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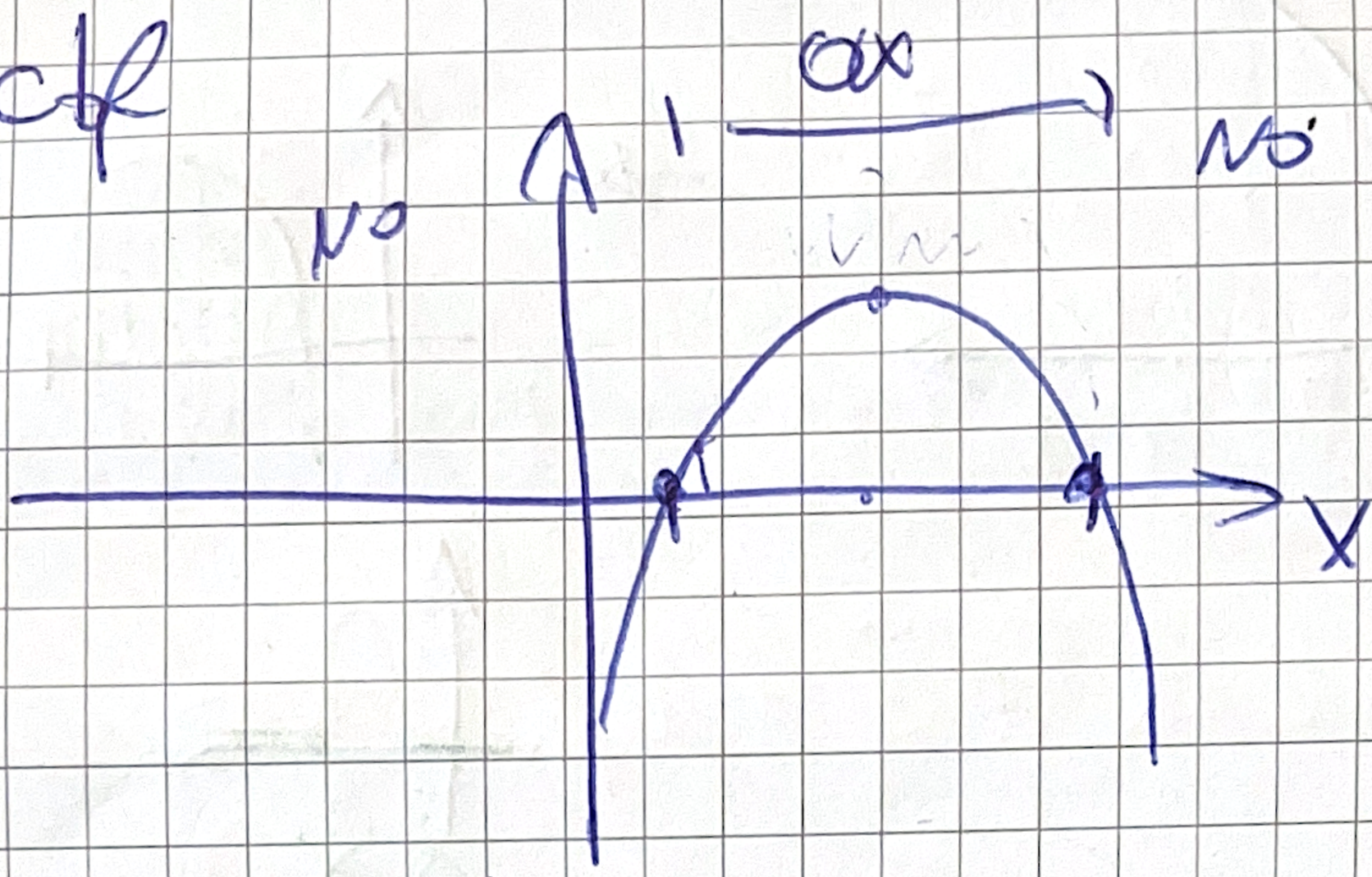

$\dot{h} > 0 \quad \dot{h} = -\gamma h$

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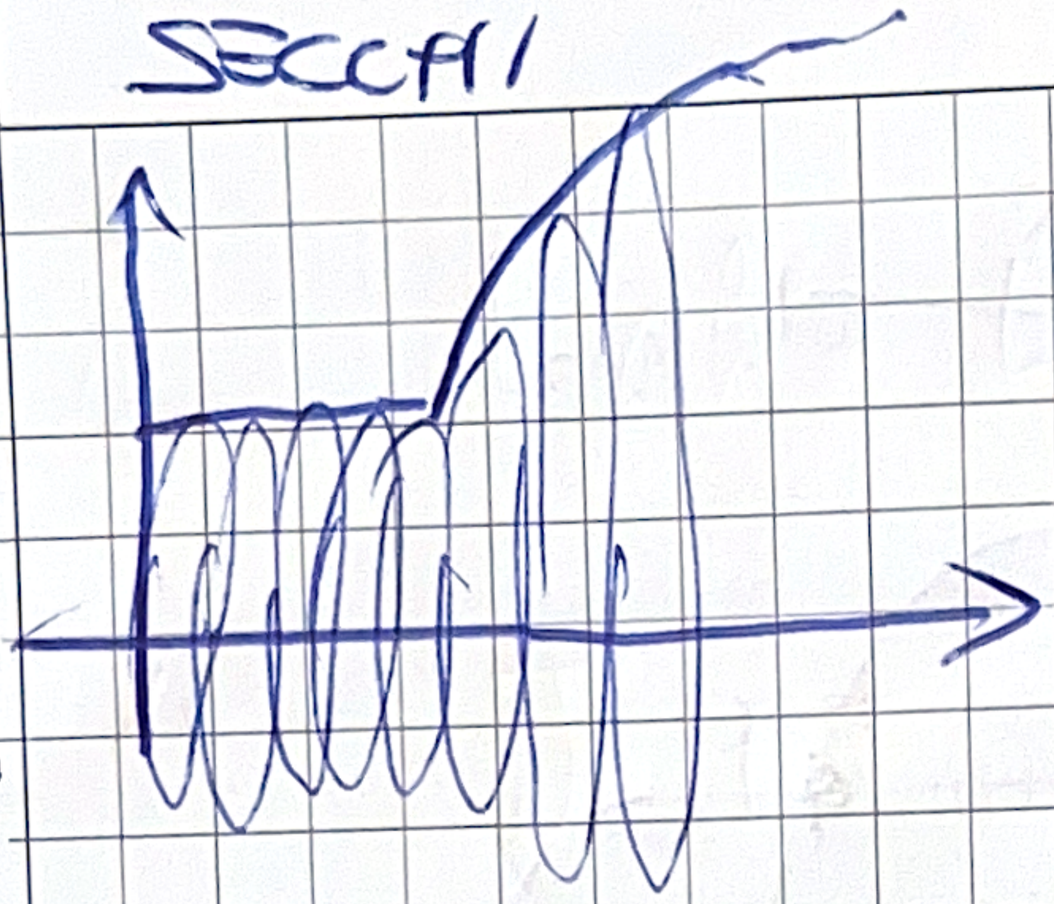
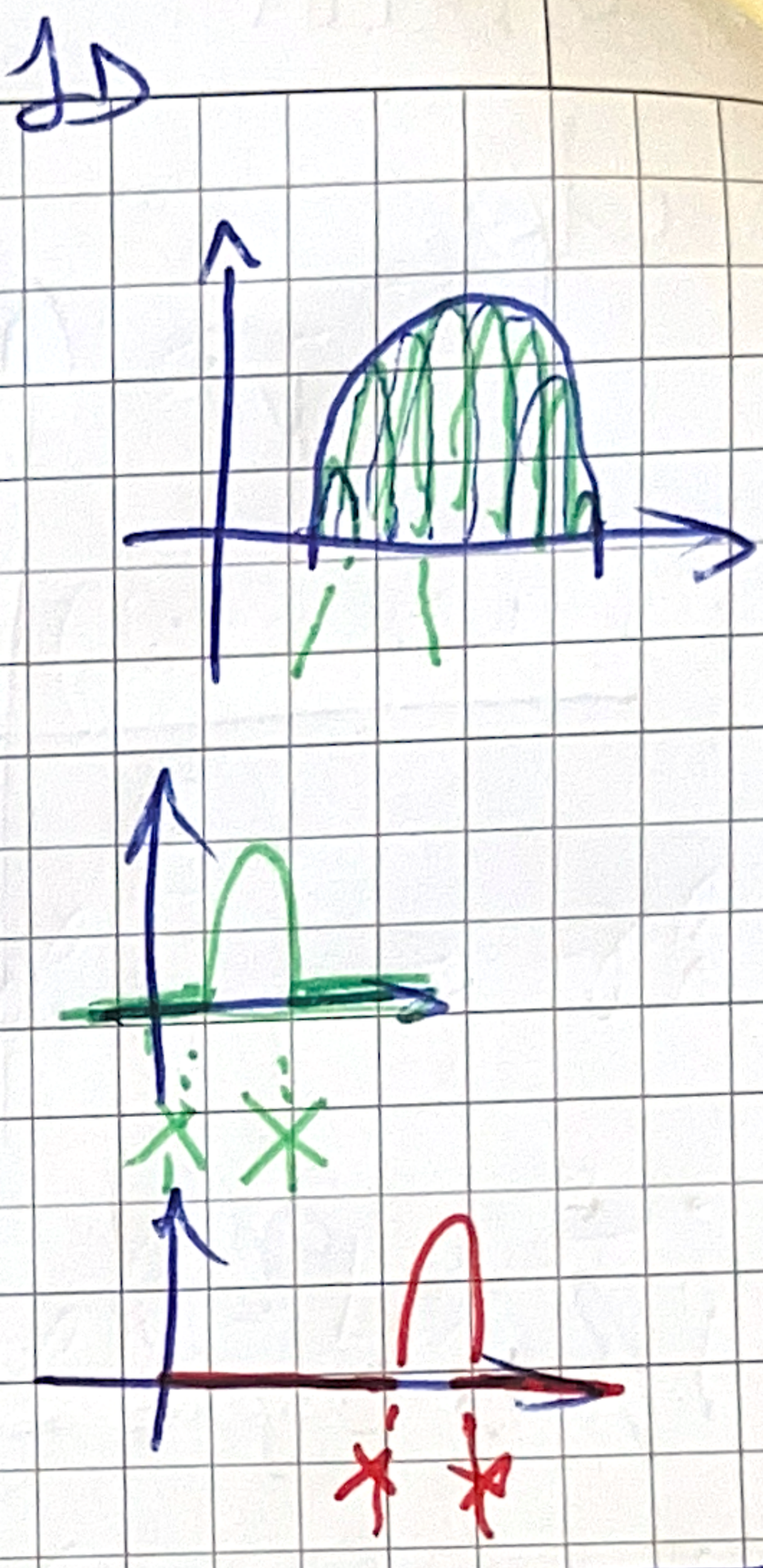
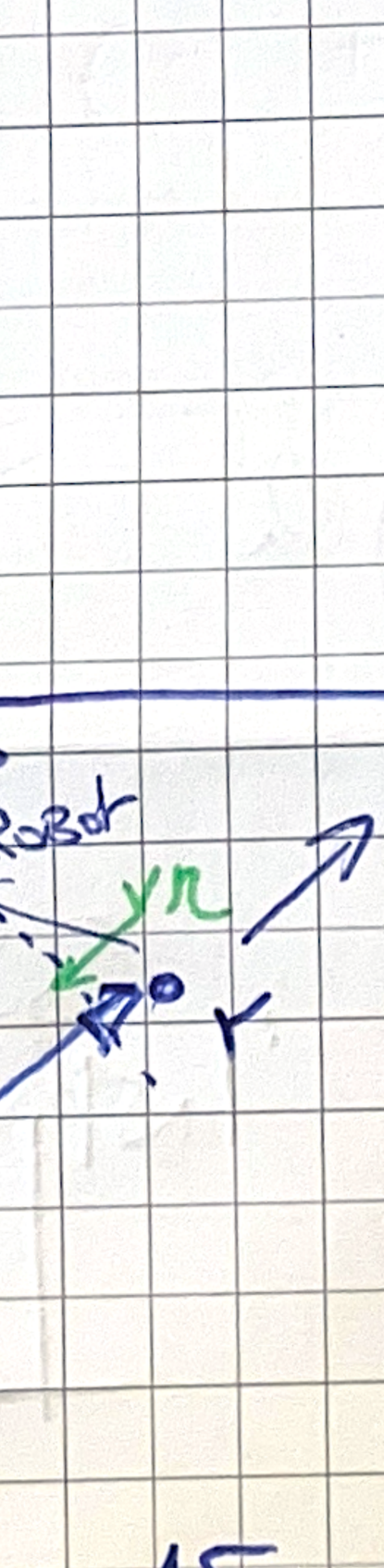
SECCIÓN







$$d = x_r - x_h$$

$$\dot{d} = v_r - v_h$$

$v_R < 0$ ACERCANDO

$v_R > 0$ ALEJANDO

$v_h < 0$ ALEJANDO

$v_R > 0$ ACERCANDO

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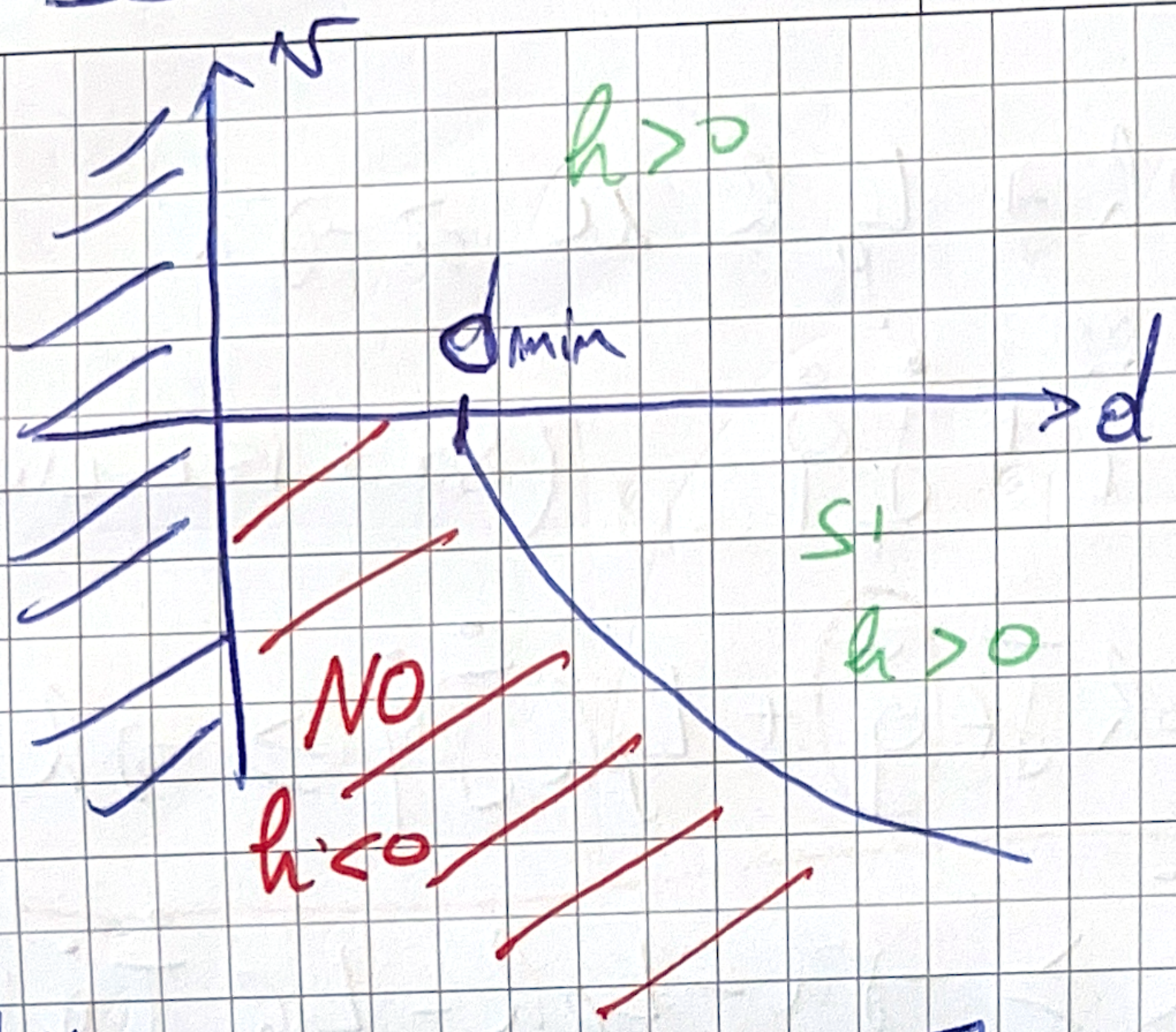
SSM



1-N1

$h(\chi)$

$\chi = \begin{bmatrix} d \\ N \end{bmatrix}$

accelerazione robot [3x1]

$\dot{N}$

[2x1]

$$\dot{\chi} = \begin{bmatrix} \dot{d} \\ \dot{N} \end{bmatrix} = \underset{[2\times1]}{f(\chi)} + \underset{[2\times3]}{g(\chi)}\,\vec{u}$$

$\dot{d} = N$

$\dot{N} = \ddot{s}$ accR − accR

$$\dot{h} = \frac{\partial h}{\partial \chi}\dot{\chi} = \underbrace{\frac{\partial h}{\partial \chi}}_{1\times2} f(\chi) + \underbrace{\frac{\partial h}{\partial \chi}}_{1\times2} g(\chi)\,u \geq -\gamma h$$

Lfh (1x2 · 2x1) Lgh (1x2 · 2x3 · 3x1)

1x1 2x1

prodotto di h 2x1 / 1x2

$N_{CART} = J\dot{q}$ $\quad \ddot{x}_{CART} = J\ddot{q} + \dot{J}\dot{q}$

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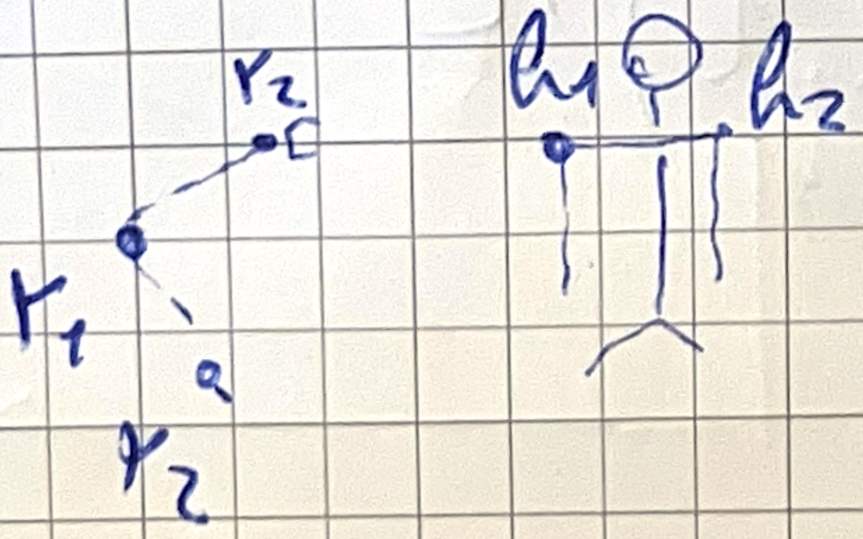
$$\begin{cases} \dot{h} = L_f h + L_g h\, u \geq -\gamma h \\ \underset{3\times 1}{u} = \underset{3\times m}{J^{\#}}\,\underset{m\times 1}{\dot{\nu}} + \dot{J}\dot{q} \end{cases} \quad \text{(SOLO VEL LINEAR}$$

$$L_f h + L_g h\, J^{\#}\ddot{q} + L_g h\,\dot{J}\dot{q} \geq -\gamma h$$

$$\boxed{L_g h\, J^{\#}\ddot{q} \geq -\gamma h - L_f h - L_g h\,\dot{J}\dot{q}}$$

$$A\ddot{q} \geq b \quad \longleftarrow \quad \forall \text{ coppia } r_i, h$$

$1\times m \qquad 1\times 1$



r_1, h_1

r_1, h_2

$$\begin{bmatrix} A_{11} \\ A_{12} \end{bmatrix} \ddot{q} \geq \begin{bmatrix} b_{11} \\ b_{12} \end{bmatrix}$$

Constraints matrix

Constraints vector

AGNELLI 3D

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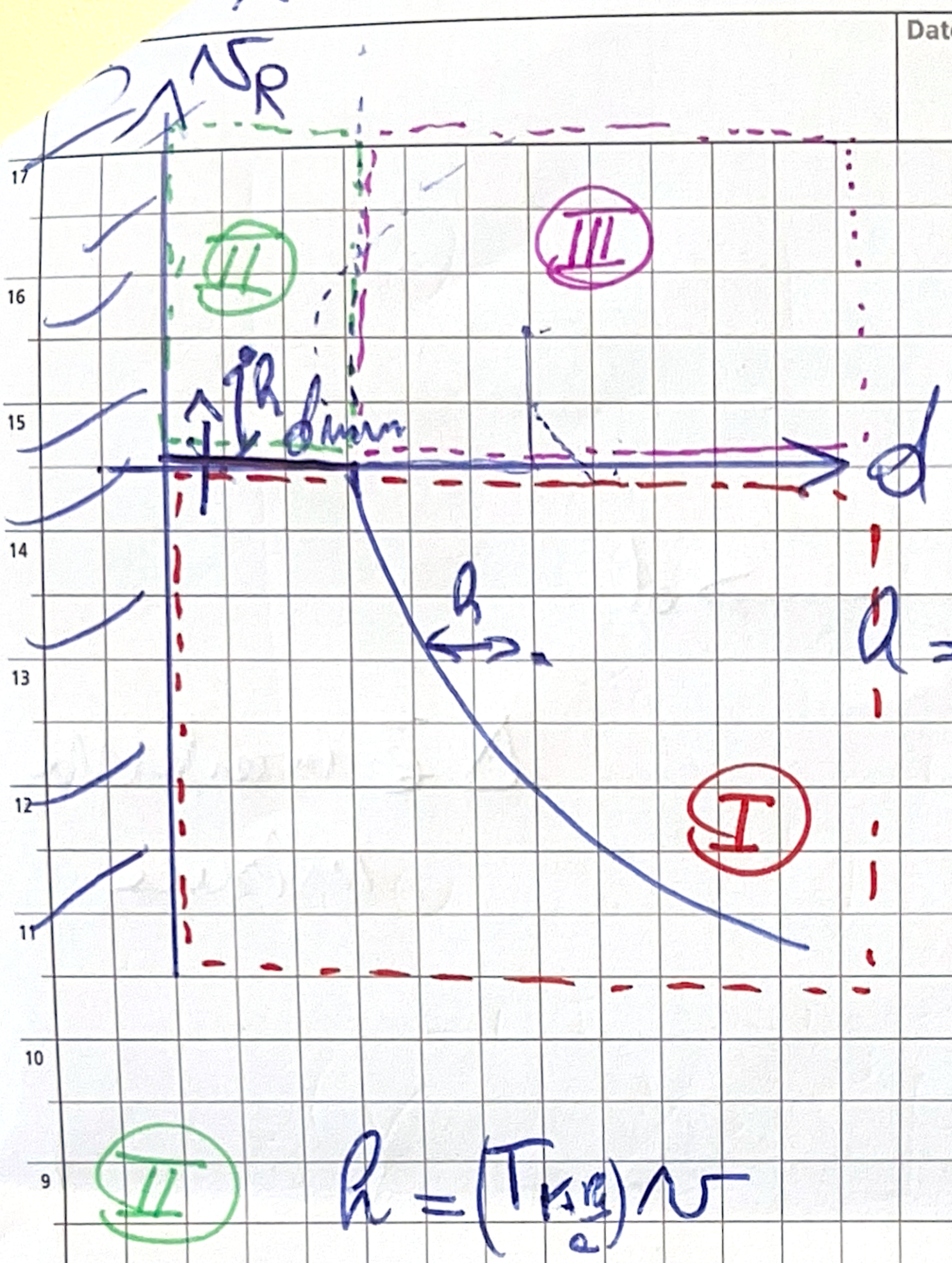

$$d = d - d_{min} \quad \text{I}$$

$$h = (T_{rif}) \cdot v$$

IPOTESI 1

$$h = \sqrt{(d - d_{min})^2 + (T_{rif} \cdot v)^2}$$

$h = \infty$ se $d = d_{min}$, $v = 0$

IPOTESI 2 (NORMA 1)

$$h = |d - d_{min}| + |(T_{rif} \cdot v)|$$

$$= d - d_{min} + T_{rif} \cdot v$$

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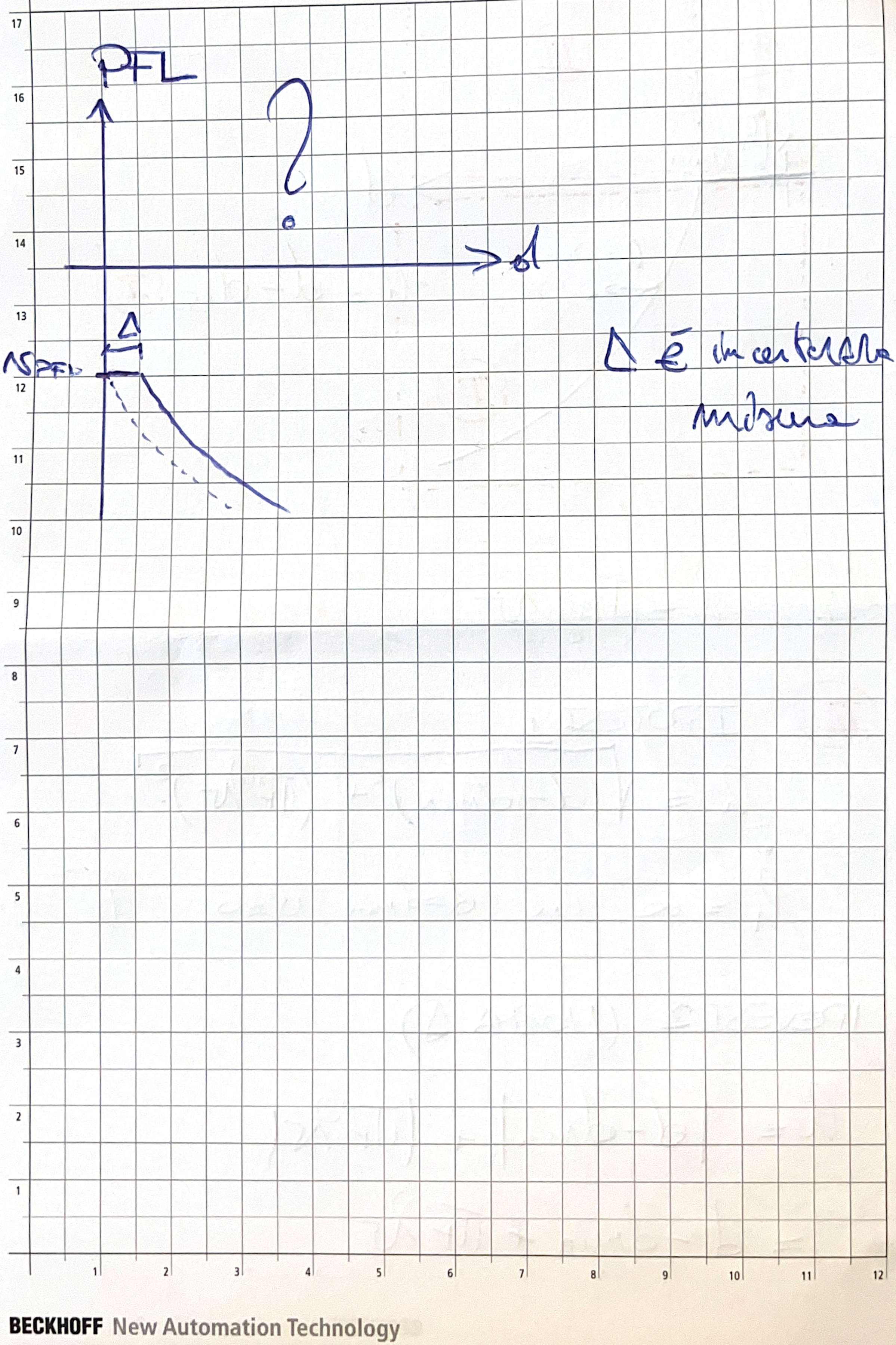

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$$\Sigma = U S V^T$$

$$S = \begin{bmatrix} \sigma_1 & & 0 \\ & \ddots & \\ 0 & & \sigma_m \end{bmatrix}$$

$$\Sigma^{-1} = (U S V^T)^{-1}$$

$$= (V^{-1})^T S^{-1} U^{-1}$$

Se $\sigma_m = 0$ ⇒

$$S = S + \lambda I$$

$$(S \neq \frac{S}{S^2 + \lambda I})$$

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(1) AGGIUNTA ① CONSTRAINTS $\varphi < \dot{\varphi} < \ddot{\varphi}$

② $\tau_{min} < \tau < \tau_{max}$

$$\tau = H\ddot{q} + ME(q,\dot{q})$$

(2) PFL ANALISI $h, \frac{\partial h}{\partial x}$

$q_0, \dot{q}_0$ passivel attuali

$$\dot{q}_{MIN} < \dot{q} < \dot{q}_{MAX}$$

$$\dot{q}_{NEXT} = \dot{q}_0 + \ddot{q}\,\Delta t$$

$$q_{MIN} < q < q_{MAX}$$

$$q_{NEXT} = q_0 + \dot{q}_0 \Delta t + \frac{1}{2}\ddot{q}\,\Delta t^2$$

$$q > q_{MIN} \Rightarrow \left(\frac{1}{2}\Delta t^2 I\right)\ddot{q} > q_{MIN} - q_0 - \dot{q}_0 \Delta t$$