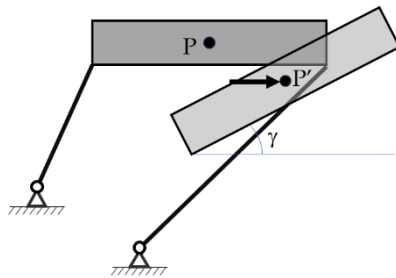


If you use AI-agents, include your prompts just like you would cite any references that you use.

Question 1 (30 points)

Consider a rigid rectangular segment of a given size. Two elastic segments of uniform cross-section area are firmly attached to it at its two bottom corners. The other ends of the elastic segments are attached to the rigid reference frame with revolute joints.



The length and height of the rectangular segment are 5 cm and 2 cm, respectively. Let the coordinates of points P and P' be (0,0) and (2,-1). The tilt angle, $\gamma = 25^\circ$.

Now, design the elastic segments so that the rectangular segment moves to a specified point with a specified tilt when a force is applied at its centroid. Use pseudo rigid-body model, loop closure equations, and force equilibrium equations to synthesize the compliant mechanism. Validate your design using finite element analysis using the Matlab nonlinear beam code as well as commercial software. In both cases, show the trajectory of the mechanism as you increase the force from zero to the specified value. You are free to choose the force.

Question 2 (10 points)

If you now replace the revolute joints with fixed connections, how does the mechanism response deviate from the one with revolute joints? What modifications would you now make to get the rectangular segment move to the same point with the same tilt under the same force?

Bonus points

Make this mechanism bistable by assuming that the force in the new position is zero.

Making prototypes that work well also get you bonus points. If you make a prototype, design its geometry such that it is easy to apply the force by hand.

What you need to submit:

1. A paper copy of your answers clearly written down with all details.
2. Graphs and pictures of your results with proper annotation (paper copy).
3. Prototypes, if any.