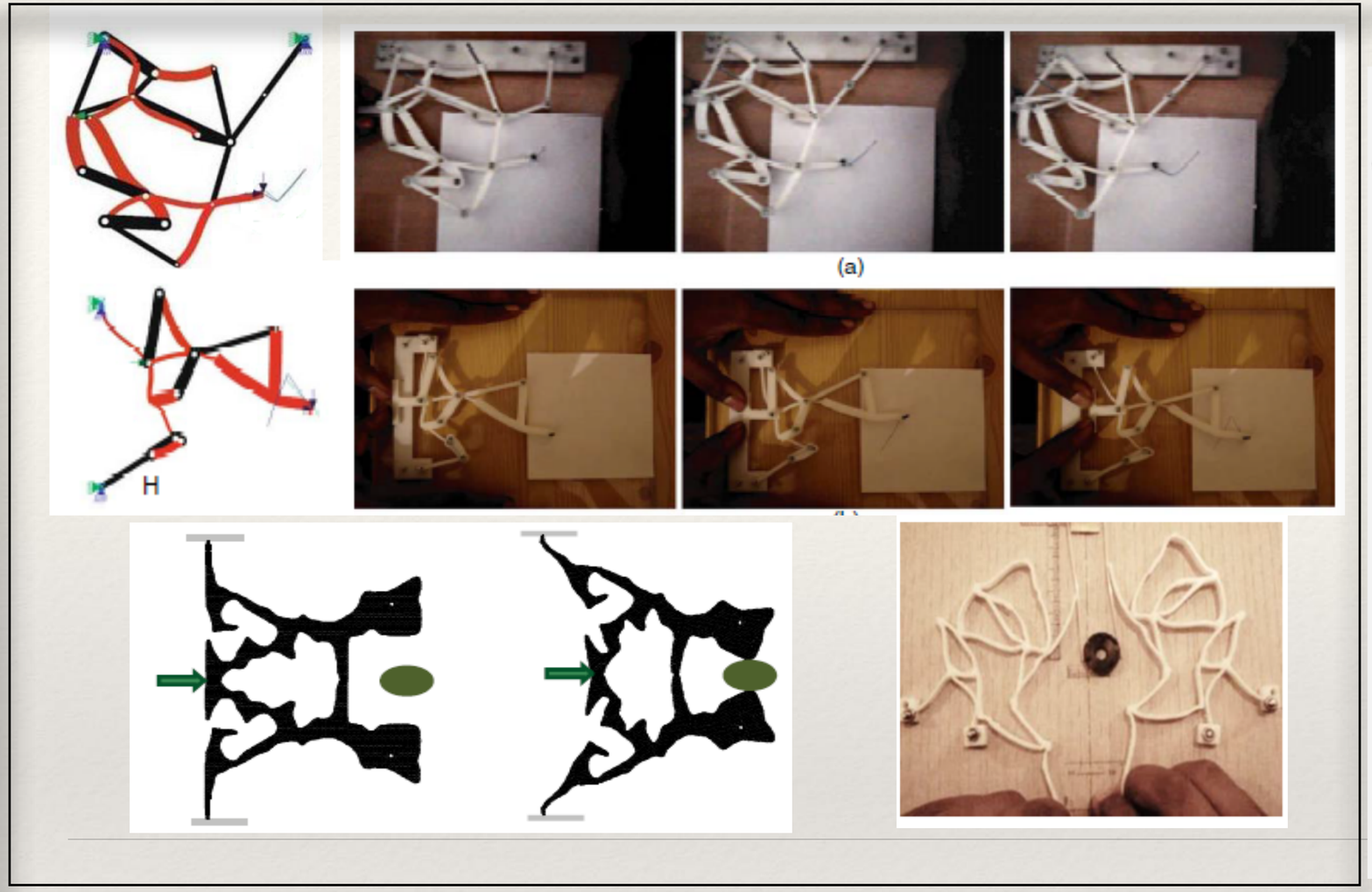

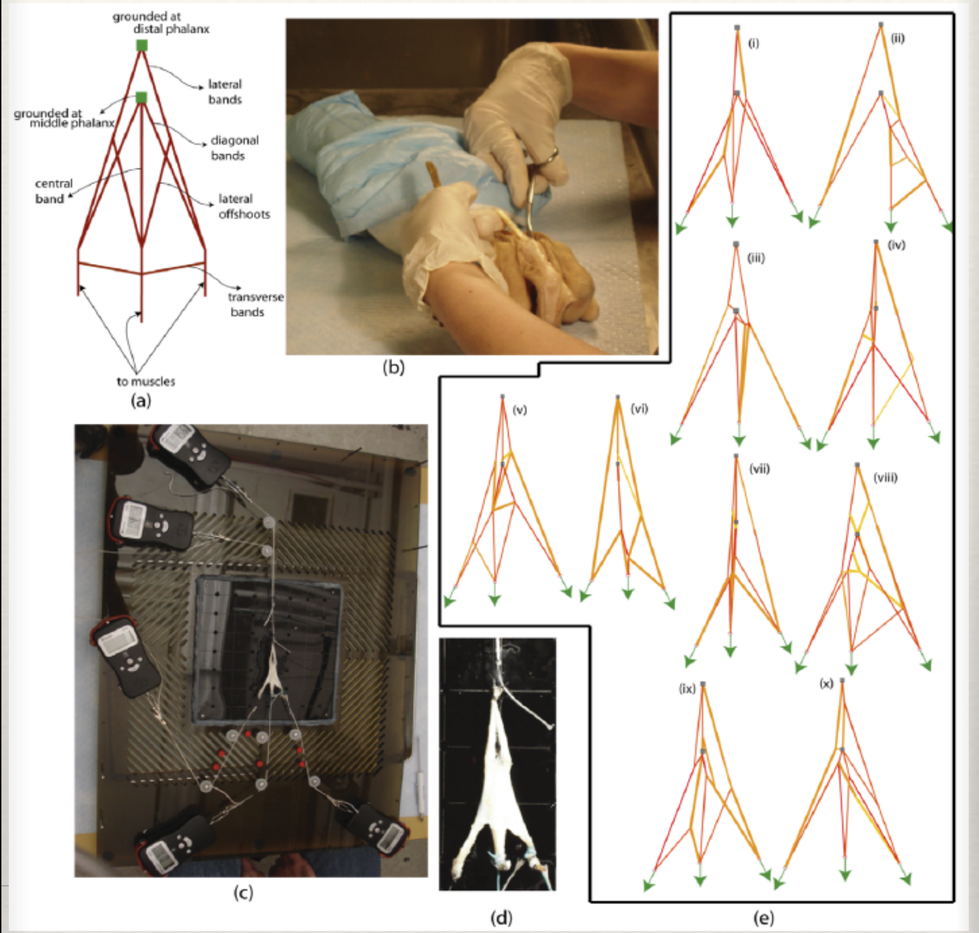

Compliant Mechanisms (ME 851)

Anupam Saxena
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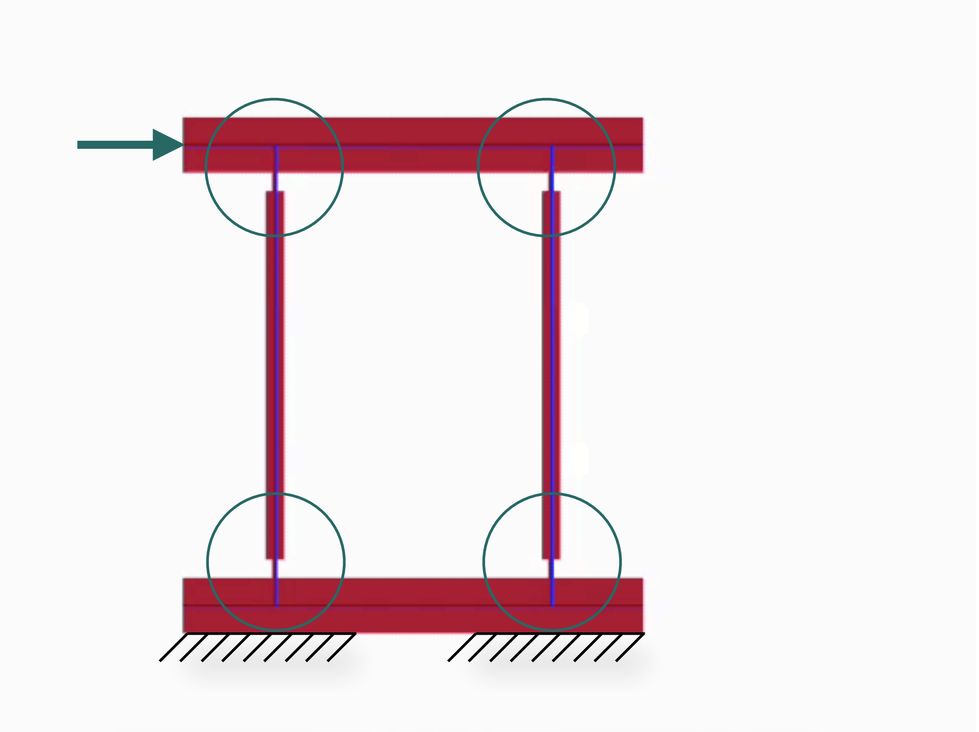
FLEXURES



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Fully Compliant Parallelogram Linkage

Thin flexures

Compliant Mechanisms (ME 851)

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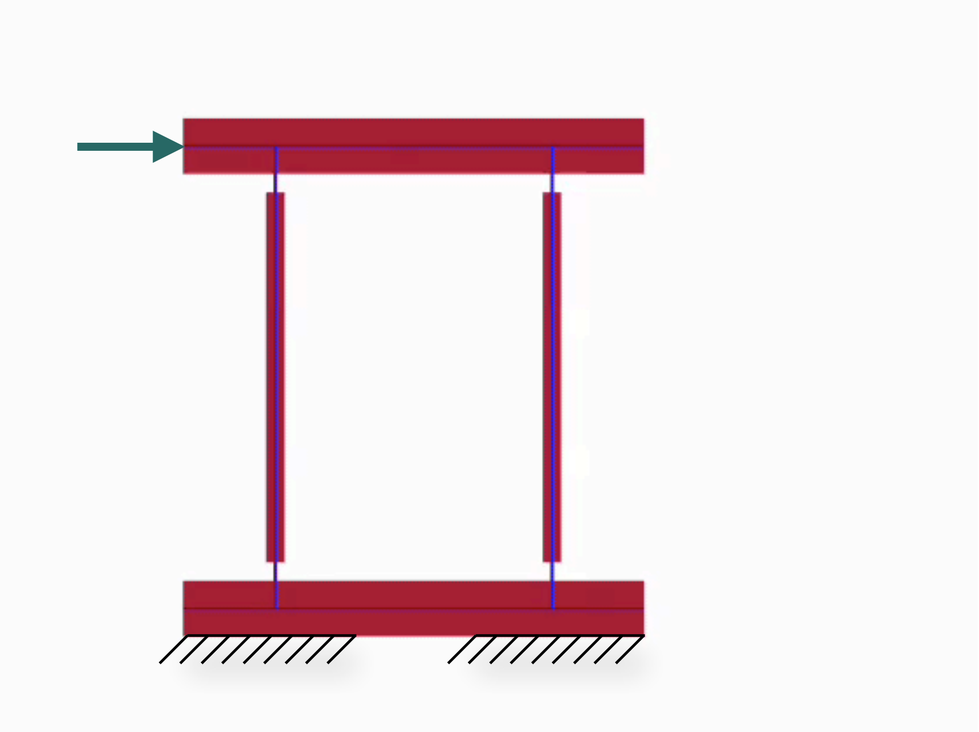
FLEXURES



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Fully Compliant Parallelogram Linkage

Thin flexures

Thiner flexures

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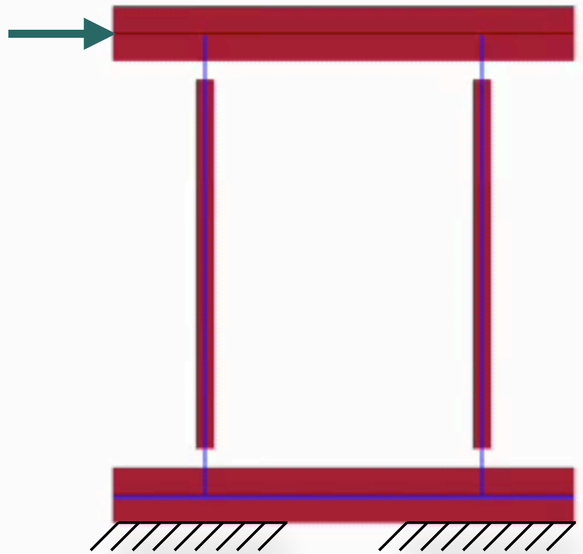

https:

Fully Compliant Parallelogram Linkage

Thin flexures

Thiner flexures

Even Thiner flexures

Compliant Mechanisms (ME 851)

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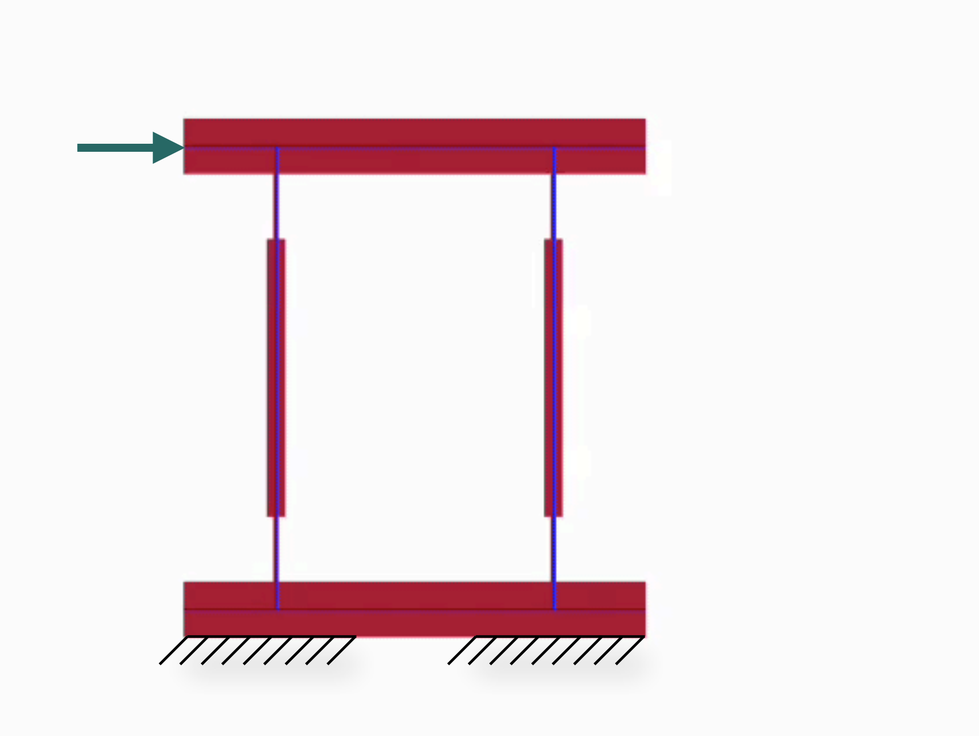

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Fully Compliant Parallelogram Linkage

Thin flexures

Thiner flexures

Even Thiner flexures

Long Thin flexures

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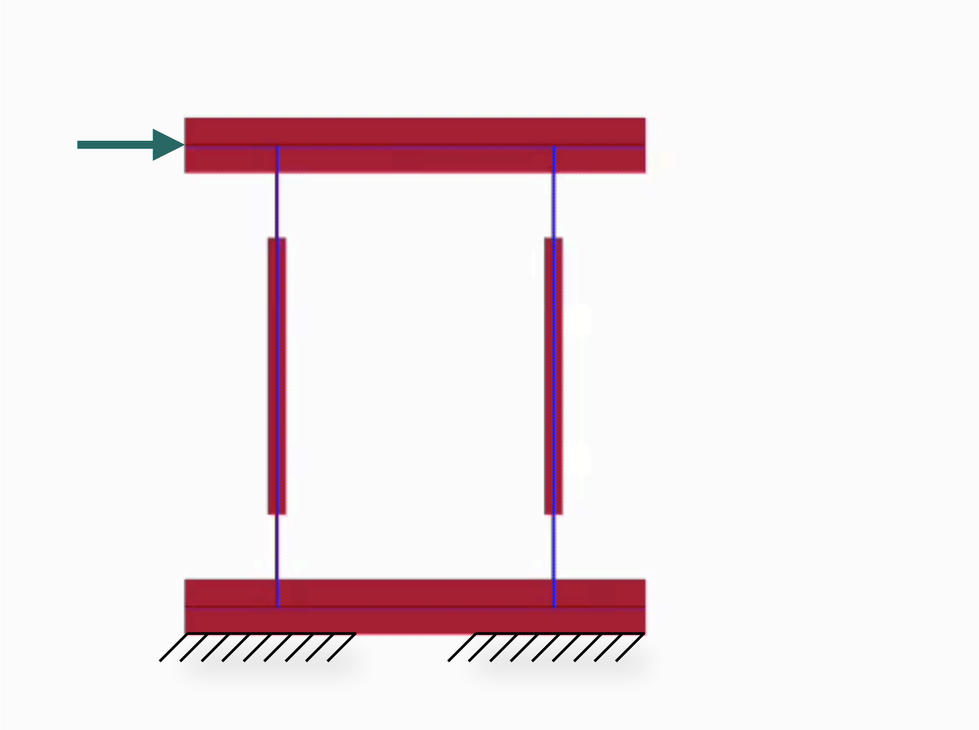

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Fully Compliant Parallelogram Linkage

Thin flexures

Thiner flexures

Even Thiner flexures

Long Thin flexures

Long Thiner flexures

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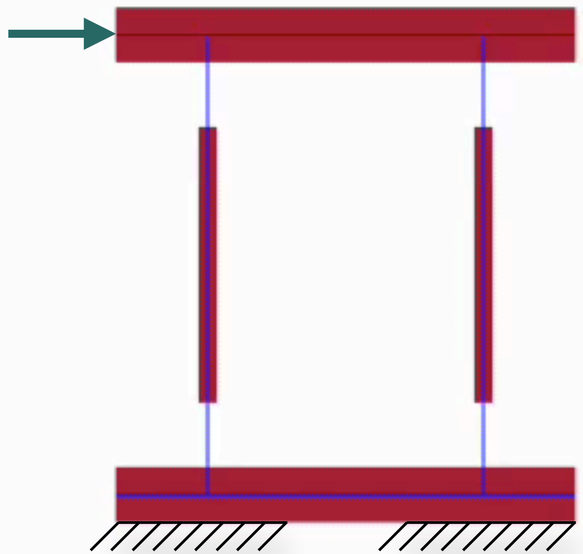

https:/

Fully Compliant Parallelogram Linkage

Thin flexures

Thiner flexures

Even Thiner flexures

Long Thin flexures

Long Thiner flexures

Long Even Thiner flexures

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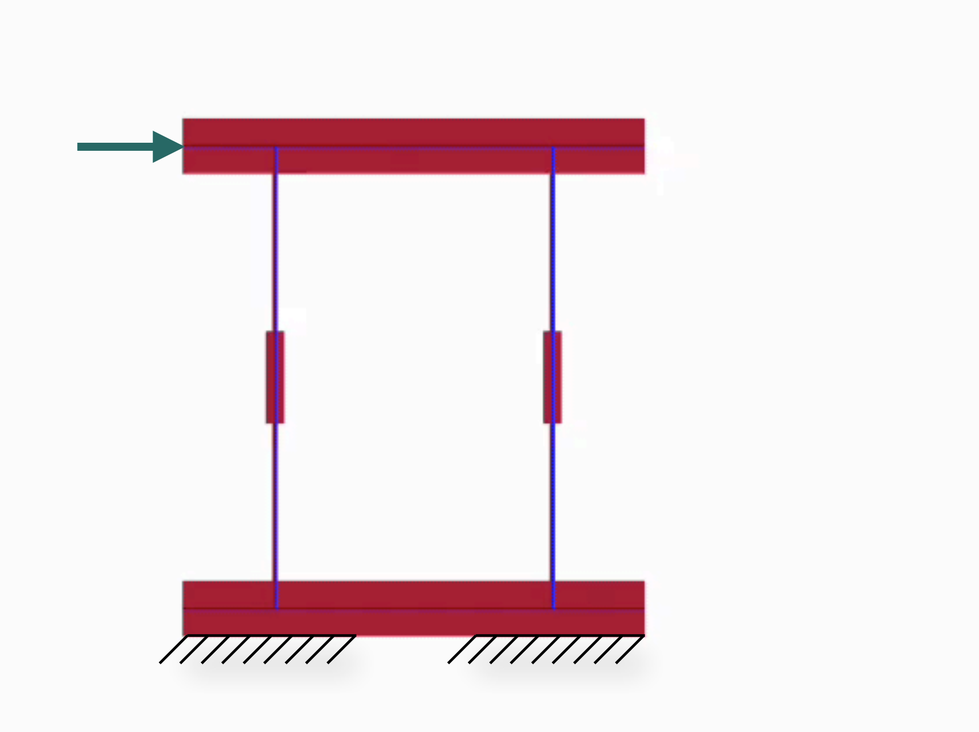

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Fully Compliant Parallelogram Linkage

Thin flexures

Thiner flexures

Even Thiner flexures

Long Thin flexures

Long Thiner flexures

Long Even Thiner flexures

Longer Thin

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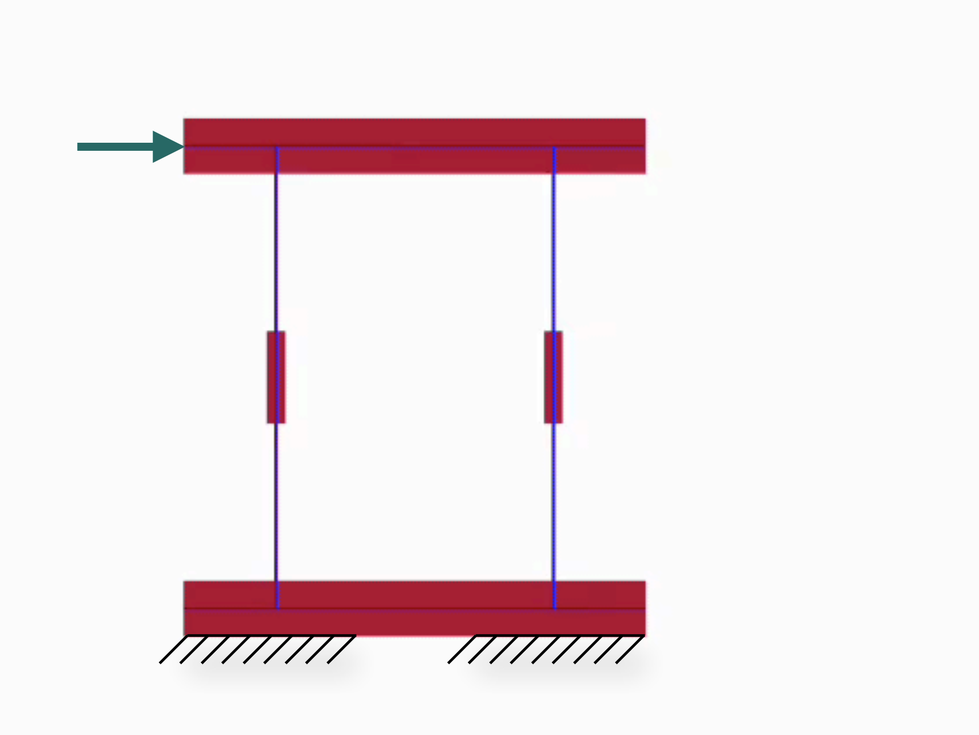

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Fully Compliant Parallelogram Linkage

Thin flexures

Thiner flexures

Even Thiner flexures

Long Thin flexures

Long Thiner flexures

Long Even Thiner flexures

Longer Thin

Longer Thiner

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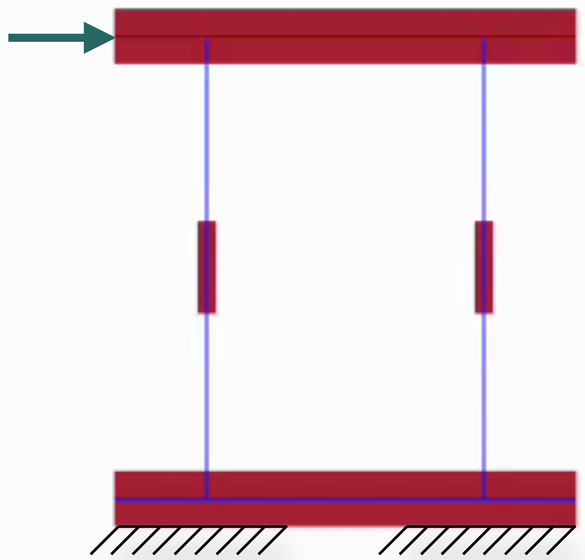

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Fully Compliant Parallelogram Linkage

Thin flexures

Thiner flexures

Even Thiner flexures

Long Thin flexures

Long Thiner flexures

Long Even Thiner flexures

Longer Thin

Longer Thiner

Longer Even Thiner

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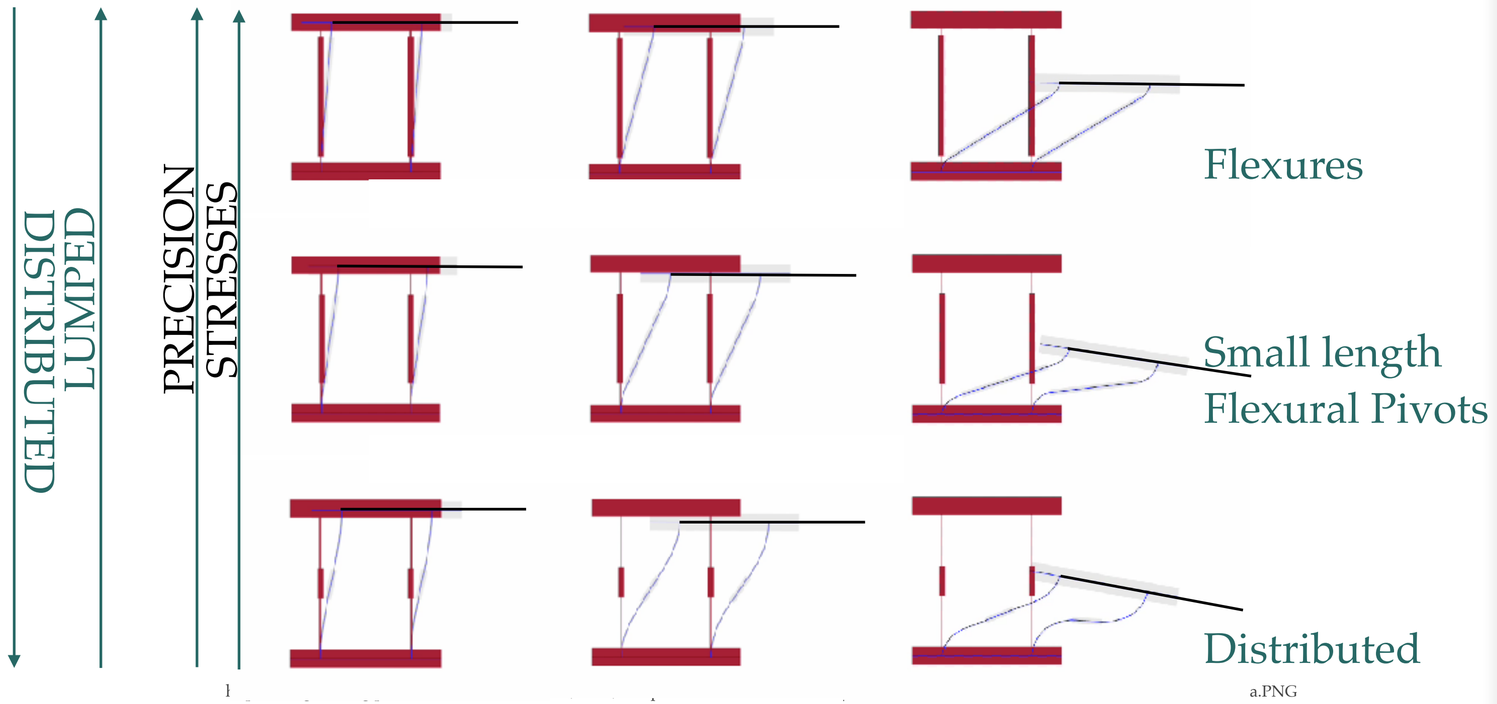
Perspective



Fully Compliant Parallelogram Linkages

Thin flexures

Thiner flexures

Even Thiner flexures

Long Thin flexures

Long Thiner flexures

Long Even Thiner flexures

Longer Thin

Longer Thiner

Longer Even Thiner

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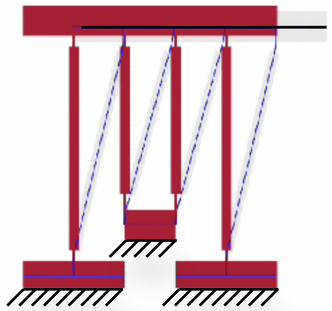
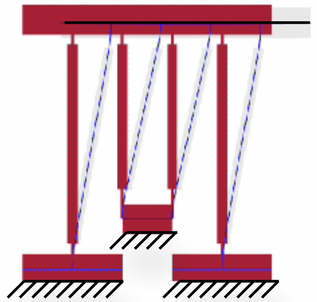
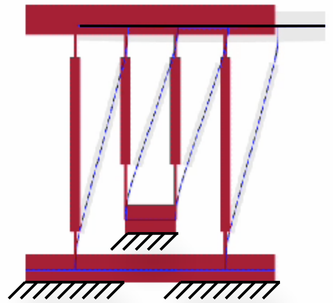


Thinner, short



Thin, short



Thin, long

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Fully Compliant Double Parallelogram Linkage

Platform almost horizontal

Platform does not get lowered much

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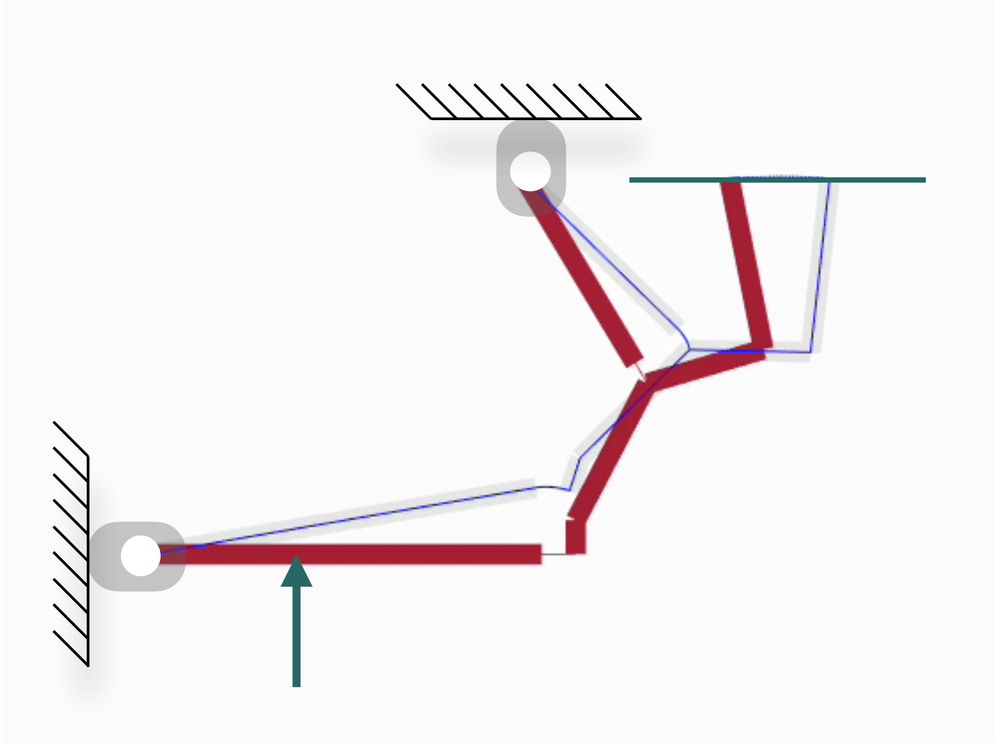
FLEXURES



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Flexure based Straight line tracer

Almost all known linkages with
kinematic pairs
can be converted into a

Fully Compliant (flexure) Mechanism

Concerns

- Stress concentration
- Parasitic (out of plane motion)
- Kinetostatics
  - What should be the stiffness?
- Failure: Plastic deformation
  - Change of stiffness/properties
  - Called **living/plastic** hinge

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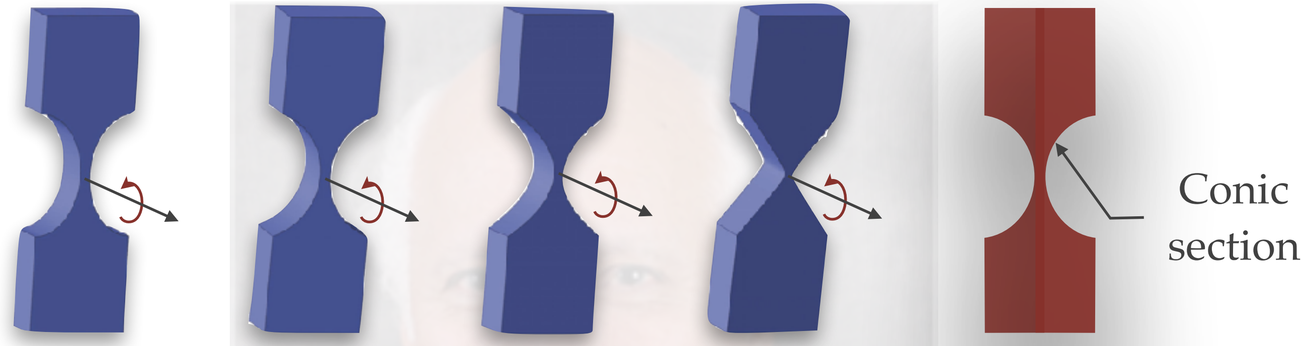
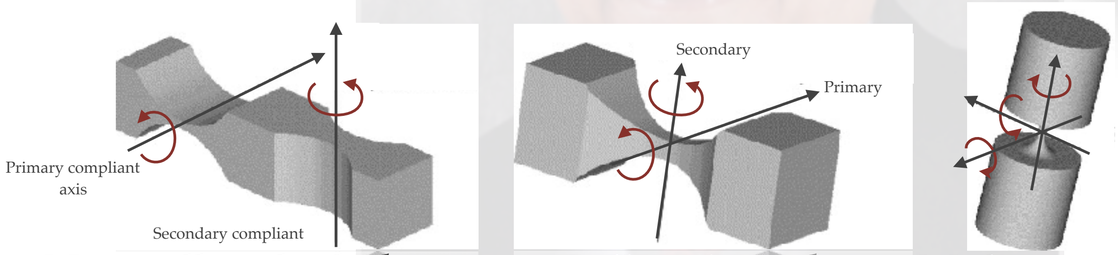
FLEXURES Different Kinds Way too many



https://doi.org/10.1177/1687814017734513



Non collated notches Collated notches Multi-axis

https://www.sciencedirect.com/science/article/pii/S0045794903000567

Prof. Ashok Midha

Single axis

Dual and Multi axes

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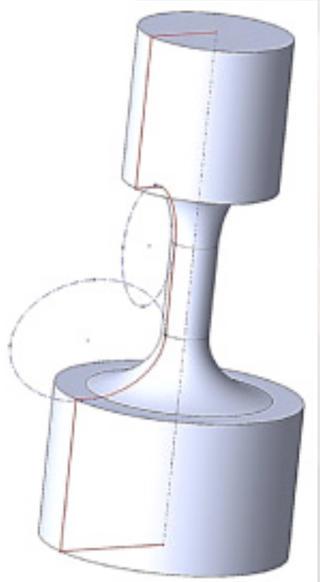
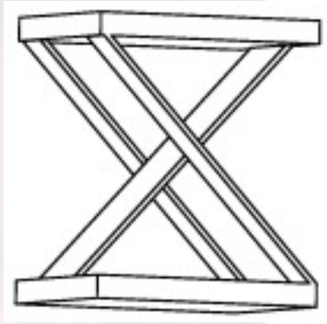
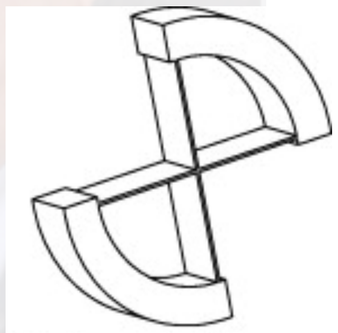
FLEXURES Different Kinds Way too many







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https://www.sciencedirect.com/science/article/pii/S0094114X09000809

- Single axis
- Dual and Multi axes
- Hybrid filleted notches
- Cross strip flexure
- Cartwheel flexure

Compliant Mechanisms (ME 851)

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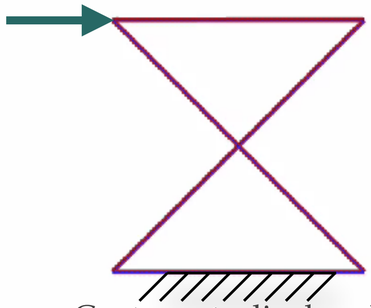
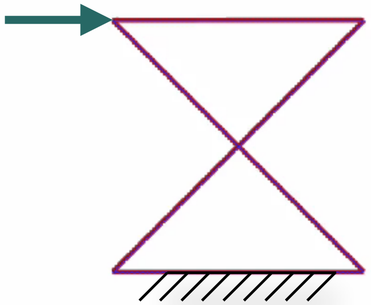
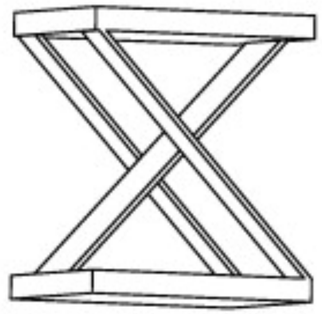


Center gets displaced if not careful — relatively flexible



Center almost fixed — relatively rigid



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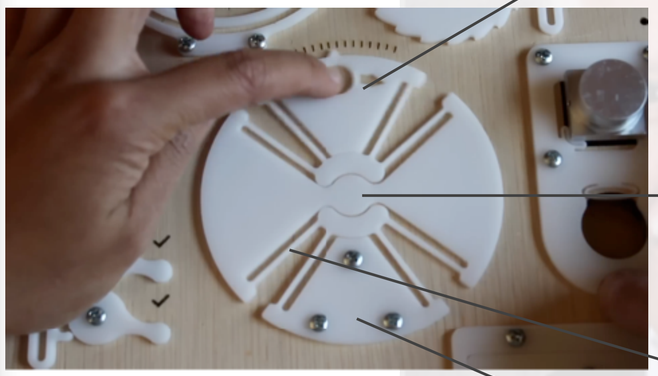


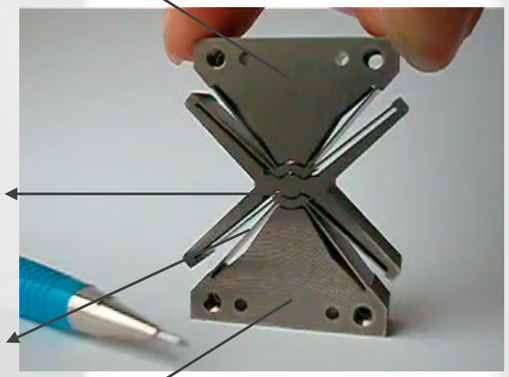
https://www.youtube.com/watch?v=YEz-r8KDY-0
Amy makes stuff

Mobile Block

Butterfly Block

Large Deformation beams

Stationary Block



https://www.youtube.com/watch?v=KfVNPtMtXMw
Christophe Yamagata

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https://www.sciencedirect.com/science/article/pii/S0094114X09000809

Center almost fixed — relatively rigid

- Single axis
- Dual and Multi axes
- Hybrid filleted notches
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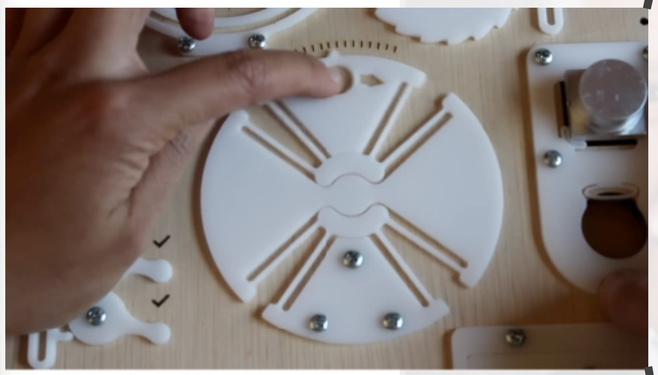

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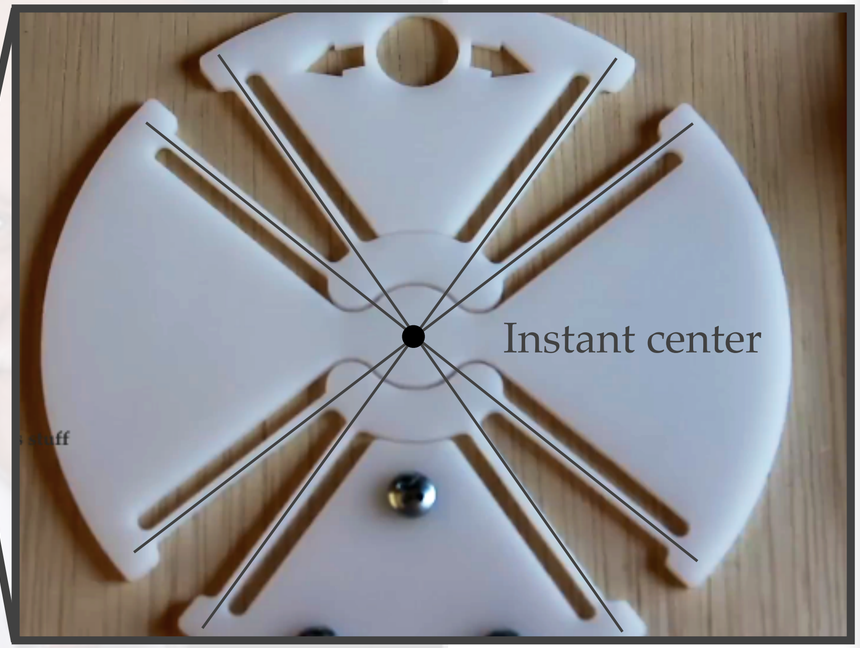

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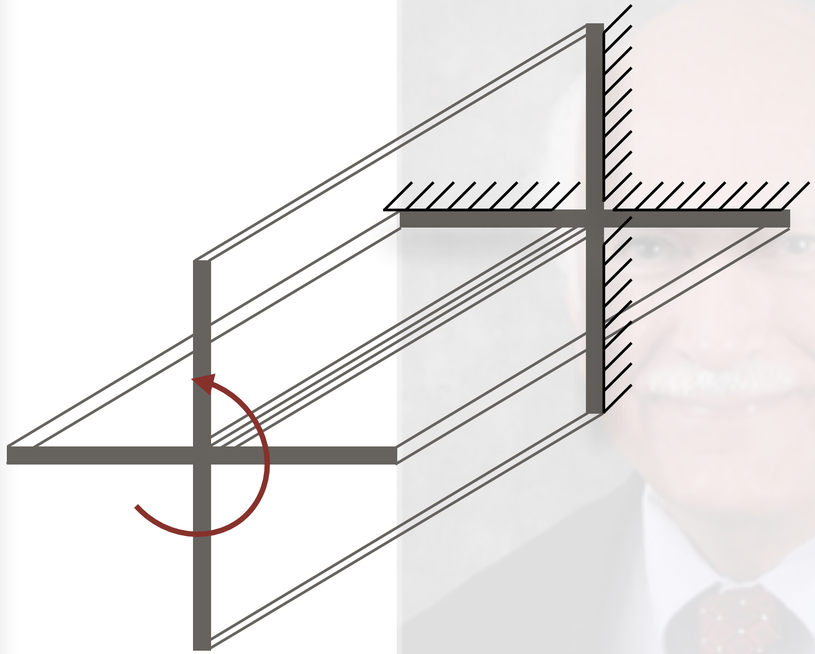

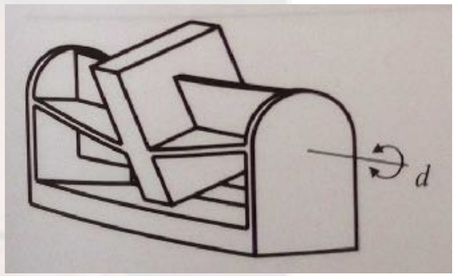

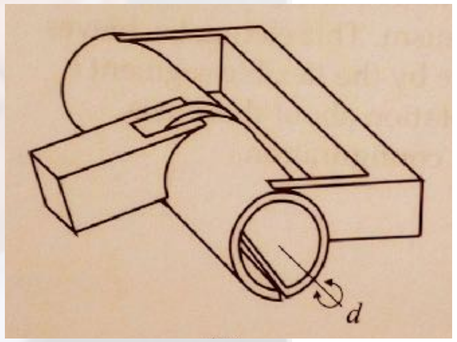

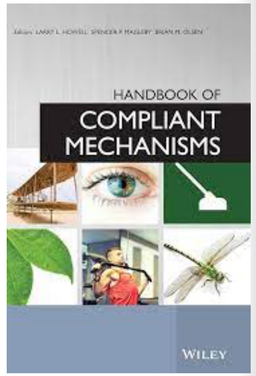

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https://www.sciencedirect.com/science/article/pii/S0094114X09000809

- Single axis
- Dual and Multi axes
- Hybrid filleted notches
- Cross strip flexure
- Cartwheel flexure
- Butterfly flexure
- Large deformation flexure
  - Cruciform flexure
  - Split tube flexure

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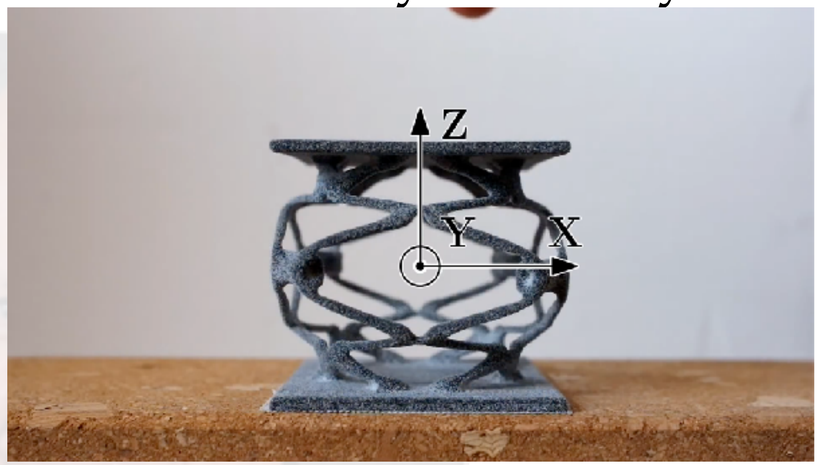
FLEXURES Different Kinds Way too many

Two axis

Precision



https://www.youtube.com/watch?v=jHqkL6dLo2M

Precision ?

All such monolithic setups permit rotations

Is the Pseudo hinge almost fixed? (Precision)

Is there parasitic (e.g., out of plane) motion?

Adequately stiff?

Adequately strong?

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Single axis

Dual and Multi axes

Hybrid filleted notches

Cross strip flexure

Cartwheel flexure

Butterfly flexure

Large deformation flexure

Cruciform flexure

Split tube flexure

Spatial flexures

Compliant Mechanisms (ME 851)

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