



2021 INTERNATIONAL WORKSHOP ON  
EMBODIED INTELLIGENCE



Break-out session1: Beyond Soft Robotics, 25 March, 5pm- GMT

# Rod Integration and Embodied Intelligence

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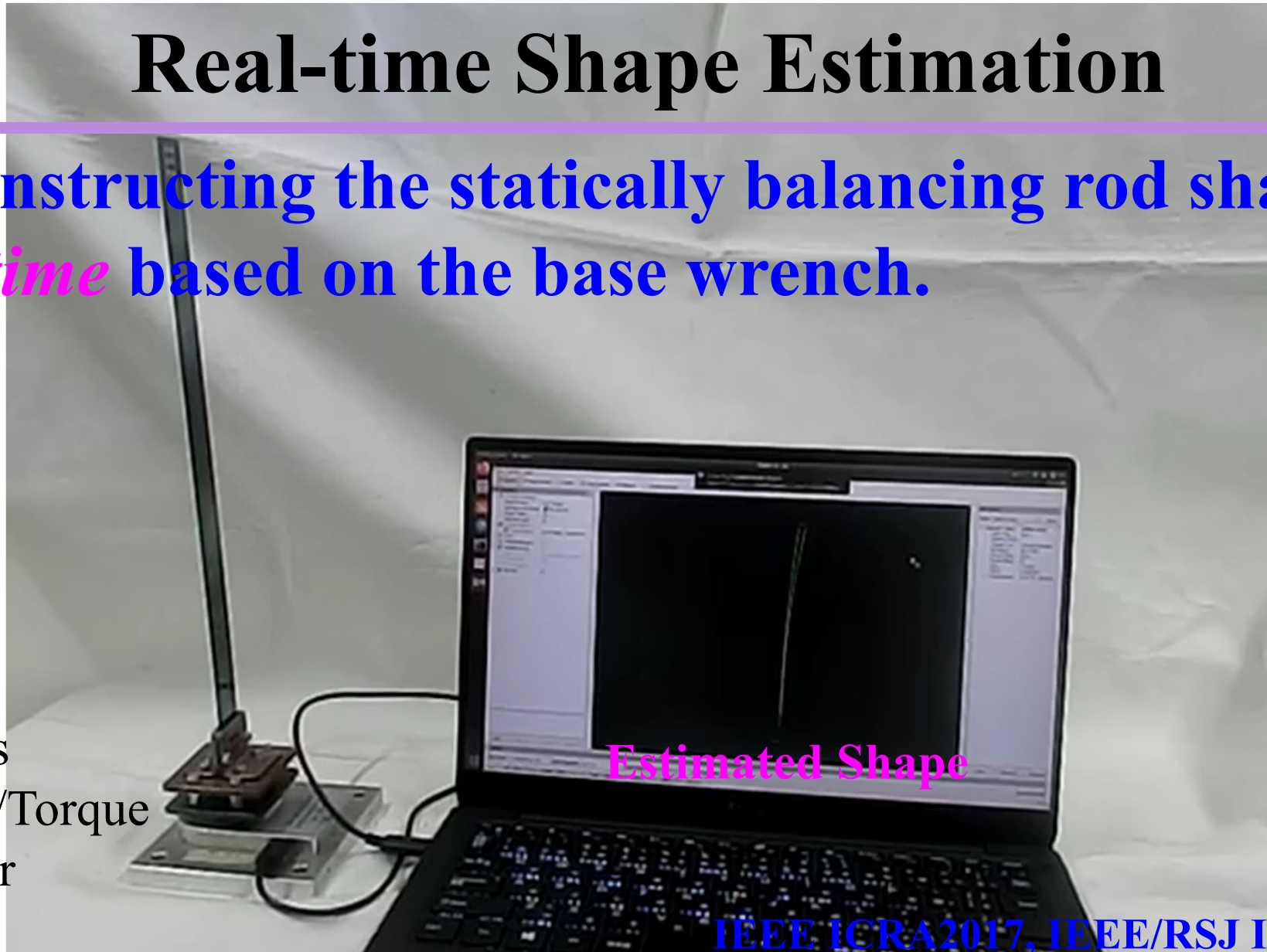
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# Real-time Shape Estimation

Reconstructing the statically balancing rod shape *in real time* based on the base wrench.

6-axes  
Force/Torque  
Sensor



# Rod Integration from EI Viewpoint

## 1. Intelligence <--- Optimization under environmental constraints

$$s^* = \underset{s \in [0, L] \times SE(3)}{\text{arg min}} P(s) \quad \begin{array}{l} \text{Elastic energy} \\ \text{stored in the rod body} \end{array}$$

Computed shape      Possible shape

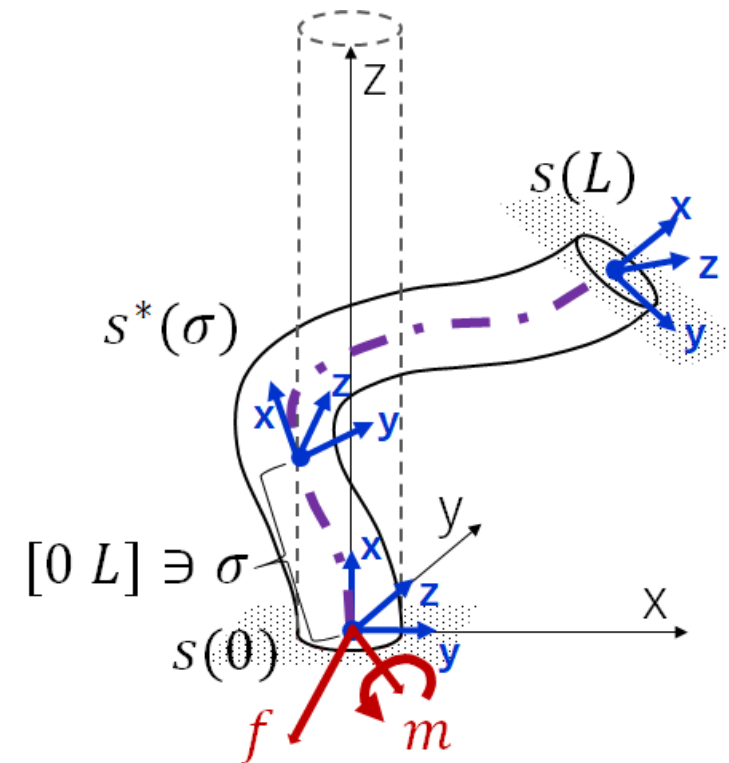
$$\text{with } \{s(0), s(L)\} = \{s_0, s_L\}$$

Rod boundary conditions

## 2. Role of “Body”

$$s^* = \phi \left( \begin{bmatrix} f \\ m \end{bmatrix} \right) \dots \text{Base wrench} \in \mathbb{R}^6 \quad \begin{array}{l} \text{Measurable} \\ \text{through the body!} \end{array}$$

Rod Integration  
(Bijective)

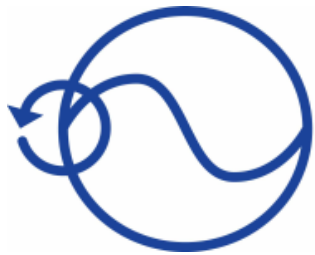


## 3. Challenges: Extend this viewpoint to more general contexts in terms of structure, dynamics, mechanism design and control.

# Thank you!

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新学術領域「ソフトロボット学」

Science of Soft Robot

