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Let's do some coding...

11. collocation integrator

Hands-on CasADi course on optimal control

Joris Gillis

Collocation method

- Initial value problem
  - Get to $x(t_0+\Delta t)$ from $x(t_0)$ $\dot{x}(t)=f(t,x)$
  - Assume $x(t)$ is approximated by polynomial $\Pi(t)$
  - Evaluate polynomial at $t_0+\Delta t$

Collocation method

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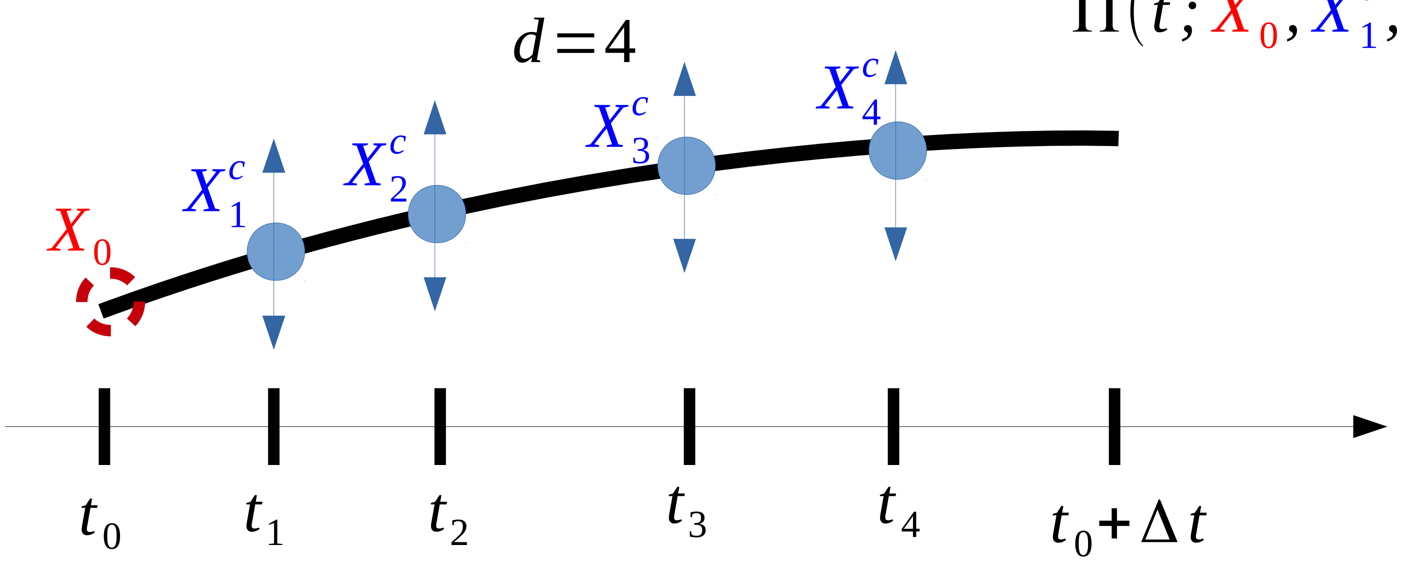
  - Get to $x(t_0+\Delta t)$ from $x(t_0)$ $\dot{x}(t)=f(t,x)$
  - Assume $x(t)$ is approximated by polynomial $\Pi(t;coefficients)$
  - Find the coefficients
  - Evaluate polynomial at $t_0+\Delta t$

Collocation method

- Initial value problem
  - Get to $x(t_0+\Delta t)$ from X_0 $\qquad \dot{x}(t)=f(t,x)$

$$\Pi(t; X_0, X_1^c, X_2^c, \ldots)$$



  - Find the coefficients

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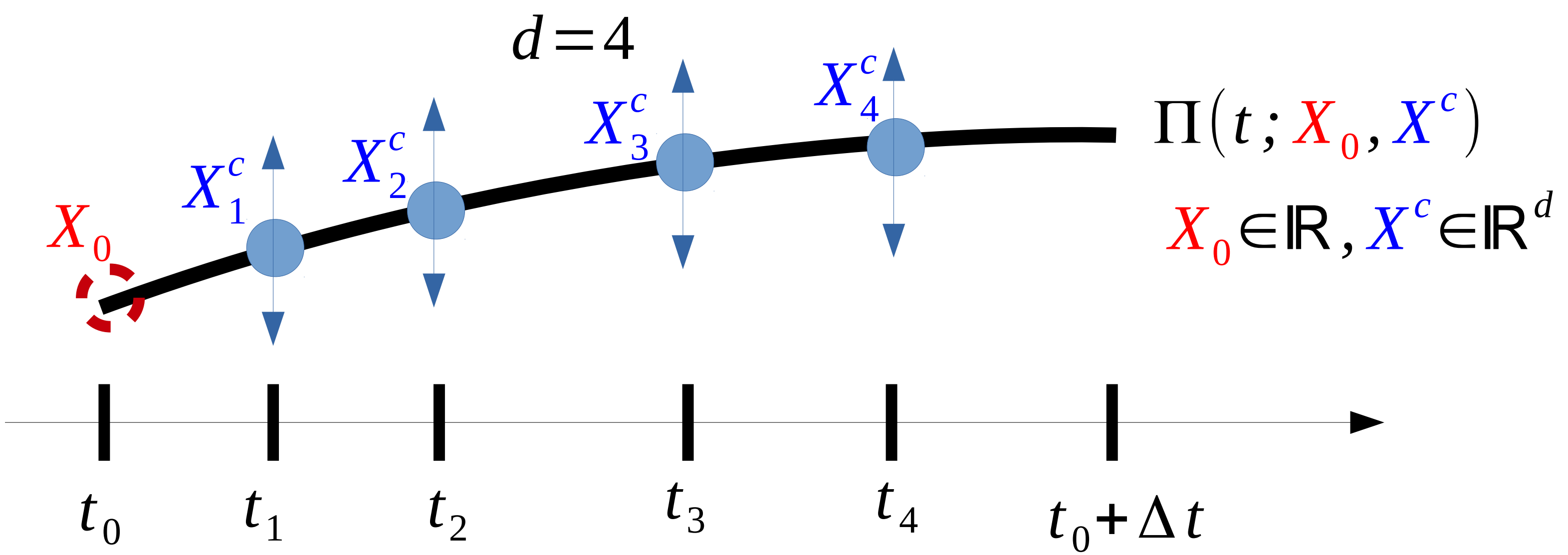

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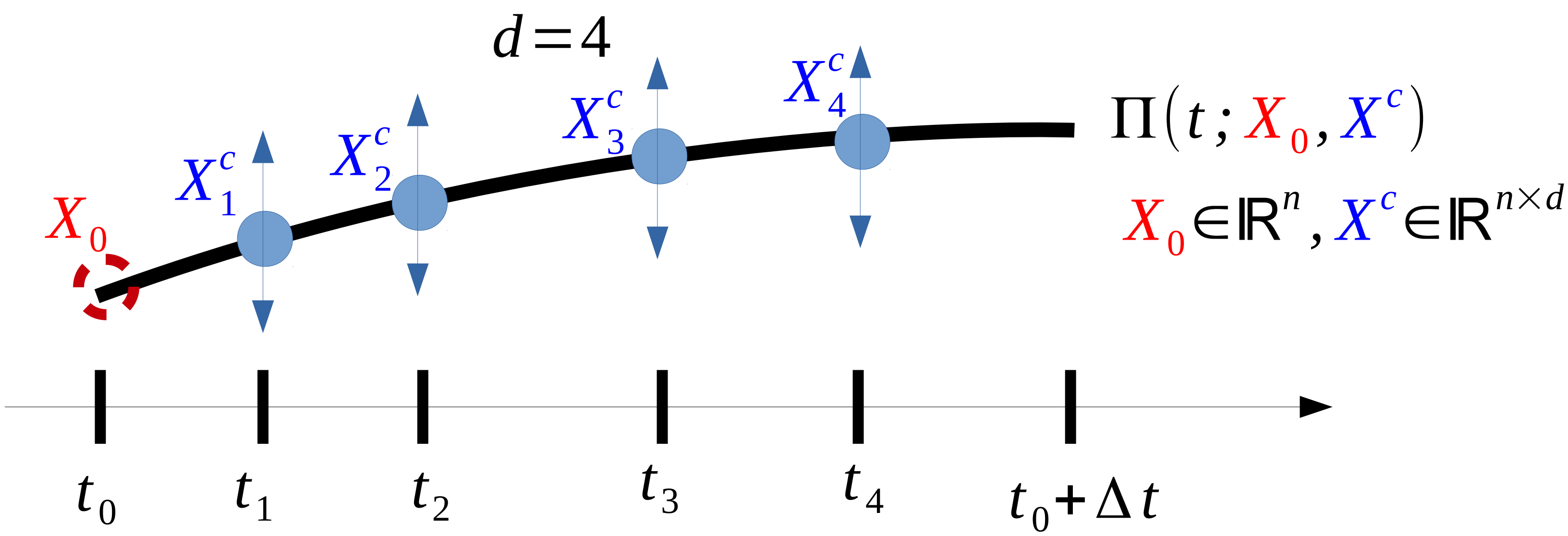

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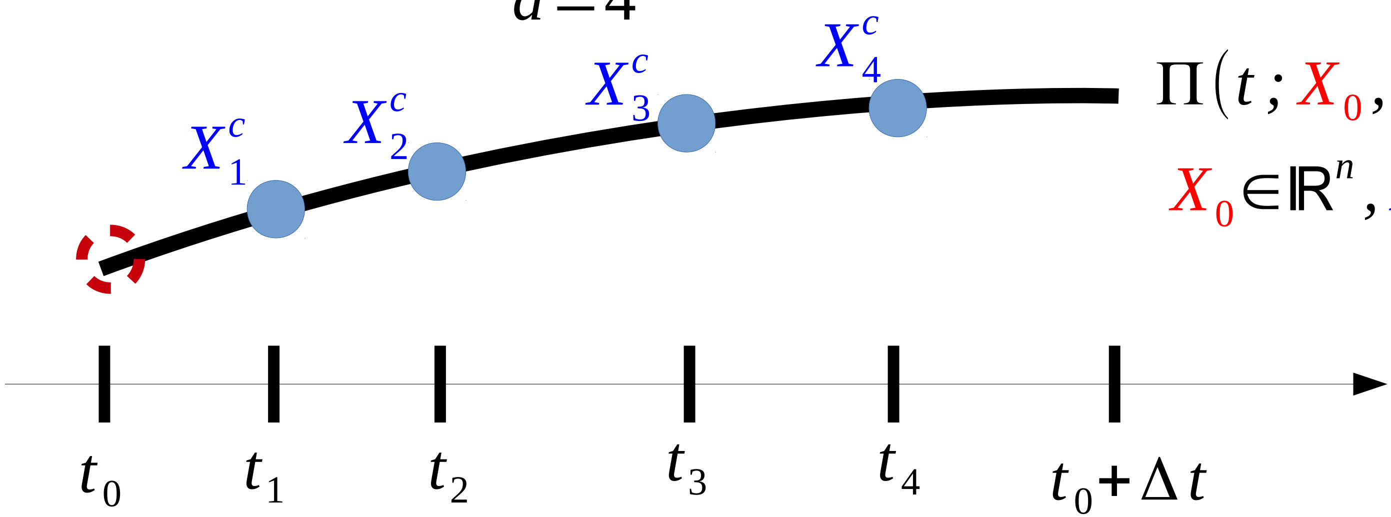
$d=4$



$\Pi(t;X_0,X^c)$

$X_0 \in \mathbb{R}^n, X^c \in \mathbb{R}^{n\times d}$

$$\dot{\Pi}(t_j;X_0,X^c)=f(t_j,X_j^c) \quad j=1,2,\ldots d$$

Rootfinding $\rightarrow X^c$

Collocation method

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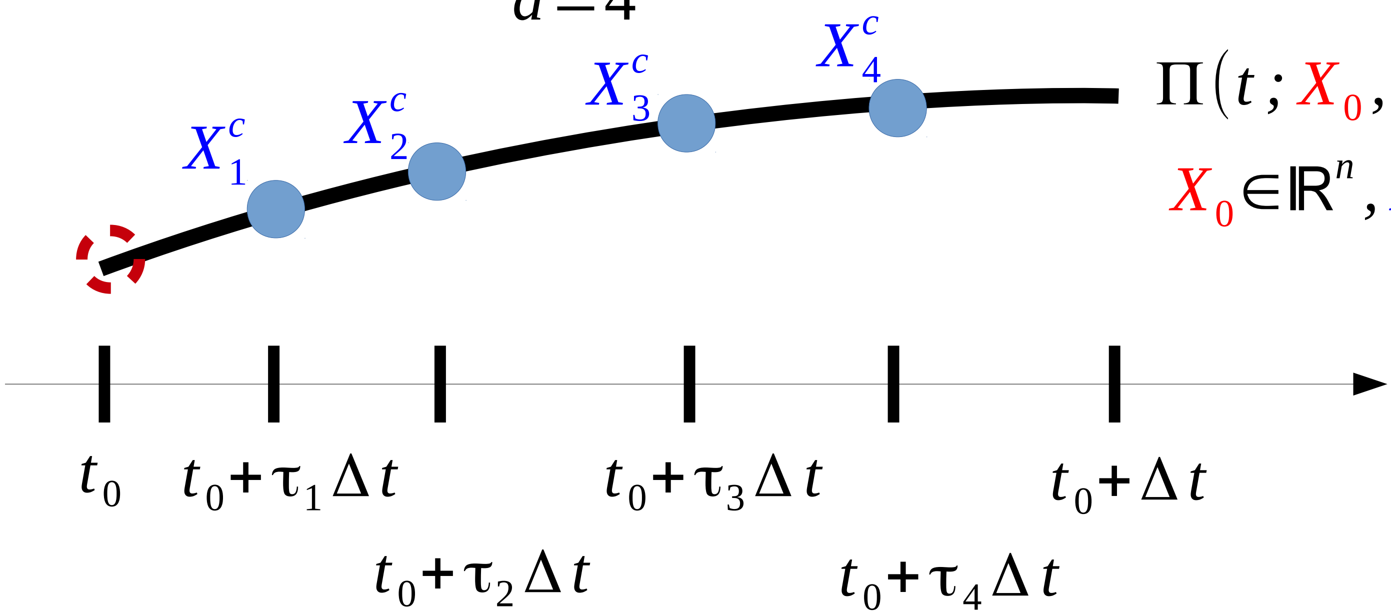
$d=4$



$\Pi(t;X_0,X^c)$

$X_0\in\mathbb{R}^n, X^c\in\mathbb{R}^{n\times d}$

$\tau\in\mathbb{R}$

$$\dot{\Pi}(t+\tau_j\Delta t;X_0,X^c)=f(t+\tau_j\Delta t,X_j^c)$$

Rootfinding $\rightarrow X^c$

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