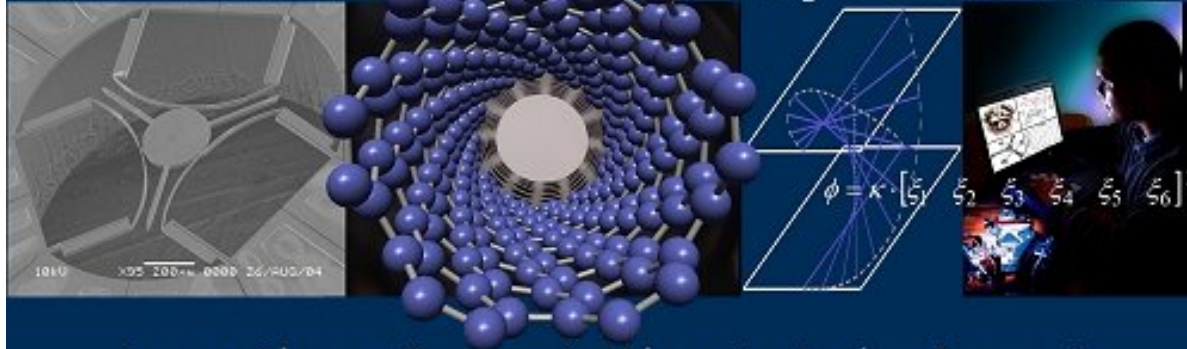


## Precision Compliant Systems Lab.



Nano • Micro • Macro • Multi-scale Design Research

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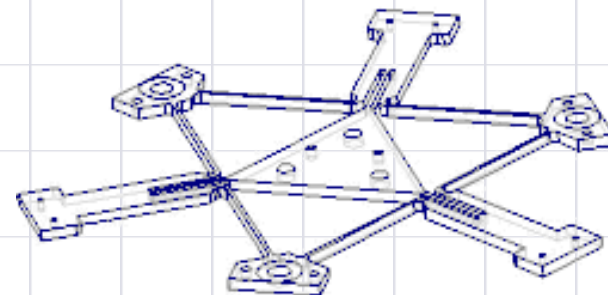
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## News events and recently submitted publications:

(1) Paper: [Synthesis of Multi-degree of Freedom Flexure System Concepts via Freedom and Constraint Topologies \(FACT\)](#)



HexFlex Nanomanipulator:  
2003 R&D 100 Award

The purpose of our research is to generate the knowledge required to synthesize, model and manufacture new six axis, nano-, micro- and macro-scale nanopositioners. These nanopositioners are relevant to (a) instruments that enable us to measure/understand, and (b) equipment that enables us to manipulate/affect, that which happens at the micrometer and nanometer scales. The long-term impact of this work is aimed at increasing the type/pace of scientific discoveries (via instrumentation) and the pace/quality with which these discoveries may be converted into tangible goods (via manufacturing equipment). We focus on problems wherein performance requirements and/or geometric constraints demand unusually small machine envelopes. For example in vivo biomedical devices require mm-scale devices. Nanomanufacturing equipment requires devices that may only obtain viable speed, cost and stability requirements if they are centimeters to 10s of nanometers in size.

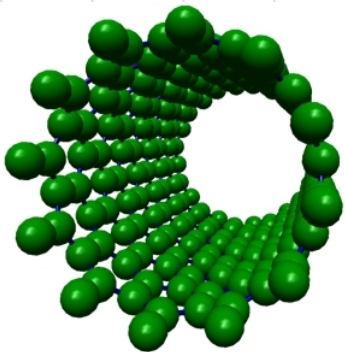
We utilize the principles of mechanical design, precision engineering, applied physics and manufacturing – in combination with invention – to synthesize new machine element concepts; and the models, tools and fabrications processes that enable their creation:

- (1) Physics-based concept synthesis tools that enable engineers to create many new machine architecture concepts, compare them, and then select the best architecture.
- (2) Compliant structure/bearing and actuator concepts that enable the conversion of machine architecture concepts into functional machines with nm-level resolution.
- (3) Micro- and nanofabrication processes that enable the creation and integration of the machine elements into nanopositioning systems.

We draw case studies from areas that are of high scientific and/or economic impact. At present, the scientific and practical applications of this work are focused on the following fields:

**Nano-scale science and engineering:**

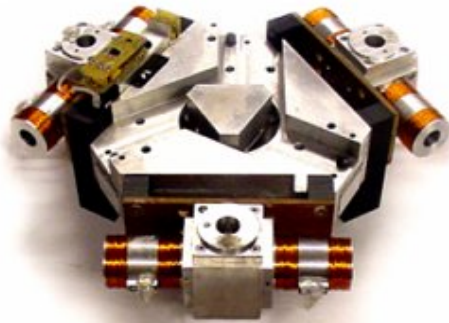
- Nanopositioning
- Nanoinstrumentation
- Nanomechanical devices



*Ex: CNT-based mechanisms [Chang]*

**Precision engineering:**

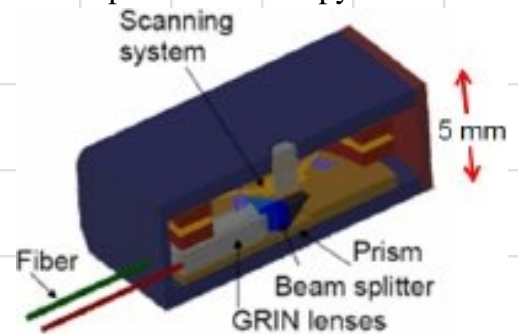
- Compliant machine elements
- Exact constraint design theory
- Mechanism design



*Ex: HexFlex Nanopositioner [NSF]*

**Biomedical**

- Micro-optical scanners
- 3D in vivo tissue imaging
- Two-photon endoscopy



*Ex: Cancer detection [NIH]*