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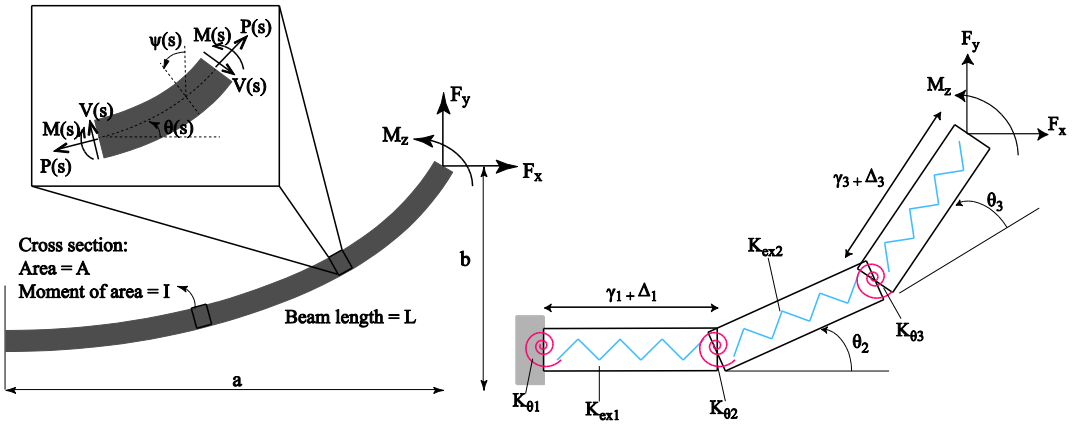
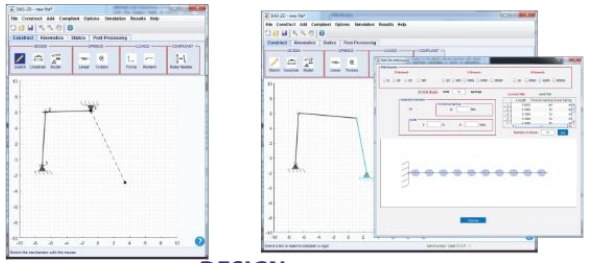
Design Innovation and Simulation Lab

Computational Modeling of Compliant Mechanisms

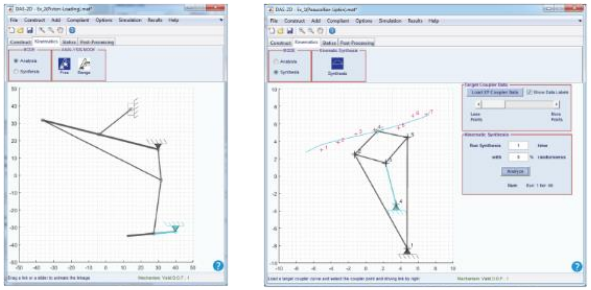
- Pseudo-Rigid-Body Models of Compliant Joints and Mechanisms
- Computer-Aided Design of Compliant Mechanisms
- Manufacturing of Compliant Mechanisms and Structures



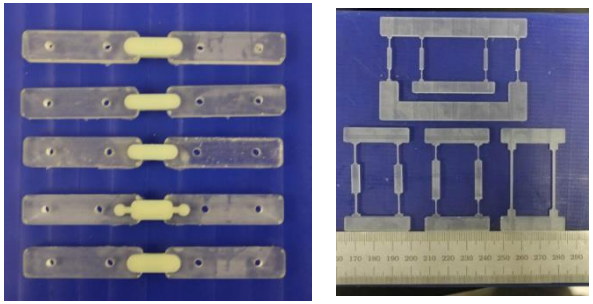
Conversion of beam model into Pseudo-Rigid-Body model



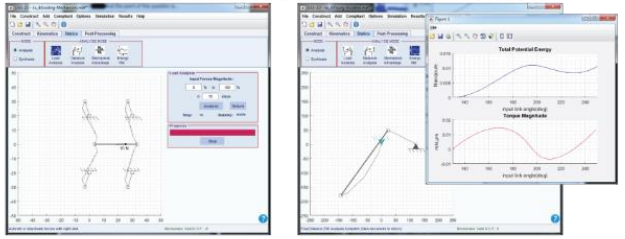
DESIGN



KINEMATIC ANALYSIS AND SYNTHESIS



Shape deposition manufacturing



STATIC ANALYSIS

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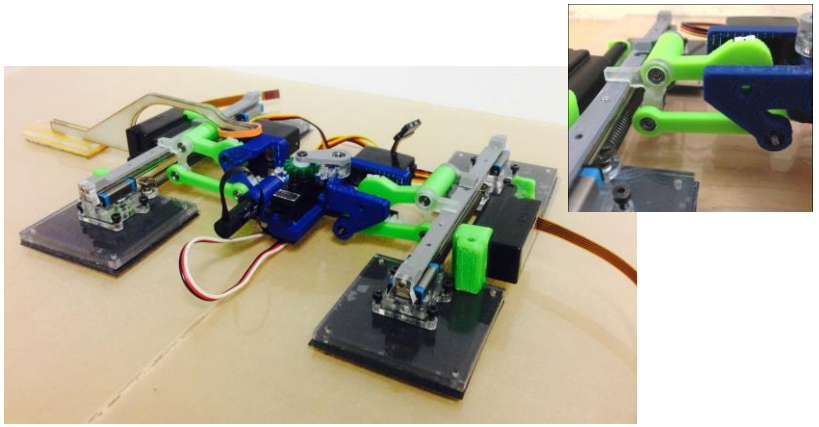
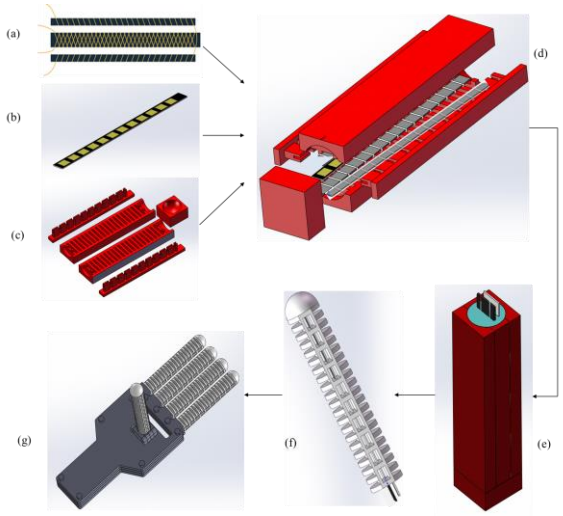
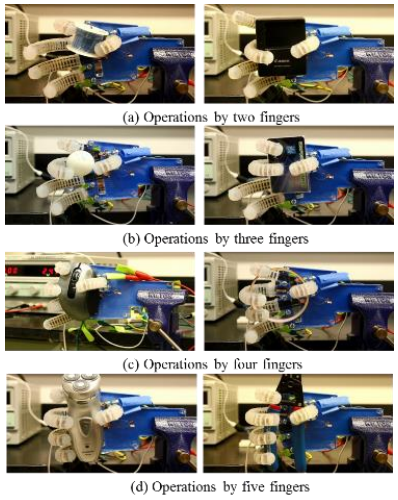
Design of Intelligent Robotic Systems

- Design of soft robotic hands
- Design of a mobile robot with transformable wheels
- Design of gecko climbing robot
- Design of origami wheel





Fabrication process



Grasping tests

(a) Stuck in sand

(b) Normally run in sand

(c) Stuck in leaves

(d) Normally run in leaves

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Design of DNA Origami Nano Mechanisms and Robots

- Design of mechanisms and machines in nanometer scale using DNA Origami using kinematic concepts such as links, joints and assembly of links
- dsDNA (double strand) structures has a sufficiently large stiffness that function as a rigid link
- ssDAN (single strand) has a relatively small stiffness that function as joints
- Design and modeling of compliant DNA origami mechanisms

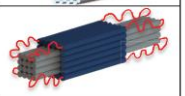
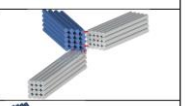
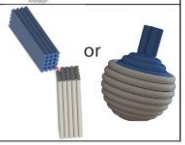
Joint	DOF	Solid Model	DNA Origami Design
Revolute	1		
Prismatic	1		
Cylindrical	2		
Universal	2		
Spherical	3		

Figure 5 : Five basic kinematic joints and the corresponding DNA origami design. The red curves represent ssDNA strands that are very soft. Cylinders represent dsDNA strands that are relatively rigid.