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NPTEL

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Courses » Compliant Mechanisms : Principles and Design

Announcements Course Ask a Question Progress

Unit 6 - Week 4: Analysis and synthesis using pseudo rigid-body models



Course outline

How to access the home page?

Assignment 0

Week 1:
Overview of compliant mechanisms; mobility analysis.

Week 2:
Modeling of flexures and finite element analysis

Week 3: Large-displacement analysis of a cantilever beam and pseudo rigid-body modeling

Week 4: Analysis and synthesis using pseudo rigid-body models

- Lec 19: Modeling a partially compliant mechanism
- Lec 20: Kinematic coefficients of a four-bar linkage with and without springs
- Lec 21: Solving equations of PRB modeling and comparing with finite

Assignment Week 4

The due date for submitting this assignment has passed. **Due on 2018-02-21, 23:59 IST.** As per our records you have not submitted this assignment.

1) Which of the following is not possible using pseudo rigid-body model approach? **1 point**

- Function generation
- Path generation.
- Feasibility map generation.
- Motion generation.

No, the answer is incorrect.

Score: 0

Accepted Answers:

Feasibility map generation.

2) Assertion: Torsion spring(s) and a rigid body can replace a compliant segment. Reasoning: The locus of the moving tip of a cantilever beam can be approximated to a circular arc. **1 point**

- Assertion is correct but not the reasoning.
- Assertion is incorrect but the reasoning is correct.
- Assertion and reasoning are both correct.
- Neither the assertion nor the reasoning is correct.

No, the answer is incorrect.

Score: 0

Accepted Answers:

Assertion and reasoning are both correct.

3) Which of the following are not used for solving compliant mechanism synthesis problem using the PRBM approach? **1 point**

- Replacement of compliant segments with torsion spring(s) and a rigid bodies.
- Optimization
- Minimum potential energy principle.
- Burmester theory.

No, the answer is incorrect.

Score: 0

Accepted Answers:

Optimization

4) Find the torsional spring constant in the PRBM of beam with small length flexure shown in the figure ($E = 2.1$ GPa, *length of flexure* = 5 mm, *in-plane thickness of flexure* = 0.5 mm, *width* = 1 cm). **1 point**

element analysis

- Lec 22: Loop-closure equations for PRB models of compliant mechanisms
- Lec 23: Burmester theory for compliant mechanisms
- Lec 24: PRB-based Synthesis Examples
- Quiz : Assignment Week 4
- Solutions

Week 5: Structural optimization approach to "design for deflection" of compliant mechanisms

Week 6: Designing compliant mechanisms using continuum topology optimization; distributed compliance

Week 7: Spring-lever (SL) and spring-mass-lever (SML) models for compliant mechanisms, and selection maps

Week 8: Non-dimensional analysis of compliant mechanisms and kinetoelastic maps

Week 9: Instant centre and building-block methods for designing compliant mechanisms

Week 10: Bistable compliant



- 0.0438 Nm/rad
- 0.0512 Nm/rad
- 0.8028 Nm/rad
- 0.0842 Nm/rad

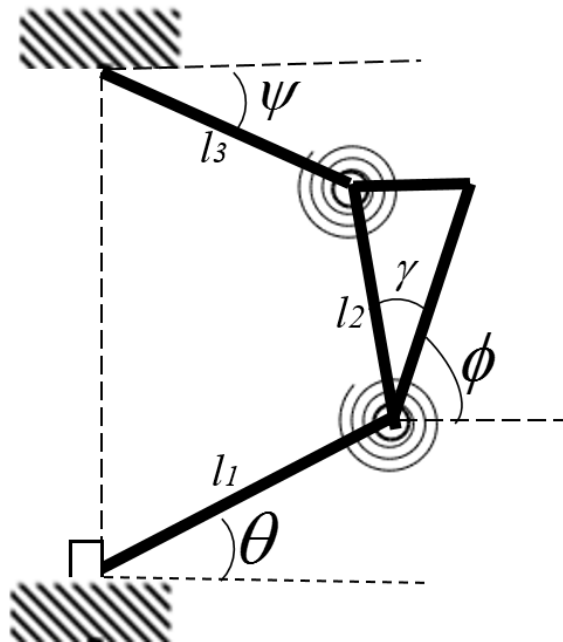
No, the answer is incorrect.

Score: 0

Accepted Answers:

0.0438 Nm/rad

5) Which of the following is the correct loop-closure equation for the PRBM model of a compliant mechanism?



- $l_1 \cos(\theta) - l_2 \cos(\phi) - l_3 \cos(\psi) = 0$
- $l_1 \cos(\theta) + l_2 \cos(\phi + \gamma) - l_3 \cos(\psi) = 0$
- $l_1 \sin(\theta) + l_2 \sin(\phi) + l_3 \sin(\psi) = 0$
- $l_1 \sin(\theta) - l_2 \sin(\phi + \gamma) + l_3 \sin(\psi) = 0$

No, the answer is incorrect.

Score: 0

Accepted Answers:

$l_1 \cos(\theta) + l_2 \cos(\phi + \gamma) - l_3 \cos(\psi) = 0$

6) In a function generation problem of the compliant mechanism shown in the figure, how many free variables need to be chosen in order to solve the synthesis equations? **1 point**



1 point

mechanisms and static balancing of compliant mechanisms

Week 11: Compliant mechanisms and microsystems; materials and prototyping of compliant mechanisms

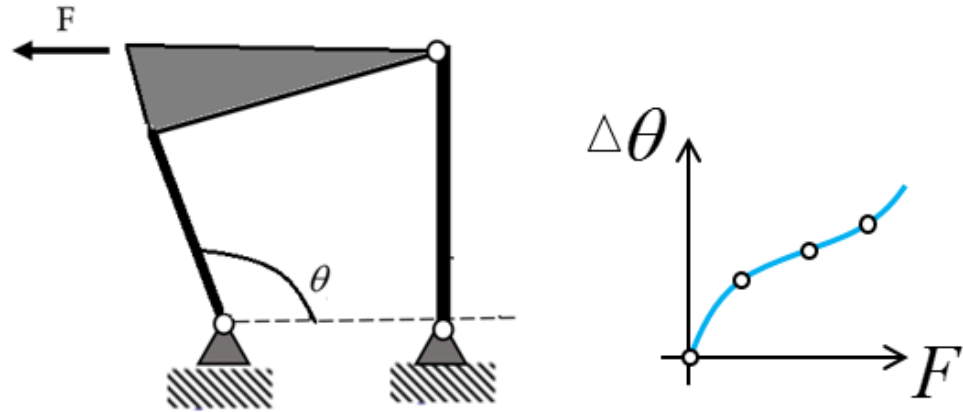
Week 12: Six case-studies of compliant mechanisms

MATLAB Online Access

MATLAB: Introduction to MATLAB

MATLAB: Vector and Matrix Operations

MATLAB: Advanced Topics



- 5
 4
 3
 1

No, the answer is incorrect.

Score: 0

Accepted Answers:

5

7) In Q. 6, if the dimensions of the coupler-body are given, how many extra positions are need **1 point** to be specified so that there are no free variables?

- 4
 3
 2
 1

No, the answer is incorrect.

Score: 0

Accepted Answers:

2

8) A load of constant magnitude is applied to a cantilevered beam tip and it continues to remain **1 point** in the transverse direction as the beam deforms. Calculate the angle of deflection of cantilever beam when the value of n (ratio of axial to vertical component of force) becomes 0.577.

- 45 deg
 60 deg
 30 deg
 None of these

No, the answer is incorrect.

Score: 0

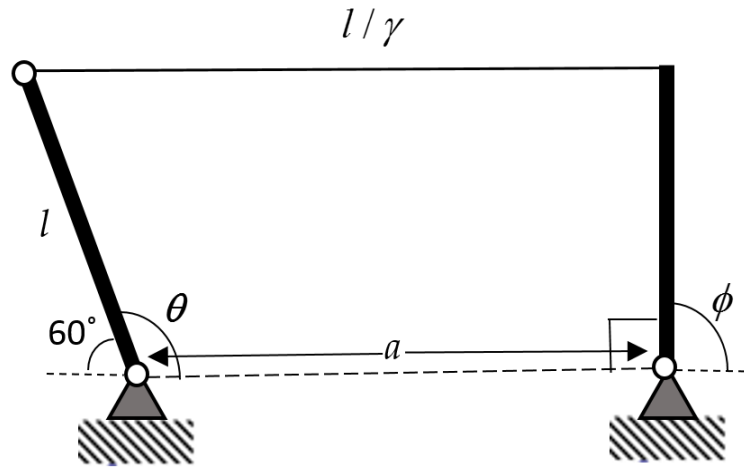
Accepted Answers:

30 deg

9) For the compliant mechanism (undeformed state) shown in the figure, calculate the kinematic **1 point** sensitivity $\frac{d\phi}{d\theta}$ when an external torque $\tau = 0.006 \text{ Nm}$ has caused θ to deflect by an angle ϕ . [Given $l = a$



= 5 cm, γ (characteristic radius factor) = 0.85, $\Delta\theta$ and τ are in clockwise direction]



- 0
 0.67
 1
 -0.5

No, the answer is incorrect.

Score: 0

Accepted Answers:

1

10 Calculate the value of $\Delta\theta$ given in Q. 9. Take $EI = 2.5e-4$ and $\gamma K_{\theta} = 2.25$.

1 point

- 0.000 rad
 0.131 rad
 0.262 rad
 0.523 rad

No, the answer is incorrect.

Score: 0

Accepted Answers:

0.523 rad

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