

Calculus of variations

Euler-Lagrange equation

$$S(q) = \int_a^b L(t, q(t), q'(t)) dt$$

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· :

$$q : [a, b] \rightarrow \mathbb{R} \text{ and } q(a) = x_a, q(b) = x_b$$

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$$J(q) = \int_a^b F(t, q(t), q'(t)) dt$$

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$$\frac{dF}{d\epsilon} = \frac{\partial F}{\partial x} \frac{dx}{d\epsilon} + \frac{\partial F}{\partial g} \frac{dg}{d\epsilon} + \frac{\partial F}{\partial g'} \frac{dg'}{d\epsilon} = \eta(x) \frac{\partial F}{\partial g} + \eta'(x) \frac{\partial F}{\partial g'}.$$

$$\frac{dJ}{d\epsilon} = \int_a^b \left[\eta(x) \frac{\partial F}{\partial g} + \eta'(x) \frac{\partial F}{\partial g'} \right] dx.$$

$$\epsilon = 0 \quad g_\epsilon = f, \quad f \text{ 가 } J$$

$$J'(0) = 0,$$

$$J'(0) = \int_a^b \left[\eta(x) \frac{\partial F}{\partial f} + \eta'(x) \frac{\partial F}{\partial f'} \right] dx = 0.$$

$$0 = \int_a^b \left[\frac{\partial F}{\partial f} - \frac{d}{dx} \frac{\partial F}{\partial f'} \right] \eta(x) dx + \left[\eta(x) \frac{\partial F}{\partial f'} \right]_a^b.$$

$$\eta$$

$$0 = \int_a^b \left[\frac{\partial F}{\partial f} - \frac{d}{dx} \frac{\partial F}{\partial f'} \right] \eta(x) dx.$$

$$0 = \frac{\partial F}{\partial f} - \frac{d}{dx} \frac{\partial F}{\partial f'}.$$

가

$$2 \quad \left(a, y_a \right) \quad \left(b, y_b \right) \text{가}$$

$$\text{가} \quad L$$

$$L[f] = \int_a^b \sqrt{1 + f'(x)^2} dx$$

$$f(a) = y_a, f(b) = y_b$$

$$-$$

$$f$$

$$0 = -\frac{d}{dx} \frac{\partial f}{\partial f'} \sqrt{1 + f'(x)^2}$$

$$\begin{matrix} 0 & =& \frac{d}{dx} \frac{\partial}{\partial f'} \sqrt{1 + f'^2} \\ & =& \frac{d}{dx} \frac{f'}{\sqrt{1 + f'^2}} \end{matrix}$$

0

,

$$\frac{f'}{\sqrt{1 + f'^2}} = k$$

가 , f'

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$$f' = C$$

가

$$f = Cx + D$$

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