y(t)-x(t))\\ \dfrac{dy(t)}{dt}=\rho x(t)-y(t)-x(t)z(t)\\ \dfrac{dz(t)}{dt}=x(t)y(t)-\beta z(t)\end{cases};\quad(\sigma,\rho,\beta)\in\mathbb{R}_+^{*\,3}$$

$$\frac{\partial \underline{q}}{\partial t}=\underline{D}\Delta\underline{q}+R(\underline{q})$$



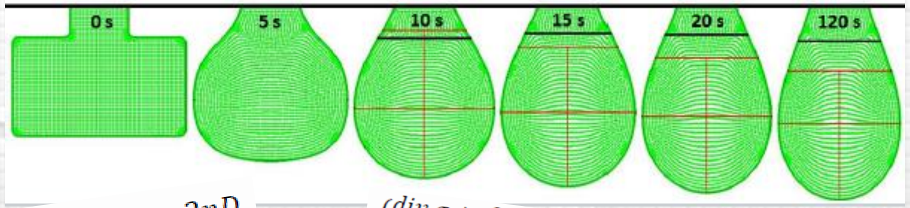


$$\frac{\partial T(t,x)}{\partial t}=D_{th}\frac{\partial^2(T(t,x))}{\partial x^2}$$

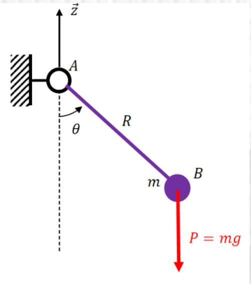


$$\begin{cases}\dfrac{dX(x,y,t)}{dt}=\lambda_x\left(\dfrac{\partial^2X(x,y,t)}{\partial x^2}+\dfrac{\partial^2X(x,y,t)}{\partial y^2}\right)+k_1AY(x,y,t)+k_5AX(x,y,t)-k_2X(x,y,t)Y(x,y,t)-2k_6X^2(x,y,t)\\ \dfrac{dY(x,y,t)}{dt}=\lambda_y\left(\dfrac{\partial^2Y(x,y,t)}{\partial x^2}+\dfrac{\partial^2Y(x,y,t)}{\partial y^2}\right)-k_1AY(x,y,t)-k_2X(x,y,t)Y(x,y,t)+k_7fZ(x,y,t)\\ \dfrac{dZ(x,y,t)}{dt}=\lambda_z\left(\dfrac{\partial^2Z(x,y,t)}{\partial x^2}+\dfrac{\partial^2Z(x,y,t)}{\partial y^2}\right)+k_5AX(x,y,t)-k_7Z(x,y,t)\end{cases}$$

$$y''(x)=\frac{1}{a}\sqrt{1+y'(x)^2}$$



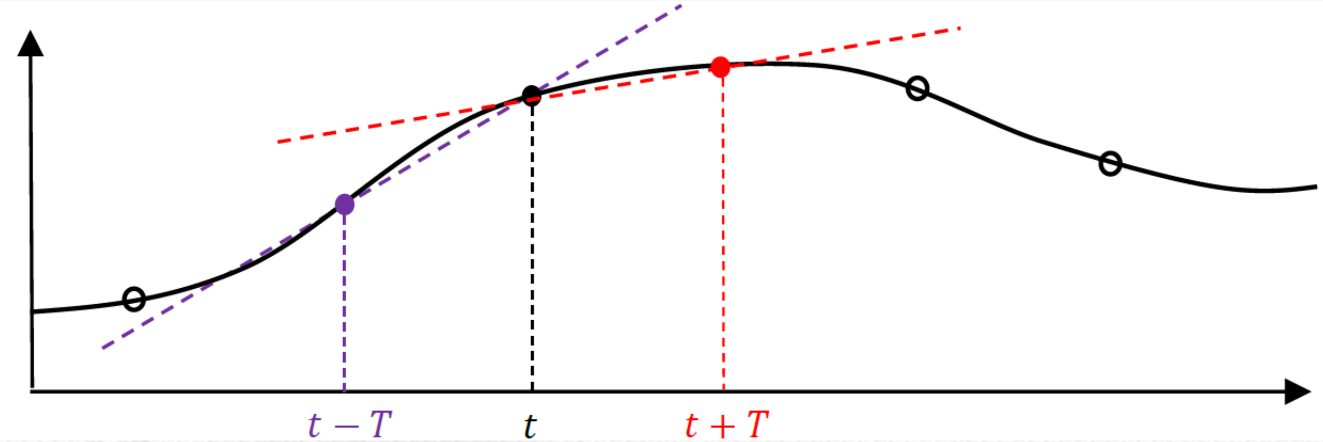
$$\underline{\underline{D}}=\frac{1}{2}\left(\underline{\mathrm{grad}}(\underline{V})+\underline{\mathrm{grad}}(\underline{V})^T\right)=\begin{pmatrix}\dfrac{\partial u}{\partial x} & \dfrac{1}{2}\left(\dfrac{\partial u}{\partial y}+\dfrac{\partial v}{\partial x}\right)\\ \dfrac{1}{2}\left(\dfrac{\partial u}{\partial y}+\dfrac{\partial v}{\partial x}\right) & \dfrac{\partial v}{\partial y}\end{pmatrix}$$

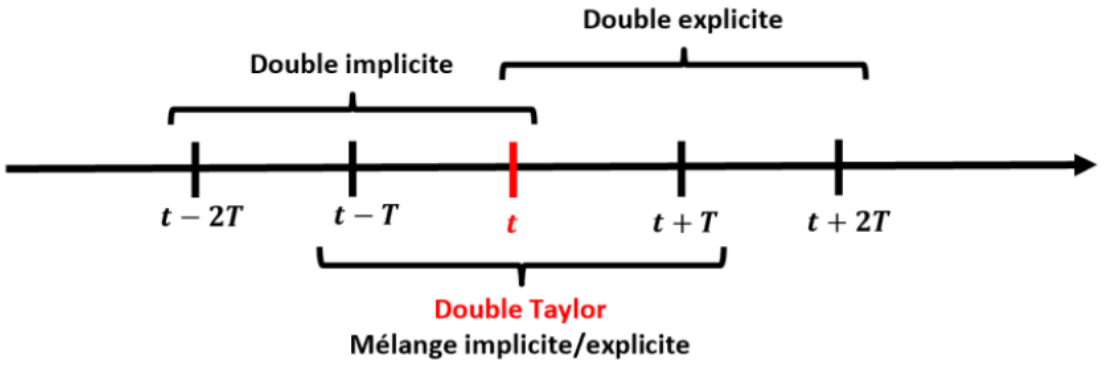


$$\ddot{\theta}(t)=\frac{-k\dot{\theta}(t)-Rmg\sin\theta(t)}{J}$$

$$\underline{\underline{\sigma}}=-p\underline{\underline{I}}+2\eta\underline{\underline{D}}$$

$$\begin{cases}div\,\underline{\underline{\sigma}}+\underline{f_d}=\rho\underline{\gamma}\\ div(\underline{V})=0\end{cases}$$

	Dérivée première	
Type d'Euler	Explicite	Implicite
Expression de $y'(t)$	$y'(\mathbf{t}) = \frac{y(\mathbf{t}+\mathbf{T}) - y(\mathbf{t})}{T}$	$y'(\mathbf{t}+\mathbf{T}) = \frac{y(\mathbf{t}+\mathbf{T}) - y(\mathbf{t})}{T}$ $y'(\mathbf{t}) = \frac{y(\mathbf{t}) - y(\mathbf{t}-\mathbf{T})}{T}$
Nouvelle valeur $y(t+T)$ lors d'une résolution	$y(t+T) = Ty'(\mathbf{t}) + y(t)$	$y(t+T) = Ty'(\mathbf{t}+\mathbf{T}) + y(t)$
Bilan		

Dérivée seconde	
Méthode à privilégier Double Taylor à l'ordre 2	$y(t+T)=y(t)+T\frac{dy(t)}{dt}+\frac{T^2}{2}\frac{d^2y(t)}{dt^2}+o(T^2)$ $y(t-T)=y(t)-T\frac{dy(t)}{dt}+\frac{T^2}{2}\frac{d^2y(t)}{dt^2}+o(T^2)$ $y(t+T)+y(t-T)=2y(t)+T^2\frac{d^2y(t)}{dt^2}$ $\frac{d^2y(t)}{dt^2}=\frac{y(t+T)-2y(t)+y(t-T)}{T^2}$
Double Euler explicite	$\frac{d^2y(t)}{dt^2}=\frac{y(t+2T)-2y(t+T)+y(t)}{T^2}$
Double Euler implicite	$\frac{d^2y(t)}{dt^2}=\frac{y(t)-2y(t-T)+y(t-2T)}{T^2}$
Euler implicite sur la dérivée seconde et explicite sur la dérivée première	$\frac{d^2y(t)}{dt^2}=\frac{y(t+T)-2y(t)+y(t-T)}{T^2}$
Explicite sur la dérivée seconde et implicite sur la dérivée première	$\frac{d^2y(t)}{dt^2}=\frac{y(t+T)-2y(t)+y(t-T)}{T^2}$
Bilan	

Equations aux différences

$$\frac{\partial^2 T(x,y)}{\partial x^2} + \frac{\partial^2 T(x,y)}{\partial y^2} = 0$$

$$\frac{\partial \underline{q}}{\partial t} = \underline{D}\Delta \underline{q} + R\left(\underline{q}\right)$$

$$\frac{\partial T(t,x)}{\partial t} = D_{th} \frac{\partial^2 \left(T(t,x)\right)}{\partial x^2}$$

$$\frac{\partial^2 \left(y(t,x)\right)}{\partial t^2} = c^2 \frac{\partial^2 \left(y(t,x)\right)}{\partial x^2}$$

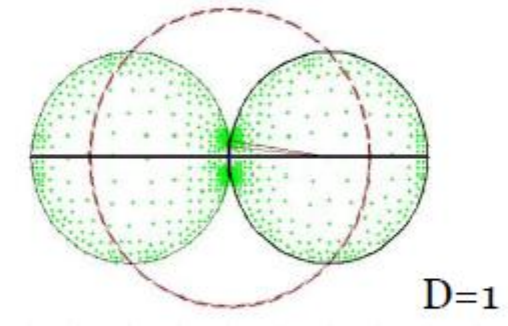
Simulation de fusion laser thermoplastique

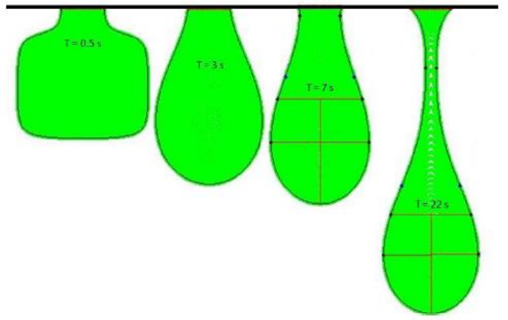
$$\begin{cases} div\,\underline{\underline{\sigma}} + \underline{f_d} = \rho \underline{\gamma} \\ div(\underline{V}) = 0 \end{cases}$$

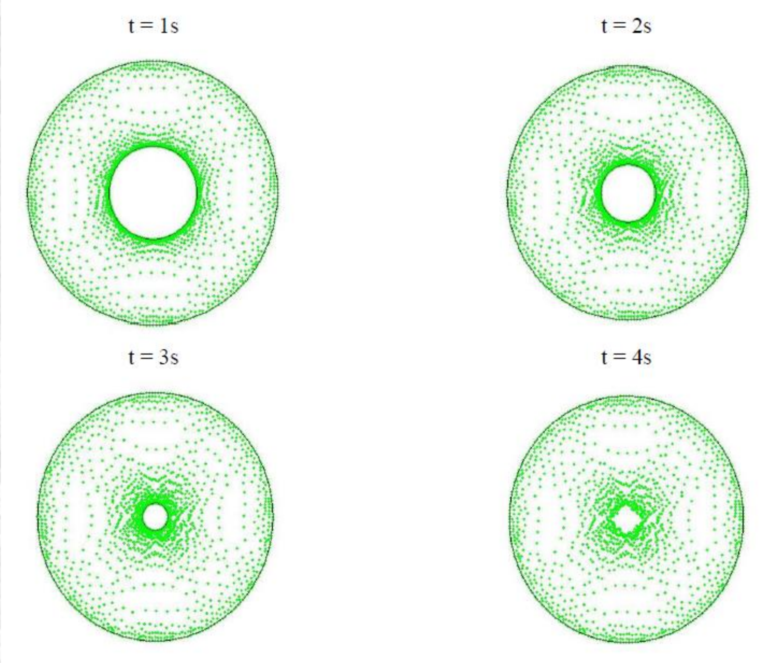
$$\underline{\underline{\sigma}} = -p\underline{\underline{I}} + 2\eta \underline{\underline{D}}$$

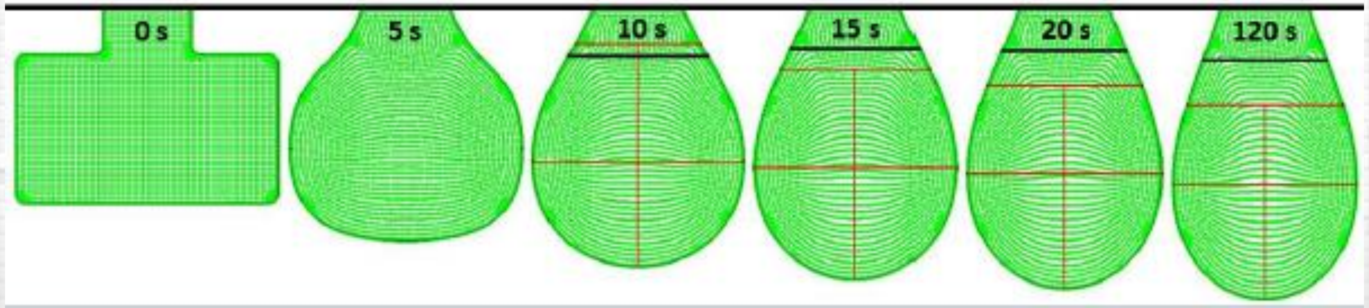
$$\underline{\underline{D}} = \frac{1}{2}\left(\underline{\underline{\mathrm{grad}}}(\underline{V}) + \underline{\underline{\mathrm{grad}}}(\underline{V})^{\mathrm{T}}\right) = \begin{pmatrix} \frac{\partial u}{\partial x} & \frac{1}{2}\left(\frac{\partial u}{\partial y} + \frac{\partial v}{\partial x}\right) \\ \frac{1}{2}\left(\frac{\partial u}{\partial y} + \frac{\partial v}{\partial x}\right) & \frac{\partial v}{\partial y} \end{pmatrix}$$

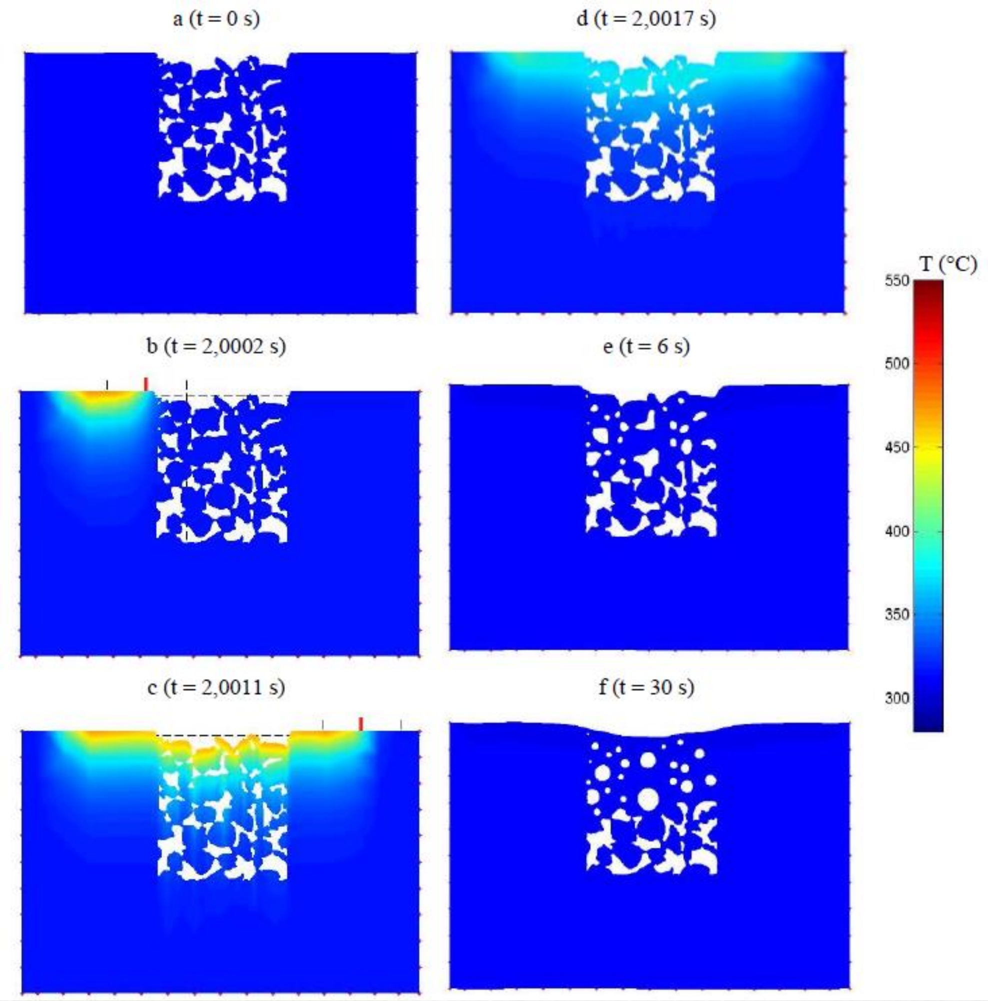
$$\lambda \Delta T + q = \rho c \frac{dT}{dt}$$









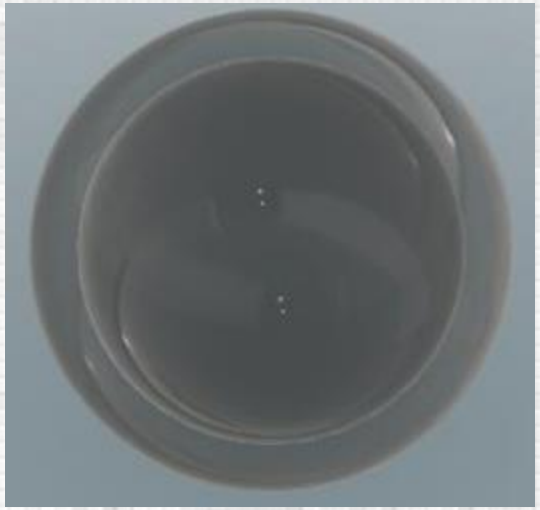


Thermique 3D sphérique

$$\frac{\partial T(t,r)}{\partial t} = D_{th}\Delta T(t,r)$$

$$F(t,r) = rT(t,r)$$

$$\frac{\partial T(t,r)}{\partial t} = D_{th}\frac{1}{r}\frac{\partial^2 F(t,r)}{\partial r^2}$$

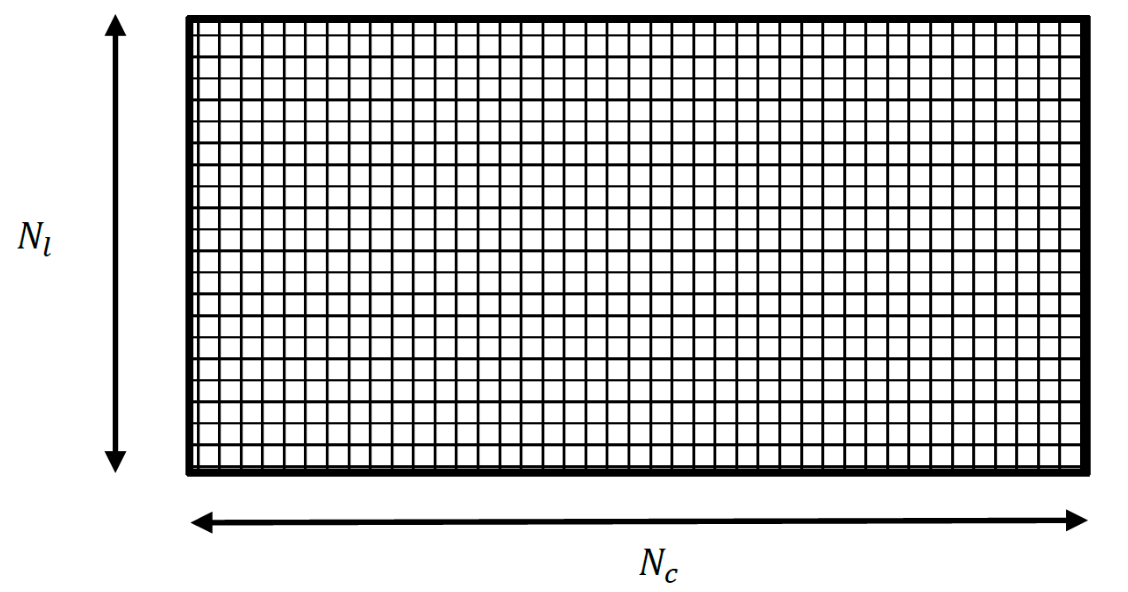


$$\begin{bmatrix} T_1^{t+dt} \\ T_2^{t+dt} \\ T_3^{t+dt} \end{bmatrix} = \begin{bmatrix} T_1^{t} \\ T_2^{t} \\ T_3^{t} \end{bmatrix} + \frac{D_{th}dt}{dr^2}\begin{bmatrix} \frac{r_1 - dr}{r_1} & -2 & \frac{r_1 + dr}{r_1} & 0 & 0 \\ 0 & \frac{r_2 - dr}{r_2} & -2 & \frac{r_2 + dr}{r_2} & 0 \\ 0 & 0 & \frac{r_3 - dr}{r_3} & -2 & \frac{r_3 + dr}{r_3} \end{bmatrix}\begin{bmatrix} T_0^{t} \\ T_1^{t} \\ T_2^{t} \\ T_3^{t} \\ T_4^{t} \end{bmatrix}$$

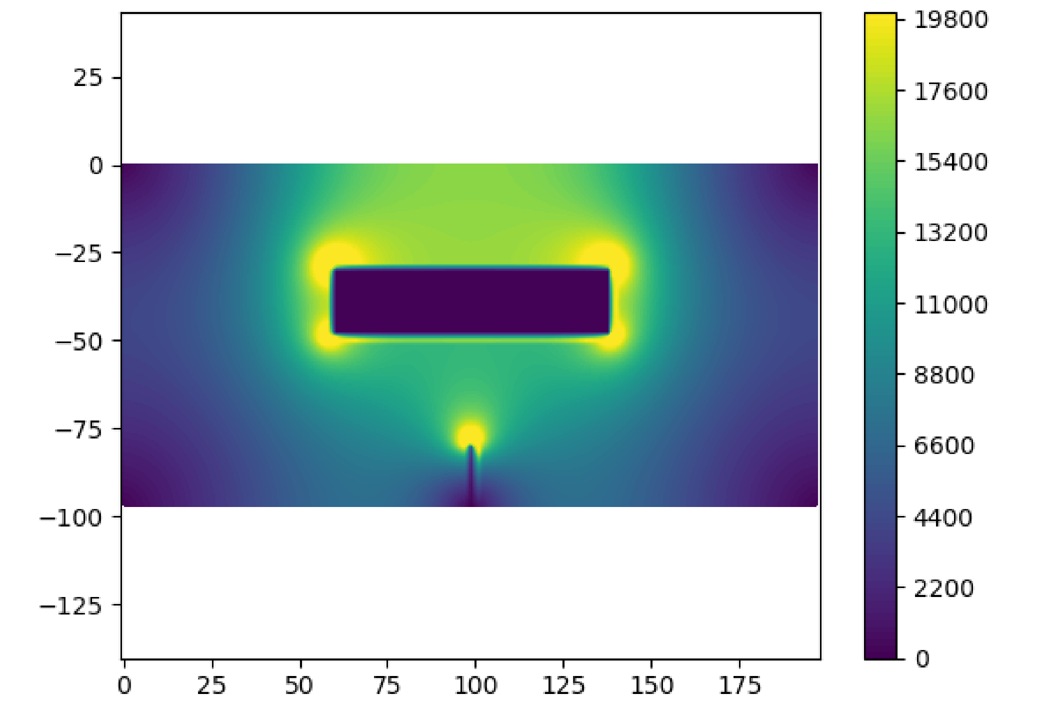
Potentiel et champ électrique

$$\Delta T(x,y) = 0$$

$$\frac{\partial^2 T(x,y)}{\partial x^2} + \frac{\partial^2 T(x,y)}{\partial y^2} = 0$$

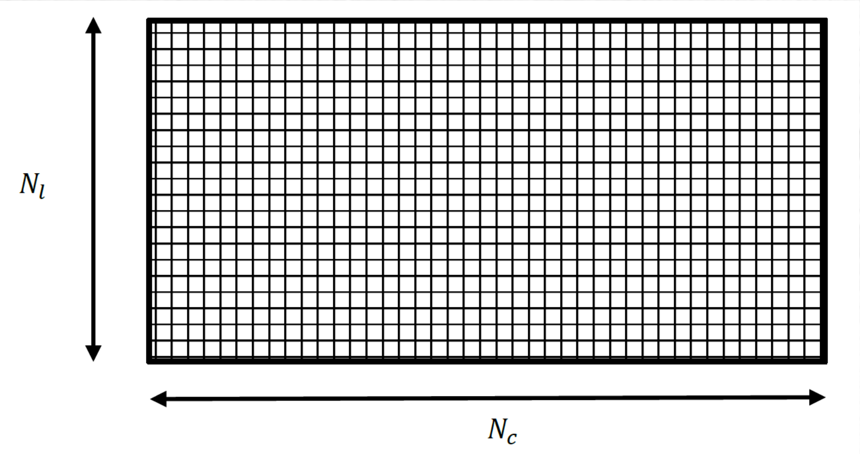


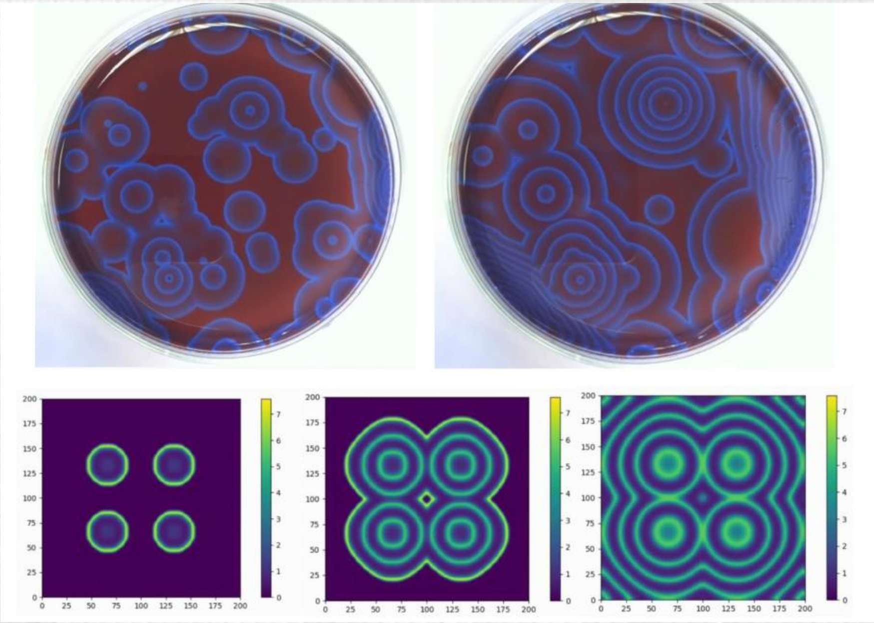
Champ électrique

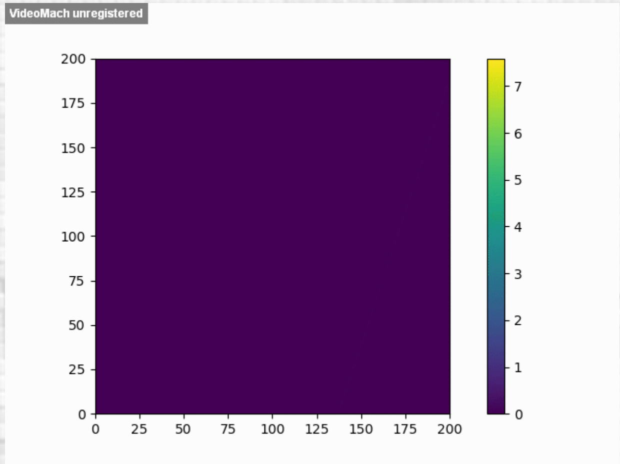


Réaction de BZ + Diffusion

$$\frac{\partial \underline{q}}{\partial t} = \underline{D}\Delta \underline{q} + R\left(\underline{q}\right)$$



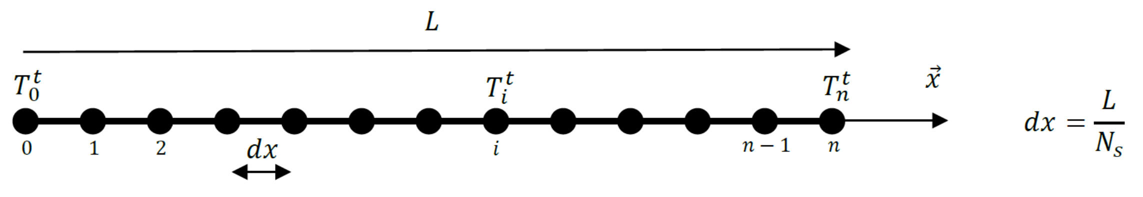


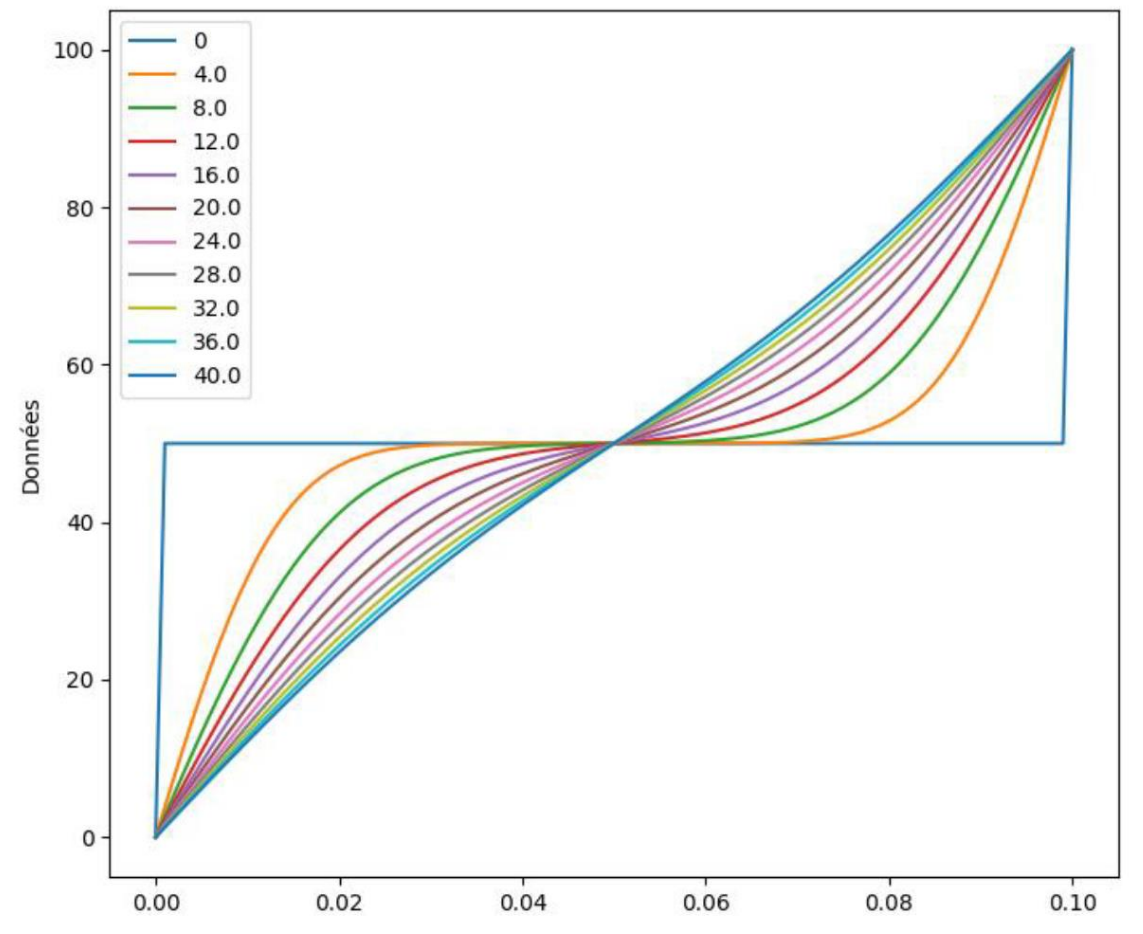


$$\begin{cases}
\dfrac{dX(x,y,t)}{dt} = \lambda_x\left(\dfrac{\partial^2 X(x,y,t)}{\partial x^2} + \dfrac{\partial^2 X(x,y,t)}{\partial y^2}\right) + k_1 A Y(x,y,t) + k_5 A X(x,y,t) - k_2 X(x,y,t) Y(x,y,t) - 2k_6 X^2(x,y,t) \\
\dfrac{dY(x,y,t)}{dt} = \lambda_y\left(\dfrac{\partial^2 Y(x,y,t)}{\partial x^2} + \dfrac{\partial^2 Y(x,y,t)}{\partial y^2}\right) - k_1 A Y(x,y,t) - k_2 X(x,y,t) Y(x,y,t) + k_7 f Z(x,y,t) \\
\dfrac{dZ(x,y,t)}{dt} = \lambda_z\left(\dfrac{\partial^2 Z(x,y,t)}{\partial x^2} + \dfrac{\partial^2 Z(x,y,t)}{\partial y^2}\right) + k_5 A X(x,y,t) - k_7 Z(x,y,t)
\end{cases}$$

Thermique 1D

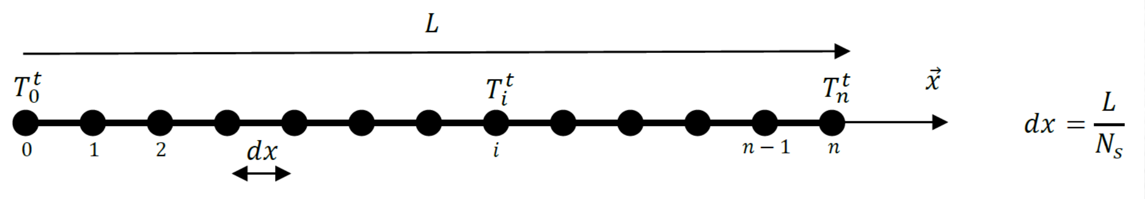
$$\frac{\partial T(t,x)}{\partial t} = D_{th}\frac{\partial^2\big(T(t,x)\big)}{\partial x^2}$$

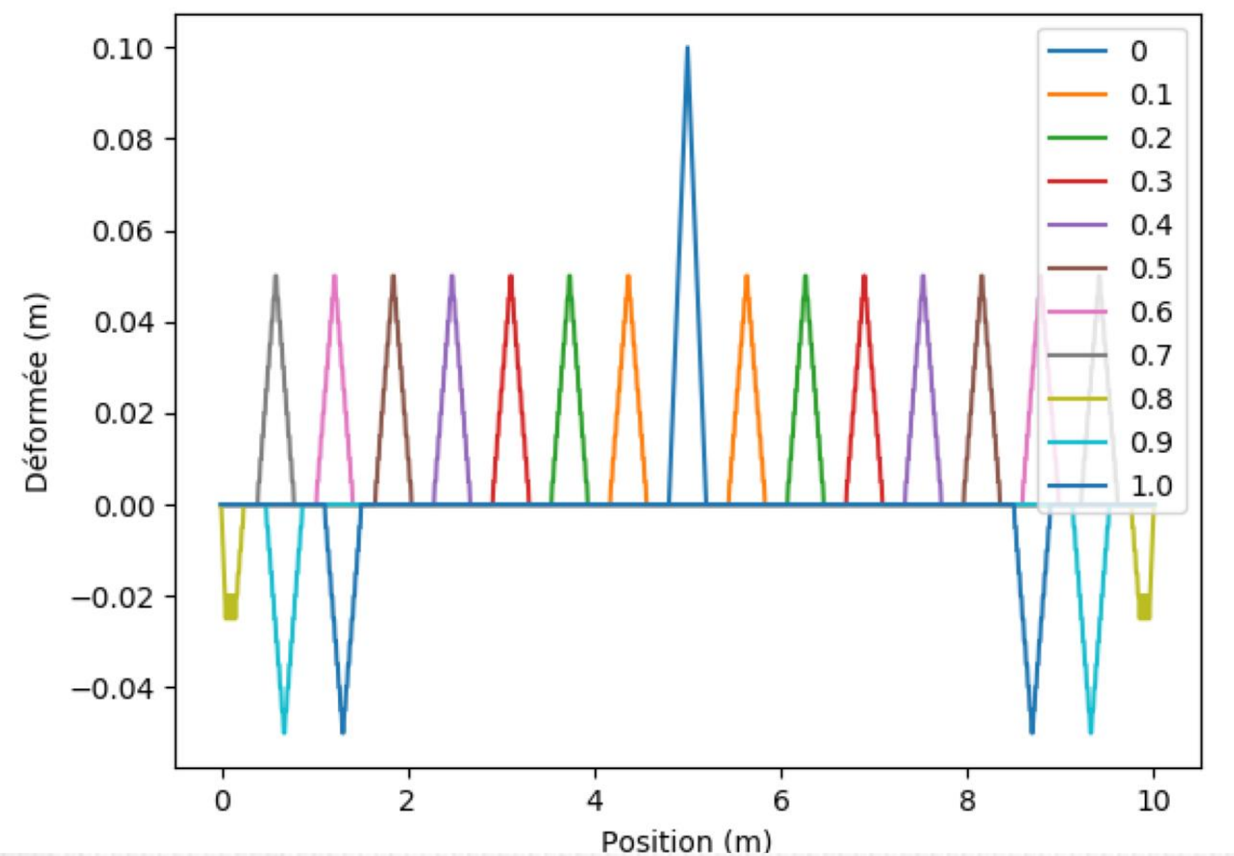




Ondes 1D

$$\frac{\partial^2(y(t,x))}{\partial t^2} = c^2 \frac{\partial^2(y(t,x))}{\partial x^2}$$





Euler classique

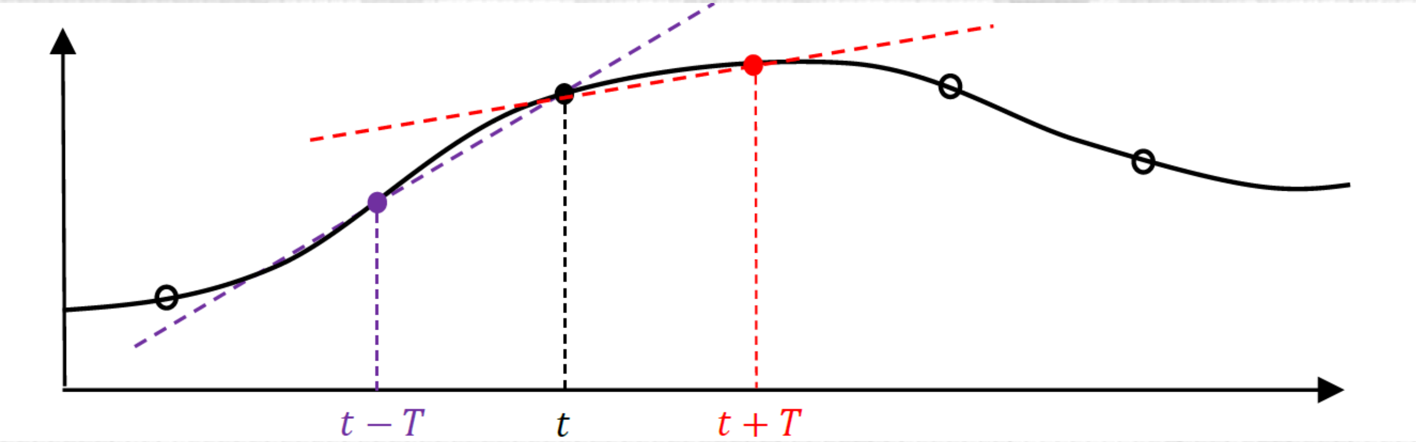
$$v'(t) = \frac{k}{m} v^2(t) - g$$

$$\ddot{\theta}(t) = \frac{-k\dot{\theta}(t) - Rmg \sin\theta(t)}{J}$$

$$\begin{cases} \dfrac{dH(t)}{dt} = aH(t) - bA(t)H(t) & (1) \\ \dfrac{dA(t)}{dt} = -cA(t) + dA(t)H(t) & (2) \end{cases} \quad ; \quad (a,b,c,d) \epsilon \mathbb{R}^4$$

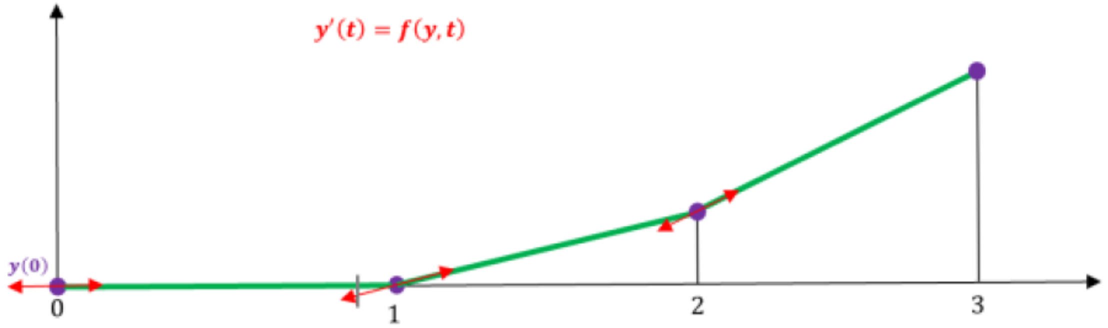
$$\begin{cases} \dfrac{d^2x(t)}{dt^2} = -\dfrac{\beta}{m} \dfrac{dx(t)}{dt} \sqrt{\dfrac{dx(t)}{dt}^2 + \dfrac{dy(t)}{dt}^2} \\ \dfrac{d^2y(t)}{dt^2} = -\mathrm{g} - \dfrac{\beta}{m} \dfrac{dy(t)}{dt} \sqrt{\dfrac{dx(t)}{dt}^2 + \dfrac{dy(t)}{dt}^2} \end{cases}$$

Type d'Euler	Explicite
Expression de $y'(t)$	$y'(t) = \dfrac{y(t+T) - y(t)}{T}$
Nouvelle valeur $y(t+T)$ lors d'une résolution	$y(t+T) = Ty'(t) + y(t)$



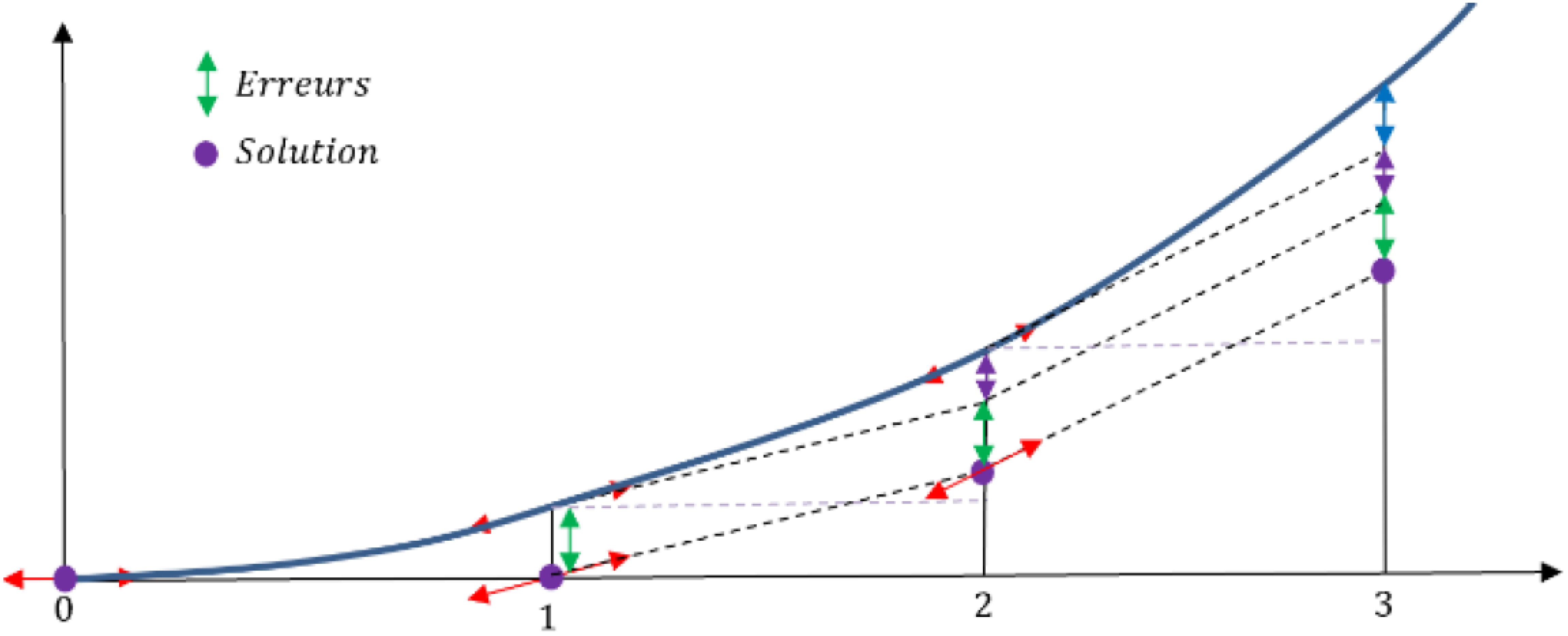
Une équation différentielle

$$y^{(i)}(t) = f\left(y^{(i-1)}(t), y^{(i-2)}(t), \ldots y(t), t\right)$$

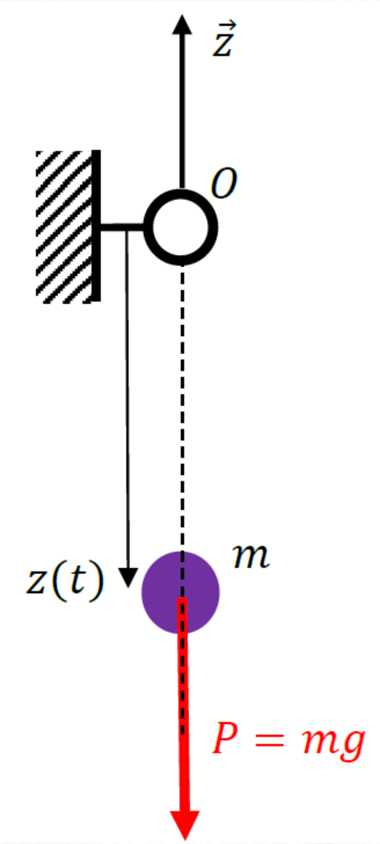
1° ordre	2° ordre
$\boldsymbol{y'(t) = f(y,t)}$ $y'(t) = \dfrac{y(t+dt) - y(t)}{dt}$ $y(t+dt) = y(t) + y'(t)dt$ $y(t+dt) = y(t) + f(y,t)dt$  	$y''(t) = f(y(t), y'(t), t) = f(Y,t)$ $Y(t) = \begin{pmatrix} y(t) \\ y'(t) \end{pmatrix}$ $\boldsymbol{Y'(t)} = \begin{pmatrix} y'(t) \\ y''(t) \end{pmatrix} = \begin{pmatrix} y'(t) \\ f(Y,t) \end{pmatrix} = \boldsymbol{F(Y,t)}$ $F: (Y,t) \mapsto \left(y', f(Y,t)\right)$ $Y(t_0) = \begin{pmatrix} y(t_0) \\ y'(t_0) \end{pmatrix}$ $Y(t+dt) = Y(t) + F(Y,t)dt$

Système d’équations différentielles	
1° ordre	2° ordre
$\begin{cases} \frac{df_1(t)}{dt} = g_1(f_1(t), f_2(t), \dots, f_n(t), t) \\ \frac{df_2(t)}{dt} = g_2(f_1(t), f_2(t), \dots, f_n(t), t) \\ \vdots \\ \frac{df_n(t)}{dt} = g_n(f_1(t), f_2(t), \dots, f_n(t), t) \end{cases}$ $Y(t) = \begin{pmatrix} f_1(t) \\ f_2(t) \\ \vdots \\ f_n(t) \end{pmatrix} \Rightarrow \begin{cases} \frac{df_1(t)}{dt} = g_1(Y, t) \\ \frac{df_2(t)}{dt} = g_2(Y, t) \\ \vdots \\ \frac{df_n(t)}{dt} = g_n(Y, t) \end{cases}$ $F_p : (Y, t) \mapsto \begin{pmatrix} f_1'(t) \\ f_2'(t) \\ \vdots \\ f_n'(t) \end{pmatrix} = \begin{pmatrix} g_1(Y, t) \\ g_2(Y, t) \\ \vdots \\ g_n(Y, t) \end{pmatrix}$ $\boldsymbol{Y'(t) = F_p(Y, t)}$ $Y(t + dt) = Y(t) + F_p(Y, t)dt$	$\begin{cases} \frac{d^2 f_1(t)}{dt^2} = g_1(f_1, f_1', f_2, f_2', \dots, f_n, f_n', t) \\ \frac{d^2 f_2(t)}{dt^2} = g_2(f_1, f_1', f_2, f_2', \dots, f_n, f_n', t) \\ \vdots \\ \frac{d^2 f_n(t)}{dt^2} = g_n(t, f_1, f_1', f_2, f_2', \dots, f_n, f_n') \end{cases}$ $Y(t) = \begin{pmatrix} f_1(t) \\ f_1'(t) \\ f_2(t) \\ f_2'(t) \\ \vdots \\ f_n(t) \\ f_n'(t) \end{pmatrix} \Rightarrow \begin{cases} \frac{d^2 f_1(t)}{dt^2} = g_1(Y, t) \\ \frac{d^2 f_2(t)}{dt^2} = g_2(Y, t) \\ \vdots \\ \frac{d^2 f_n(t)}{dt^2} = g_n(Y, t) \end{cases}$ $F_p : (Y, t) \mapsto \begin{pmatrix} f_1'(t) \\ f_1''(t) \\ f_2'(t) \\ f_2''(t) \\ \vdots \\ f_n'(t) \\ f_n''(t) \end{pmatrix} = \begin{pmatrix} f_1'(t) \\ g_1(Y, t) \\ f_2'(t) \\ g_2(Y, t) \\ \vdots \\ f_n'(t) \\ g_n(Y, t) \end{pmatrix}$ $\boldsymbol{Y'(t) = F_p(Y, t)}$ $Y(t + dt) = Y(t) + F_p(Y, t)dt$

Les erreurs se propagent



Une équation d'ordre 1

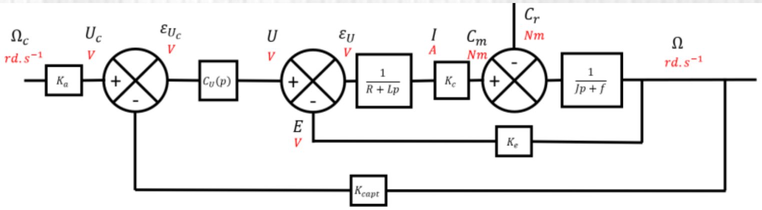


Chute libre

$$v'(t) = \frac{k}{m} v^2(t) - g$$

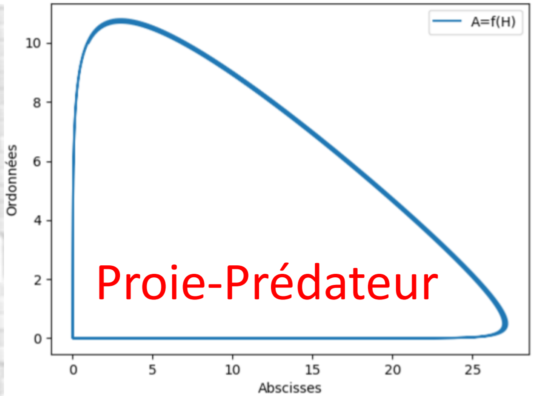
Plusieurs équations d'ordre 1

$$\begin{cases} \dfrac{di(t)}{dt} = \dfrac{u(t) - k_e\omega(t) - Ri(t)}{L} \\ \dfrac{d\omega(t)}{dt} = \dfrac{k_c i(t) - f\omega(t) - c_r(t)}{J} \\ \dfrac{du(t)}{dt} = -K_p K_{capt}\dfrac{d\,\omega(t)}{dt} + K_i\left(U_c - K_{capt}\,\omega(t)\right) \end{cases}$$



Asservissement MCC

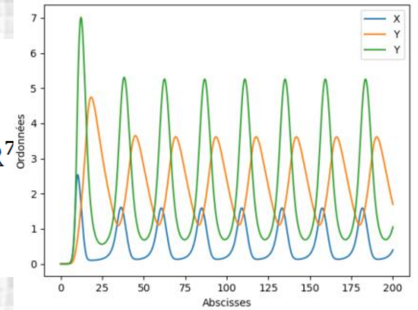
$$\begin{cases} \dfrac{dH(t)}{dt} = aH(t) - bA(t)H(t) \quad (1) \\ \dfrac{dA(t)}{dt} = -cA(t) + dA(t)H(t) \quad (2) \end{cases} \quad ; \quad (a,b,c,d)\epsilon\mathbb{R}^4$$

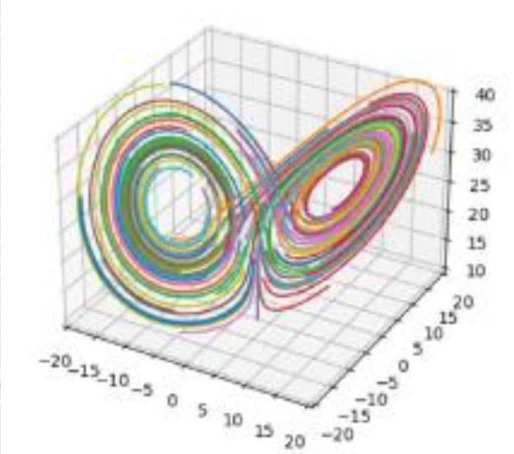


Proie-Prédateur

$$\begin{cases} \dfrac{dX(t)}{dt} = k_1AY(t) + k_5AX(t) - k_2X(t)Y(t) - 2k_6X^2(t) \\ \dfrac{dY(t)}{dt} = -k_1AY(t) - k_2X(t)Y(t) + k_7fZ(t) \\ \dfrac{dZ(t)}{dt} = k_5AX(t) - k_7Z(t) \end{cases} \quad ; \quad (k_1,k_2,k_5,k_6,k_7,f,A)\epsilon\mathbb{R}^7$$

Réaction de BZ



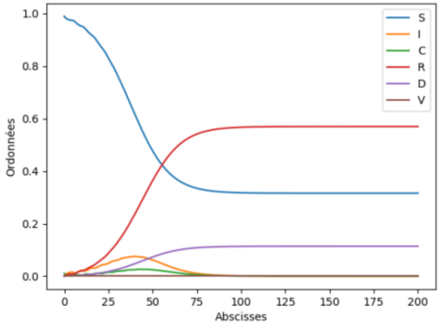


Attracteur de Lorenz

$$\begin{cases} \dfrac{dx(t)}{dt} = \sigma\big(y(t) - x(t)\big) \\ \dfrac{dy(t)}{dt} = \rho x(t) - y(t) - x(t)z(t) \\ \dfrac{dz(t)}{dt} = x(t)y(t) - \beta z(t) \end{cases} \quad ; \quad (\sigma,\rho,\beta)\,\epsilon\mathbb{R}_+^{*\,3}$$

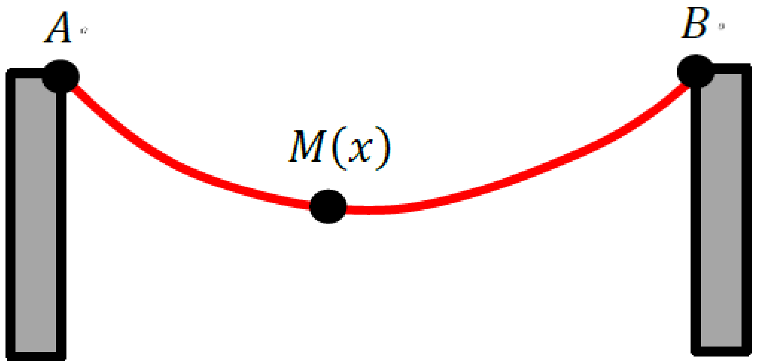
$$\begin{cases} \dfrac{dS(t)}{dt} = -p_I S(t)C(t) \\ \dfrac{dI(t)}{dt} = p_I[S(t)C(t) - S(t-T_i)C(t-T_i)] \\ \dfrac{dC(t)}{dt} = p_I S(t-T_i)C(t-T_i) - (p_R + p_D)C(t) \\ \dfrac{dR(t)}{dt} = p_R C(t) \\ \dfrac{dD(t)}{dt} = p_D C(t) \\ \dfrac{dV(t)}{dt} = 0 \end{cases}$$

Epidémie



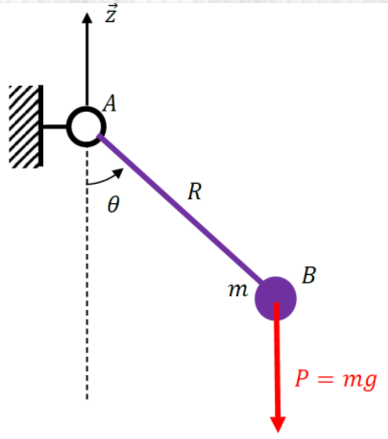
Une équation d'ordre 2

Chaînette



$$y''(x) = \frac{1}{a}\sqrt{1 + y'(x)^2}$$

Pendule

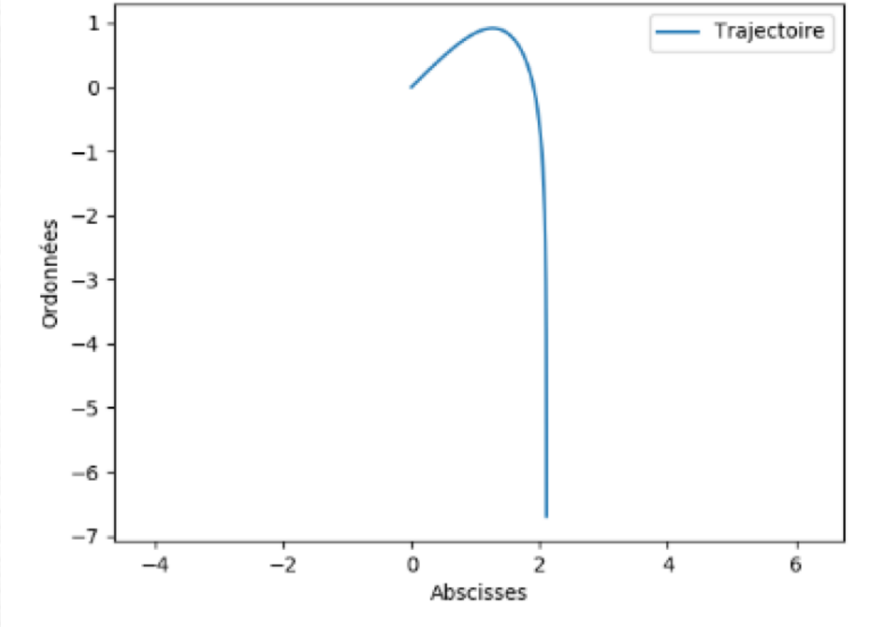


$$\ddot{\theta}(t) = \frac{-k\dot{\theta}(t) - Rmg \sin \theta(t)}{J}$$

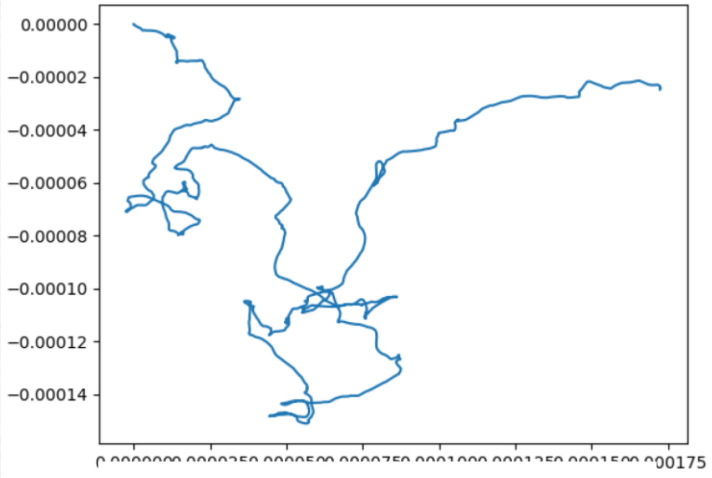
Plusieurs équations d'ordre 2

Balistique

$$\begin{cases} \dfrac{d^2x(t)}{dt^2} = -\dfrac{\beta}{m}\dfrac{dx(t)}{dt}\sqrt{\dfrac{dx(t)}{dt}^2 + \dfrac{dy(t)}{dt}^2} \\ \dfrac{d^2y(t)}{dt^2} = -g - \dfrac{\beta}{m}\dfrac{dy(t)}{dt}\sqrt{\dfrac{dx(t)}{dt}^2 + \dfrac{dy(t)}{dt}^2} \end{cases}$$



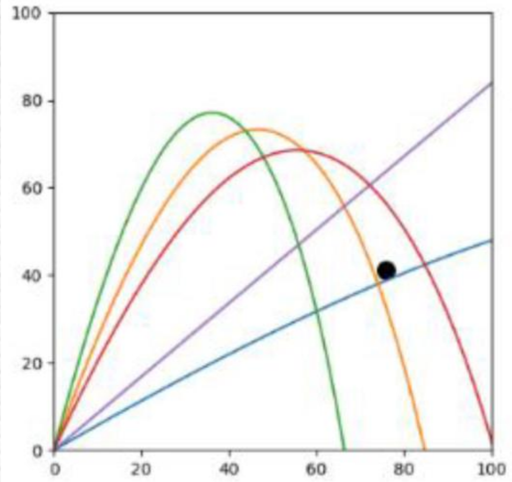
Mouvement Brownien



$$m\frac{d\overrightarrow{V(t)}}{dt} = \overrightarrow{f_f} + \overrightarrow{f_B}$$

(vectoriel)

Balistique



$$m\frac{d\overrightarrow{V(t)}}{dt} = \overrightarrow{f_f} + \overrightarrow{f_g}$$

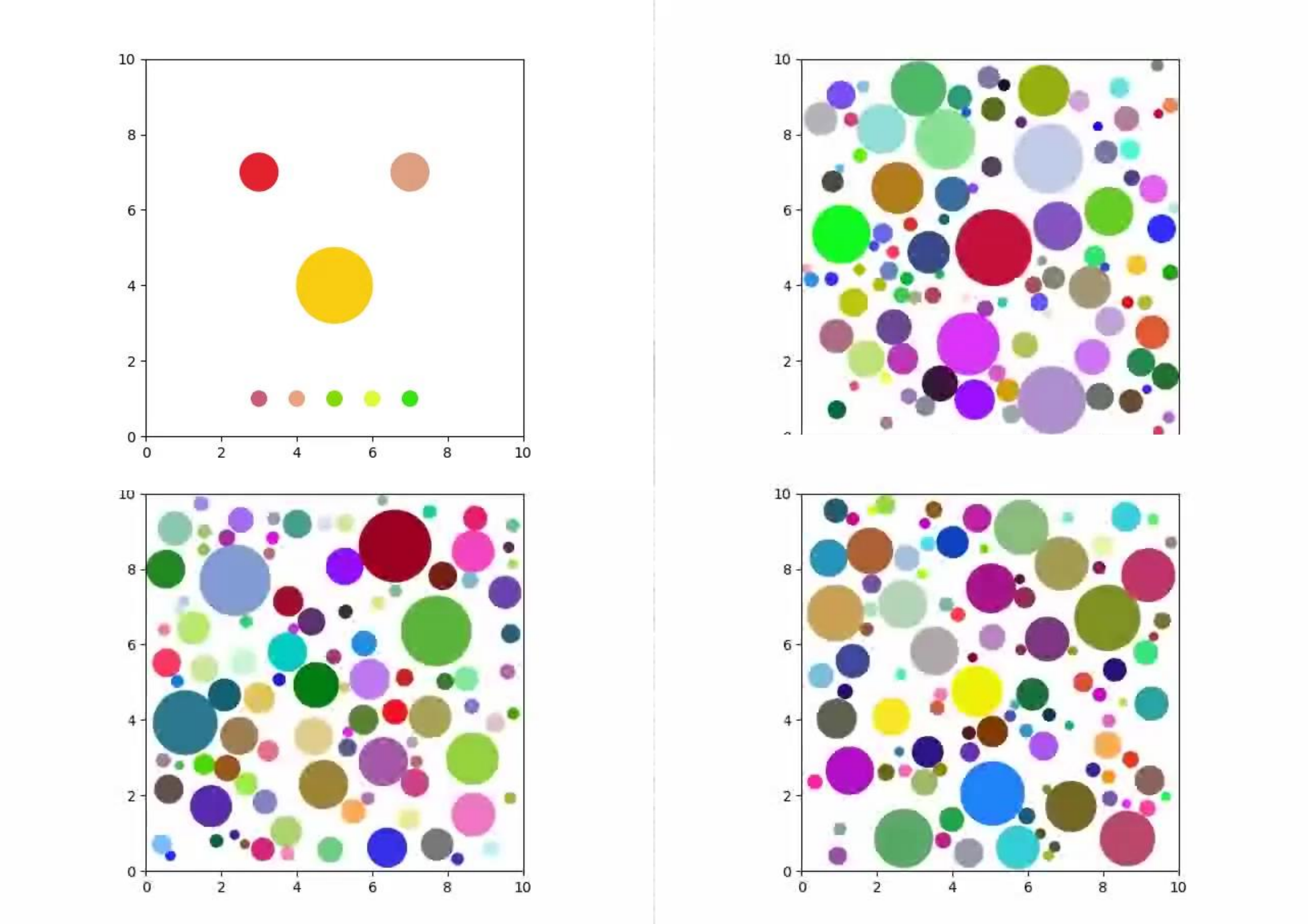
(vectoriel)

D'autres sujets

Balles 2D

$$\begin{cases} b_i.fx = b_i.m * b_i.ax \\ b_i.fy = b_i.m * b_i.ay \end{cases}$$

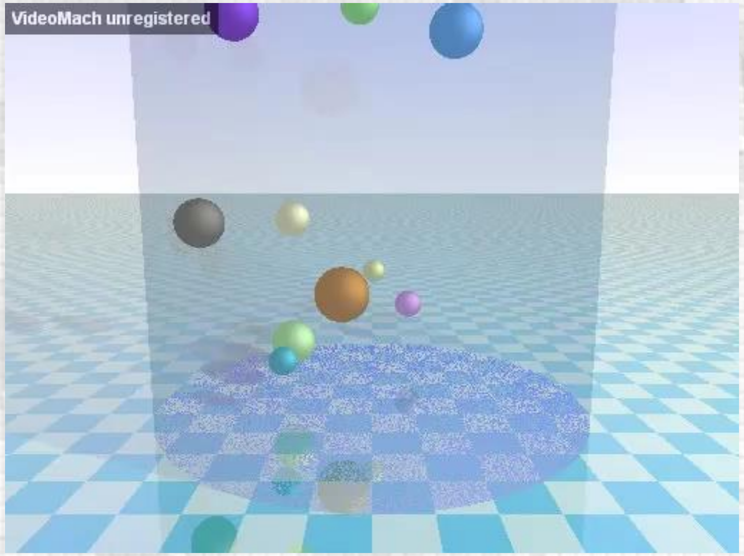
$$\begin{cases} \dfrac{db_i.x}{dt} = b_i.vx \\ \dfrac{db_i.y}{dt} = b_i.vy \end{cases}$$

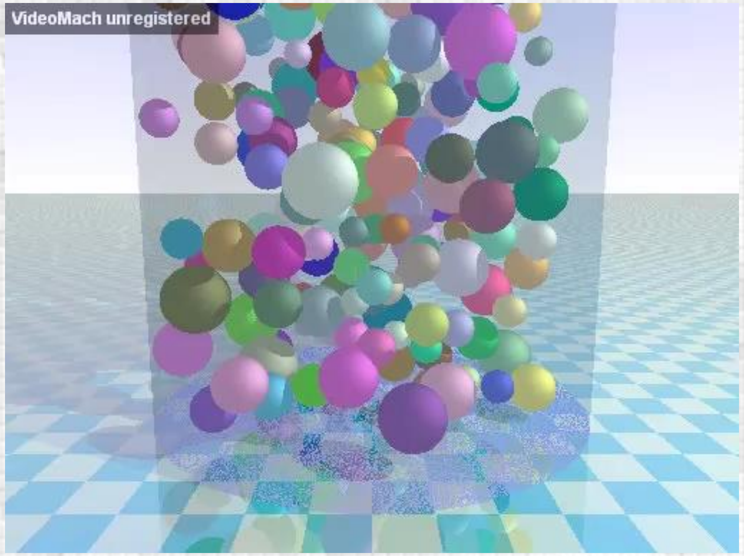


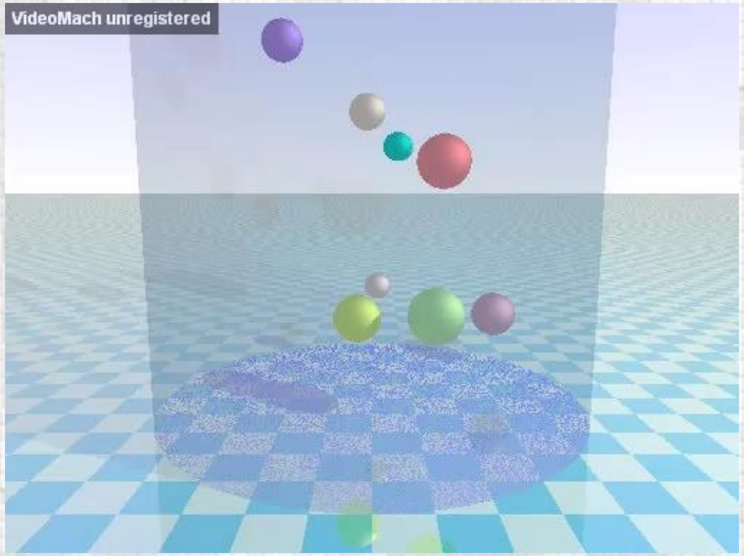

```
class new balle():

    def __init__(self,x,y,r):
        self.r = r
        self.m = pi*r**2
        self.c = [rd(),rd(),rd()]
        self.x = x
        self.y = y
        self.lx = [x]
        self.ly = [y]
        self.vx = 0
        self.vy = 0
        self.ax = 0
        self.ay = 0
        self.fx = 0
        self.fy = 0
```

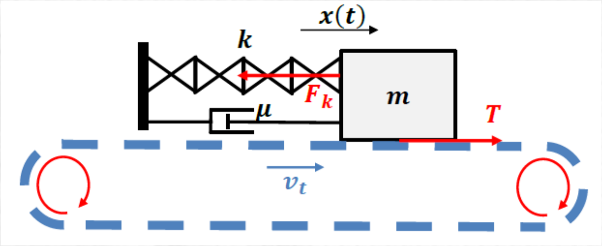
D’autres sujets

Balles 3D



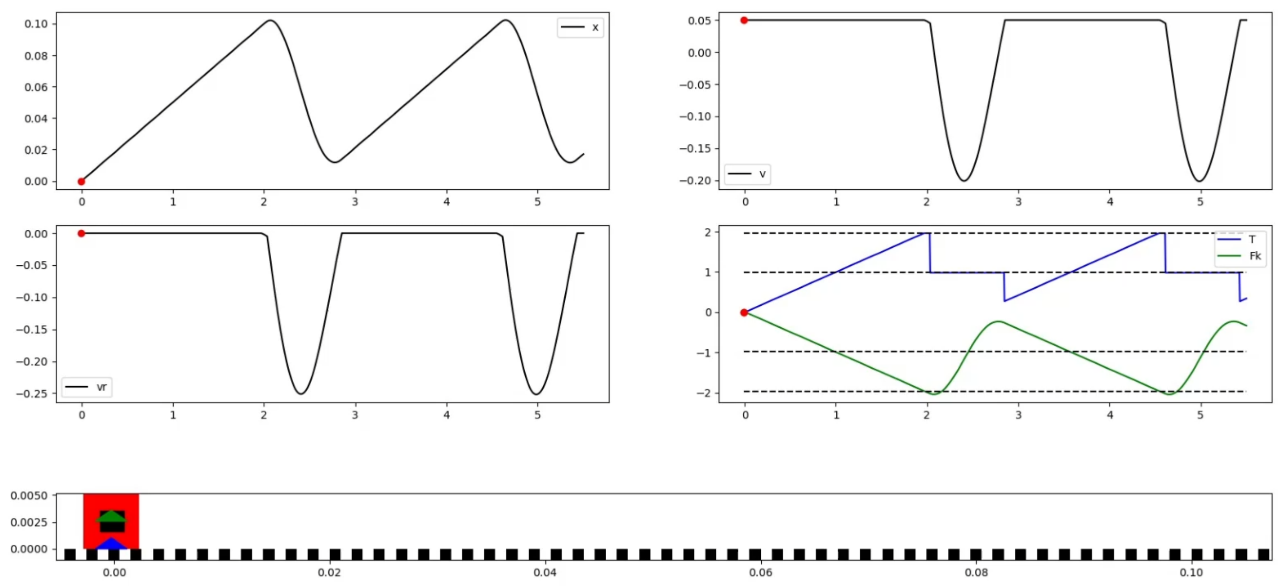






D'autres sujets

Stick Slip

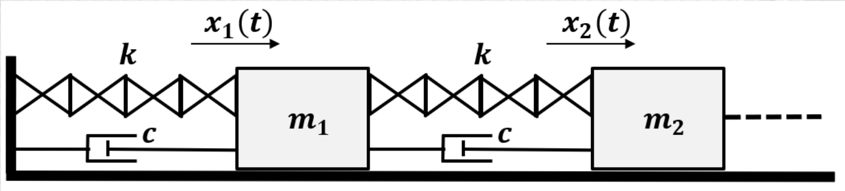


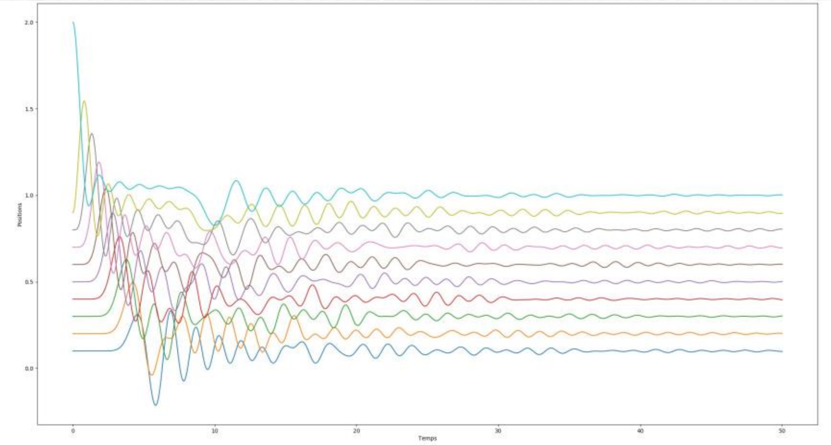
$$\frac{d^2z(t)}{dt^2} = \frac{F}{m} - \frac{\mu}{m}\frac{dz(t)}{dt} - \frac{k}{m}z(t)$$

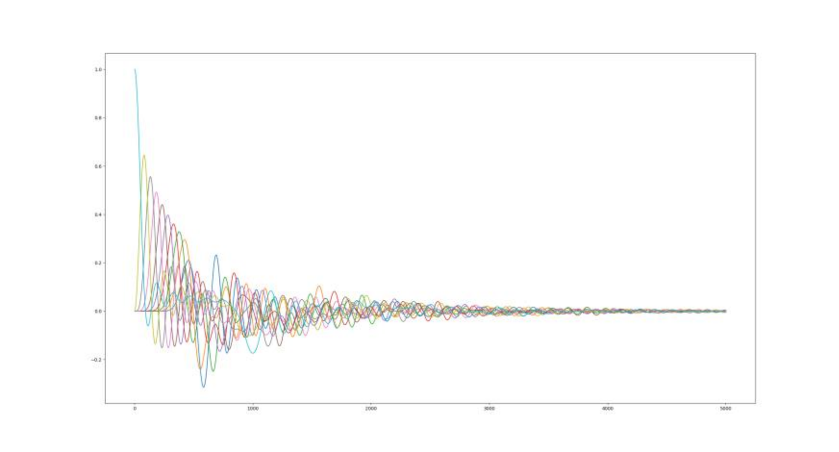
$$\begin{cases} \dfrac{d^2 x_1(t)}{dt^2} = \dfrac{F_1}{m_1} \\ \dfrac{d^2 x_2(t)}{dt^2} = \dfrac{F_2}{m_2} \\ \vdots \\ \dfrac{d^2 x_n(t)}{dt^2} = \dfrac{F_n}{m_n} \end{cases}$$

D’autres sujets

Système MRA



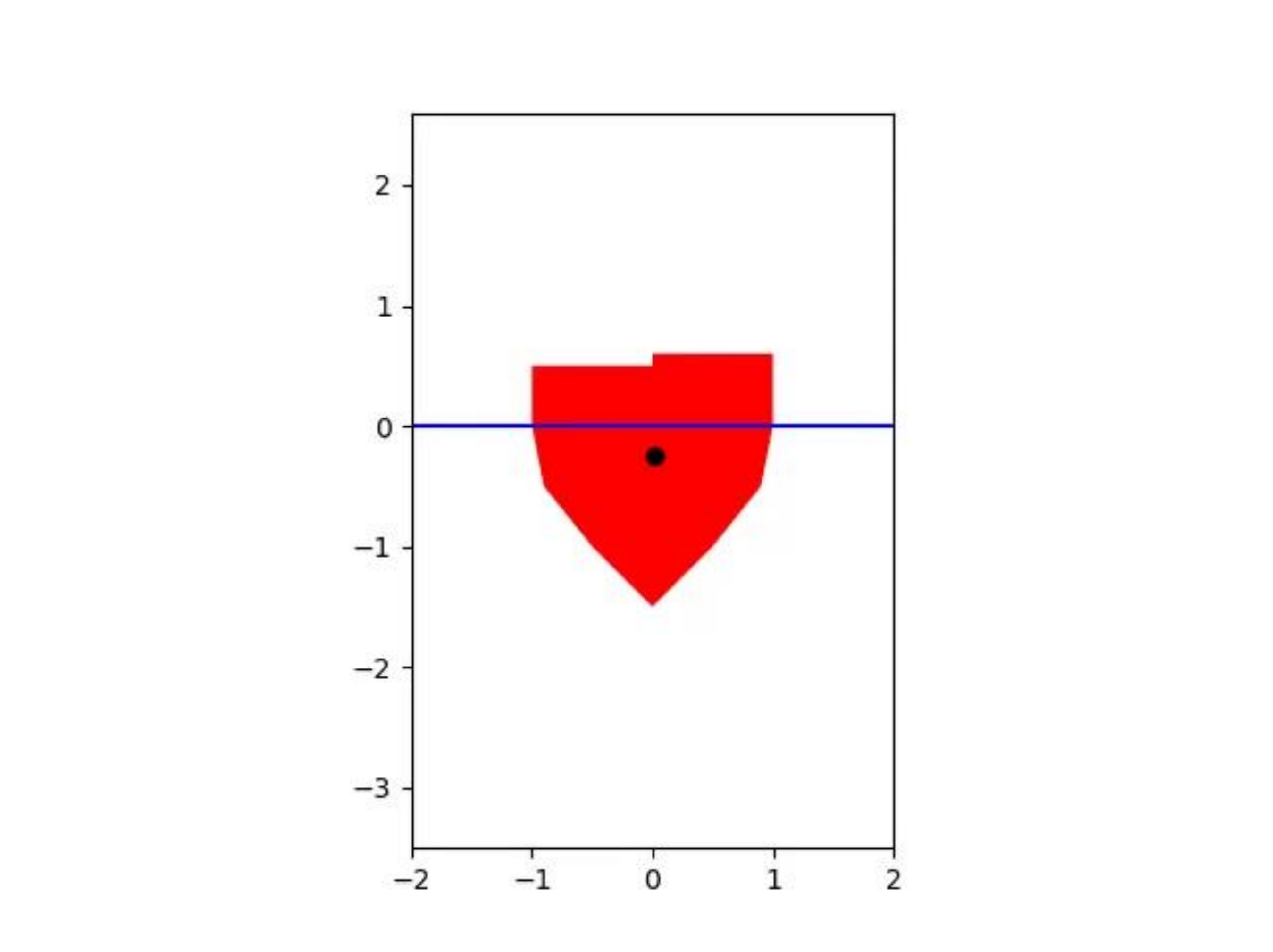


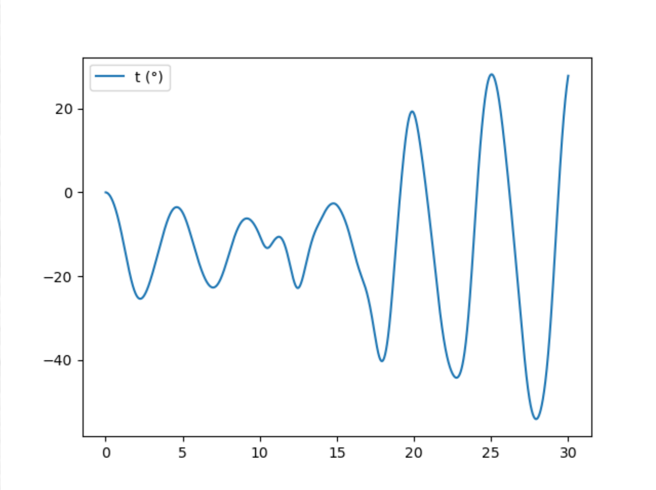


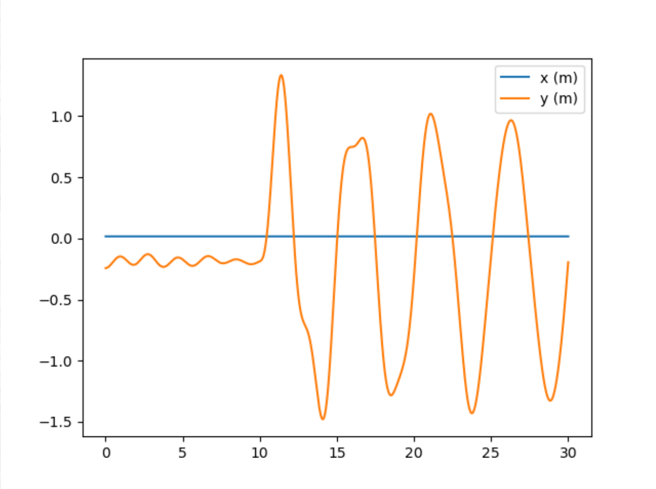
D’autres sujets

Poussée d’Archimède

$$\begin{cases} \dfrac{d^2x(t)}{dt^2} = \dfrac{F_x}{m} \\ \dfrac{d^2y(t)}{dt^2} = \dfrac{F_y}{m} \\ \dfrac{d^2\theta(t)}{dt^2} = \dfrac{M_G}{J} \end{cases}$$







Applications

$$v'(t) = \frac{k}{m} v^2(t) - g$$

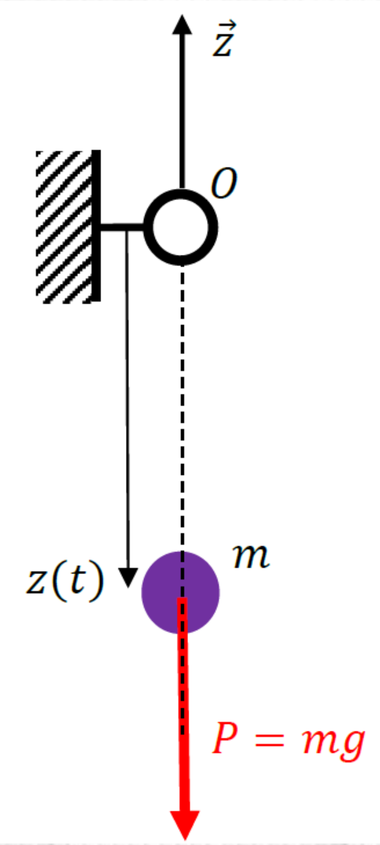
$$\ddot{\theta}(t) = \frac{-k\dot{\theta}(t) - Rmg\sin\theta(t)}{J}$$

$$\begin{cases} \dfrac{dH(t)}{dt} = aH(t) - bA(t)H(t) & (1) \\ \dfrac{dA(t)}{dt} = -cA(t) + dA(t)H(t) & (2) \end{cases} \quad ; \quad (a,b,c,d) \epsilon \mathbb{R}^4$$

$$\begin{cases} \dfrac{d^2x(t)}{dt^2} = -\dfrac{\beta}{m}\dfrac{dx(t)}{dt}\sqrt{\dfrac{dx(t)}{dt}^2 + \dfrac{dy(t)}{dt}^2} \\ \dfrac{d^2y(t)}{dt^2} = -g - \dfrac{\beta}{m}\dfrac{dy(t)}{dt}\sqrt{\dfrac{dx(t)}{dt}^2 + \dfrac{dy(t)}{dt}^2} \end{cases}$$

Une équation d’ordre 1

$$\boldsymbol{Y = v}$$
$$\boldsymbol{Y' = \dot{v}}$$



Chute libre

$$v'(t) = \frac{k}{m} v^2(t) - g$$

15 secondes

$m = 0{,}1 kg$; $g = 9{,}81 m.s^{-2}$; $k = 0{,}001\, N.m^{-1}.s^{-2}$; $v(0) = 0\, m.s^{-1}$

Plusieurs équations d'ordre 1

Proie-Prédateur

$$Y = \begin{pmatrix} H \\ A \end{pmatrix}$$

$$Y' = \begin{pmatrix} \dot{H} \\ \dot{A} \end{pmatrix}$$

$$\begin{cases} \dfrac{dH(t)}{dt} = aH(t) - bA(t)H(t) & (1) \\ \dfrac{dA(t)}{dt} = -cA(t) + dA(t)H(t) & (2) \end{cases} \quad ; \quad (a,b,c,d) \epsilon \mathbb{R}^4$$

30 jours

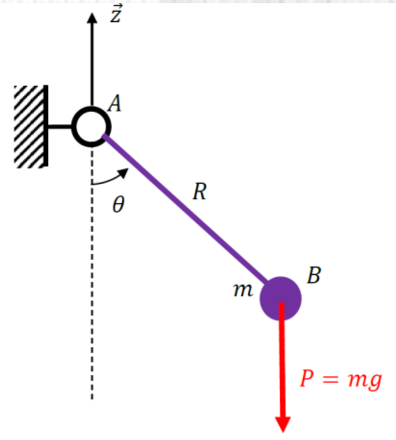
$$\begin{cases} a = 3/jour \\ b = 1/alien/jour \\ c = 1/jour \\ d = 2/humain/jour \end{cases} \quad ; \quad \begin{cases} H(0) = H_0 = 10 \\ A(0) = A_0 = 1 \end{cases}$$

Une équation d'ordre 2

Pendule

$$\boldsymbol{Y} = \begin{pmatrix} \boldsymbol{\theta} \\ \dot{\boldsymbol{\theta}} \end{pmatrix}$$

$$\boldsymbol{Y'} = \begin{pmatrix} \dot{\boldsymbol{\theta}} \\ \ddot{\boldsymbol{\theta}} \end{pmatrix}$$



$$\ddot{\theta}(t) = \frac{-k\dot{\theta}(t) - Rmg\sin\theta(t)}{J}$$

20 secondes

$m = 0{,}1kg$; $R = 0{,}1m$; $k = 0{,}001\ Nm.rd^{-1}.s$; $g = 9{,}81m.s^{-2}$

$\theta(0) = 45°$ – $\dot{\theta}(0) = 0$

Plusieurs équations d'ordre 2

$$Y = \begin{pmatrix} x \\ \dot{x} \\ y \\ \dot{y} \end{pmatrix}$$

$$Y' = \begin{pmatrix} \dot{x} \\ \ddot{x} \\ \dot{y} \\ \ddot{y} \end{pmatrix}$$

Balistique

$$\begin{cases} \dfrac{d^2x(t)}{dt^2} = -\dfrac{\beta}{m}\dfrac{dx(t)}{dt}\sqrt{\dfrac{dx(t)}{dt}^2 + \dfrac{dy(t)}{dt}^2} \\ \dfrac{d^2y(t)}{dt^2} = -g - \dfrac{\beta}{m}\dfrac{dy(t)}{dt}\sqrt{\dfrac{dx(t)}{dt}^2 + \dfrac{dy(t)}{dt}^2} \end{cases}$$

2 secondes

$$\begin{pmatrix} x_0 \\ y_0 \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \end{pmatrix} m \quad ; \quad \begin{pmatrix} V_{x0} \\ V_{y0} \end{pmatrix} = \begin{pmatrix} 10 \\ 10 \end{pmatrix} m.s^{-1} \qquad J = mR^2$$

$$T = 2\,s \quad ; \quad \beta = 1\,N.s^2.m^{-2} \quad ; \quad m = 1\,kg \quad ; \quad g = 9{,}81\,m.s^{-2}$$