

25/08/23 13:12

PME 3201

Aula 2

25.08.2023

Turma 22A

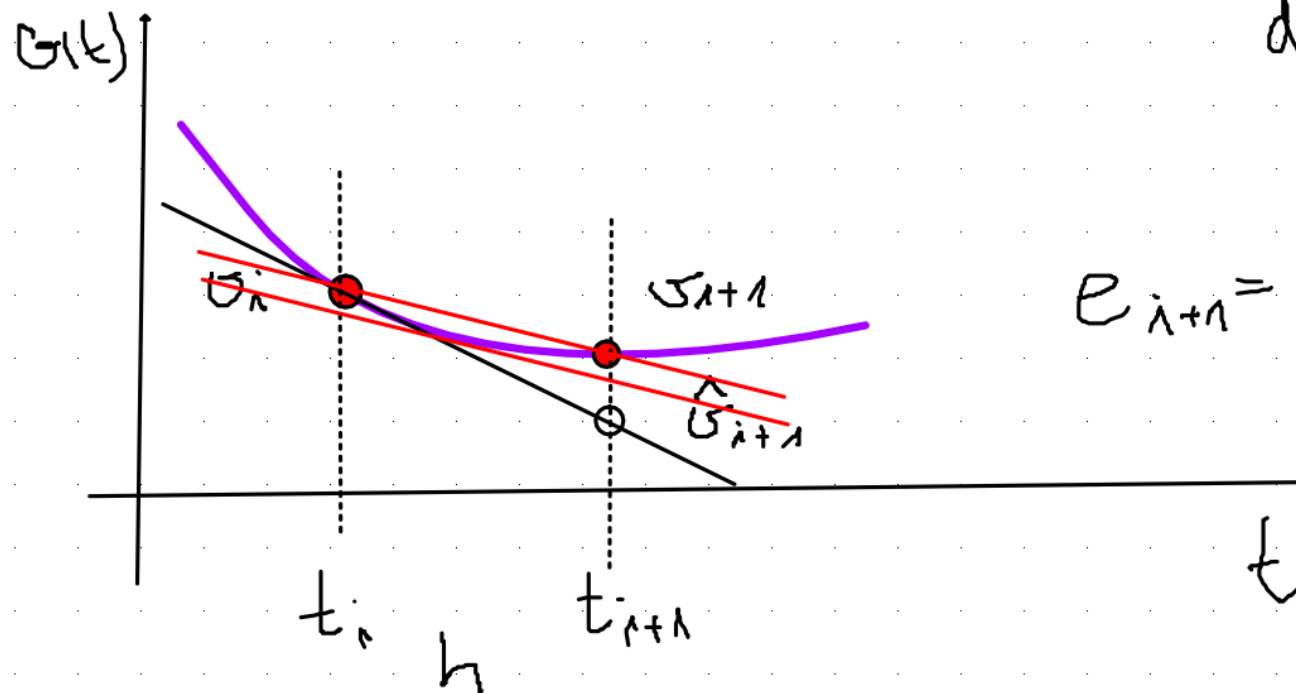
$$\sigma_{i+1} = \sigma_i + f \Delta t$$

$$f(\sigma, t) = \frac{d\sigma}{dt}$$

Euler: $f = f_i$

e.g.:

$$\frac{d\sigma}{dt} = -\frac{c}{m} \sigma$$

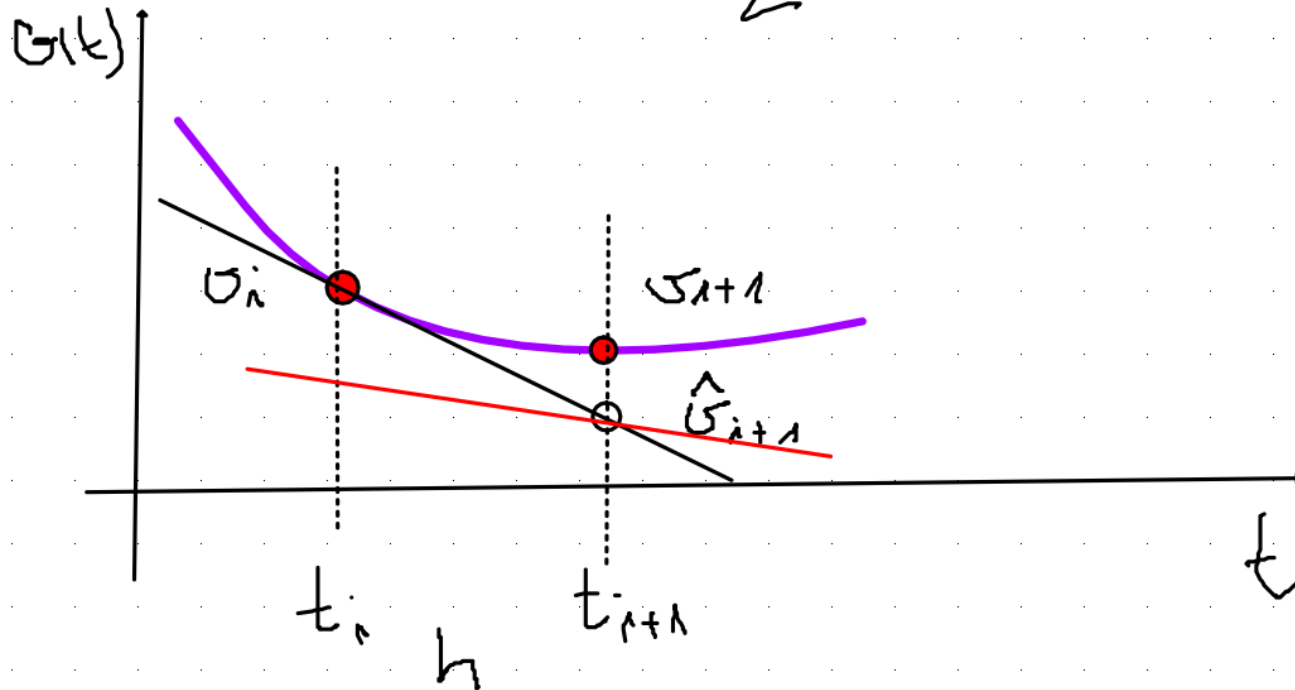


$$e_{i+1} = \hat{\sigma}_{i+1} - \sigma_{i+1}$$

Metodo de Heun:

$$U_{i+1} = U_i + f \Delta t$$

Euler: $f = \bar{f} = \frac{f_i + \hat{f}_{i+1}}{2}$



Método do Ponto Médio

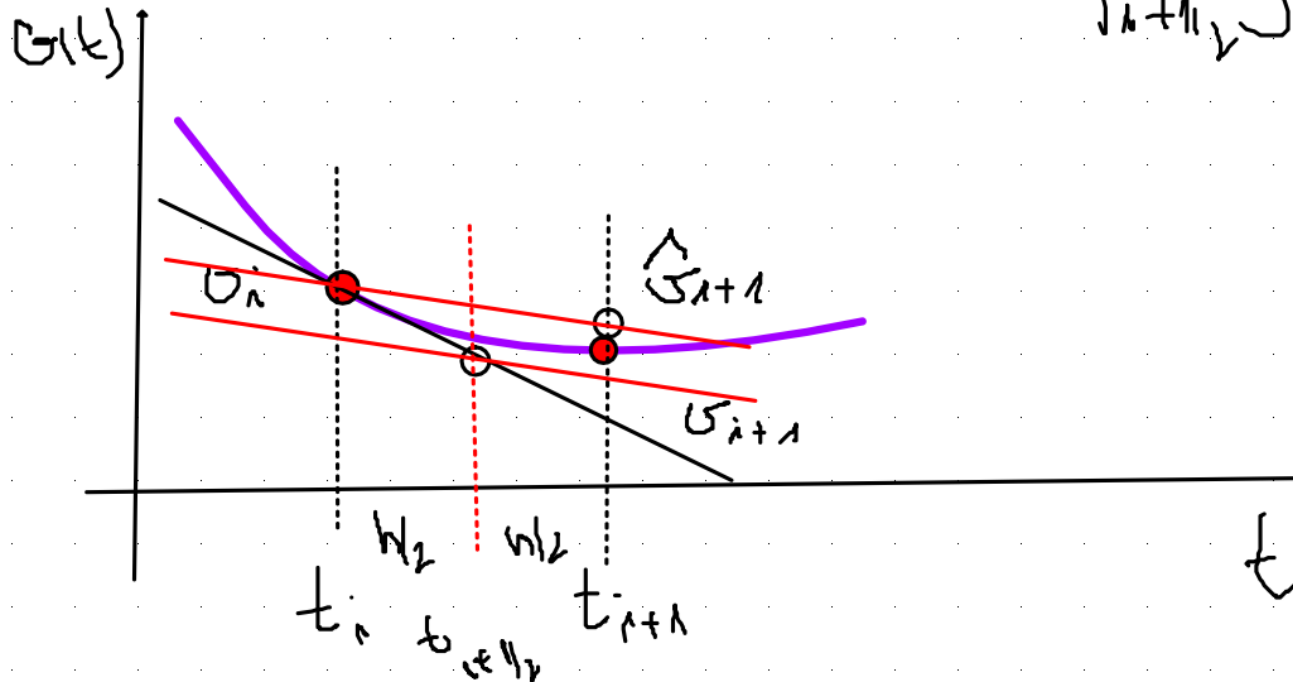
$$U_{i+1} = U_i + \bar{f} h$$

onde: $\bar{f} = f_{i+1/2}$

$$U_i \rightarrow f_i \rightarrow \hat{U}_{i+1/2}$$

$$\hat{U}_{i+1/2} \rightarrow f_{i+1/2}$$

$$\left. \begin{array}{l} U_i \\ \hat{U}_{i+1/2} \end{array} \right\} \Rightarrow \hat{U}_{i+1}$$



Metodo di Runge-Kutta 4° Ordine

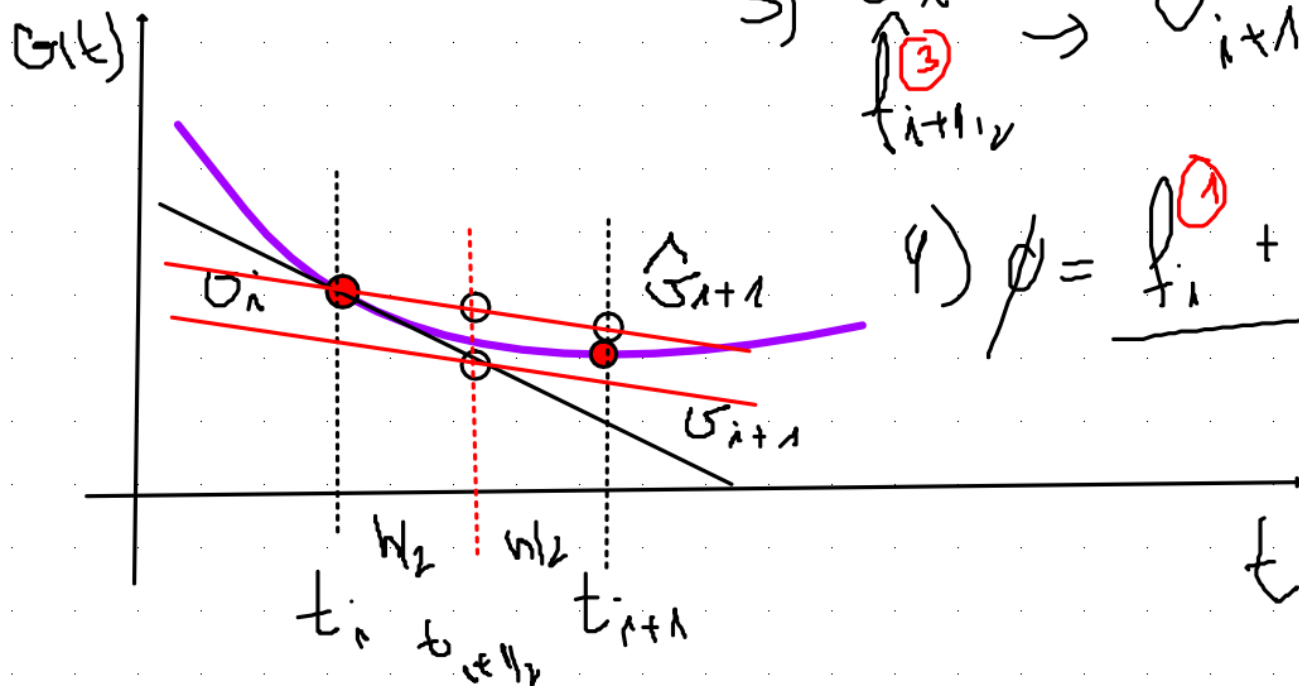
$$U_{i+1} = U_i + \phi h$$

$$1) U_i \xrightarrow{f_i^{(1)}} \hat{U}_{i+1/2}^a \xrightarrow{f_{i+1/2}^{(2)}}$$

$$2) U_i \xrightarrow{f_{i+1/2}^{(2)}} \hat{U}_{i+1/2} \xrightarrow{f_{i+1/2}^{(3)}}$$

$$3) U_i \xrightarrow{f_{i+1/2}^{(3)}} \hat{U}_{i+1} \xrightarrow{f_{i+1}^{(4)}}$$

$$4) \phi = \frac{f_i^{(1)} + 2f_{i+1/2}^{(2)} + 2f_{i+1/2}^{(3)} + f_{i+1}^{(4)}}{6}$$



$$\frac{d\sigma}{dt} = -\frac{\lambda}{\tau} \sigma = \phi \Rightarrow |\sigma_{i+1}| < |\sigma_i| \quad \tau = \frac{m}{c}$$

Enter Explícito:

$$\sigma_{i+1} = \sigma_i + \phi_i h \quad \phi_i = -\frac{\lambda}{\tau} \sigma_i$$

$$\sigma_{i+1} = \sigma_i - \frac{\lambda}{\tau} \sigma_i h$$

$$\sigma_{i+1} = \left(1 - \frac{h}{\tau}\right) \sigma_i$$

$$\frac{\sigma_{i+1}}{\sigma_i} = 1 - \frac{h}{\tau} \Rightarrow 1 - \frac{h}{\tau} = 1 \Rightarrow h = 2\tau$$

$$\therefore h \leq 2\tau$$

$$\frac{d\sigma}{dt} = -\frac{\lambda}{\tau} \sigma = \phi \Rightarrow |\sigma_{i+1}| < |\sigma_i| \quad \tau = \frac{m}{c}$$

Euler Implicit:

$$\sigma_{i+1} = \sigma_i + \phi_{i+1} h$$

$$\phi_{i+1} = -\frac{\lambda}{\tau} \sigma_{i+1}$$

$$\sigma_{i+1} = \sigma_i - \sigma_{i+1} \frac{h}{\tau}$$

$$\left(1 + \frac{h}{\tau}\right) \sigma_{i+1} = \sigma_i \Rightarrow \sigma_{i+1} = \frac{\sigma_i}{1 + \frac{h}{\tau}}$$

$$|\sigma_{i+1}| < |\sigma_i|$$

$$1 + \frac{h}{\tau} \geq 1$$