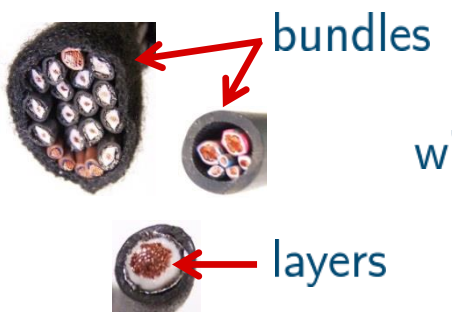
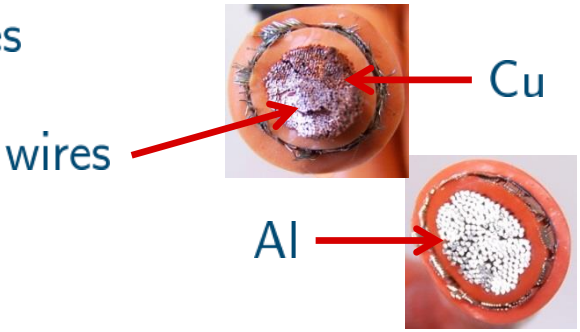
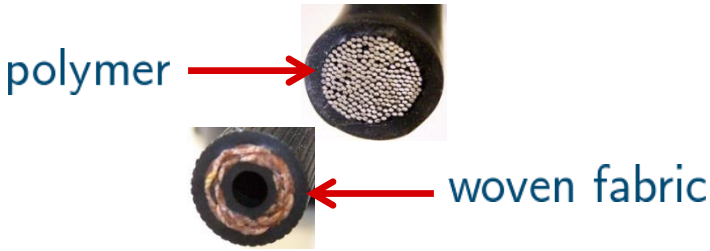
# Modeling of Cables and Hoses

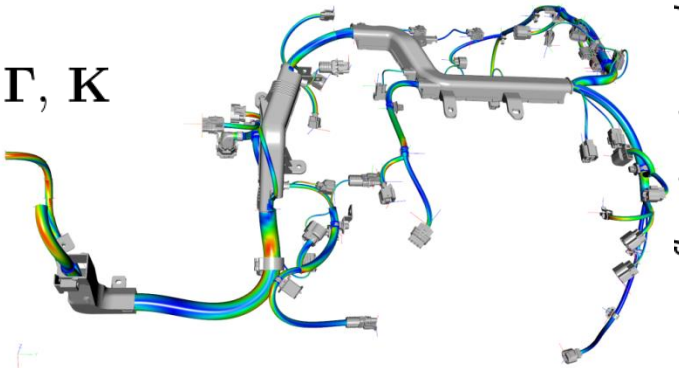
- Cables have a complex multi-component structure
  - Various materials ⇒ Different material behavior (elastic, viscous, plastic)
  - Geometrical structure ⇒ Friction, delamination, restrictions on deformation




- Cables are slender and flexible ⇒ described by Cosserat rod model
  - Geometrically exact kinematics
    Configuration variables ⇔ Strain measures $\boldsymbol{\Gamma}$, $\mathbf{K}$
  - Balance equations
    Equilibrium of sectional quantities $\mathbf{F}$, $\mathbf{M}$
  - Constitutive equations
    Strain measures ⇔ Sectional quantities



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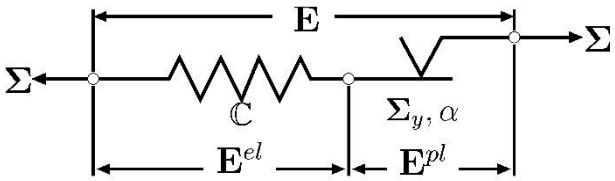
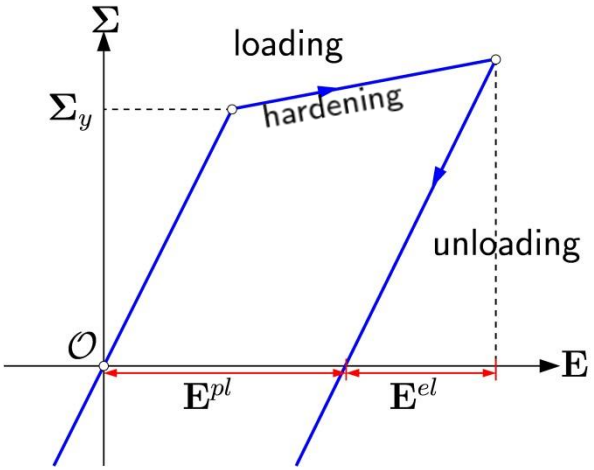
# Experimental Characterization of Plastic Cables

## • Theory



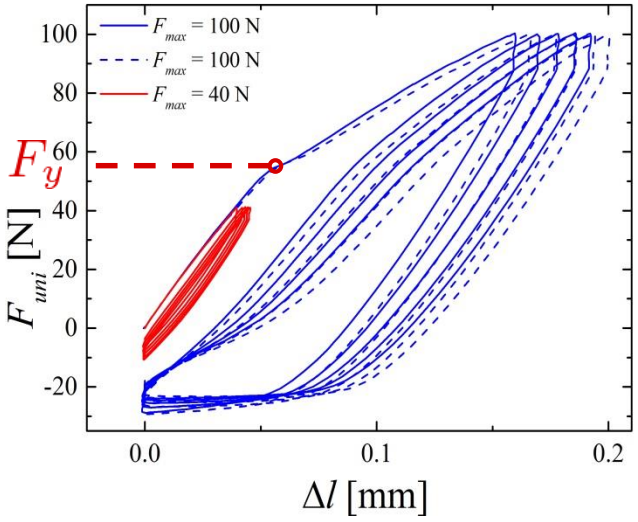

Split of strain measures

$$\mathbf{E} = \mathbf{E}^{el} + \mathbf{E}^{pl}$$

## • Cyclic Experiments

uniaxial tension
torsion
three-point bending
pure bending

Example: uniaxial tension of coaxial cable




## • Modeling

$$\mathbf{F} = \mathbb{C}^{\mathbf{F}} \left( \mathbf{\Gamma} - \mathbf{\Gamma}^{pl} \right)$$

$$\mathbf{M} = \mathbb{C}^{\mathbf{M}} \left( \mathbf{K} - \mathbf{K}^{pl} \right)$$

Yield surfaces in space of sectional forces, e.g.: