## Comparative Study of Experimental and FEA Strain for Carbon Nanotube Sensors, Extensometers, and Metal Foil Strain Gauges

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Material testing is essential across industries such as aerospace, automotive, and construction, playing a critical role in verifying material selection, diagnosing failures, and understanding the development of flaws in structures. These insights are key to designing successful, reliable systems. Conventional metal foil strain gauges are low cost and reliable, but provide limited sensitivity with a typical gauge factor around 2. Extensometers provide highly sensitive strain measurements with the disadvantage of a bulky form factor. With advanced materials such as carbon nanotubes, it is possible to manufacture a sensor with the sensitivity closer to that of an extensometer with the small form factor of a metal foil strain gauge. This thesis develops a strain sensor utilizing the piezoresistive properties of carbon nanotubes and compares it with conventional metal foil strain gauge, extensometer, and finite element analysis data for uniaxial tensile and cantilever beam tests.

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