

### Folded-Flexure Suspension Variants

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- Below: just a subset of the different versions
- All can be analyzed in a similar fashion

(a) Inner fold, continuous truss    (b) Inner fold, discontinuous truss    (c) Outer fold, continuous truss    (d) Outer fold, discontinuous truss

[From Michael Judy, Ph.D. Thesis, EECS, UC Berkeley, 1994]

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### Folded-Beam Stiffness Ratios

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- In the x-direction:  $k_x = \frac{24EI_z}{L^3}$
- In the z-direction: Same flexure and boundary conditions  $k_z = \frac{24EI_x}{L^3}$
- In the y-direction: [See Senturia, §9.2]  $k_y = \frac{8EWh}{L}$

Thus:  $\frac{k_y}{k_x} = 4\left(\frac{L}{W}\right)^2$     Much stiffer in y-direction!

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### Folded-Beam Suspensions Permeate MEMS

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Accelerometer [ADXL-05, Analog Devices]    Gyroscope [Draper Labs.]    Micromechanical Filter [K. Wang, Univ. of Michigan]

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### Folded-Beam Suspensions Permeate MEMS

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- Below: Micro-Oven Controlled Folded-Beam Resonator

Temperature Sensing Resistor    Heating Resistor    Support Struts    Substrate Edge    Micro-Platform

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