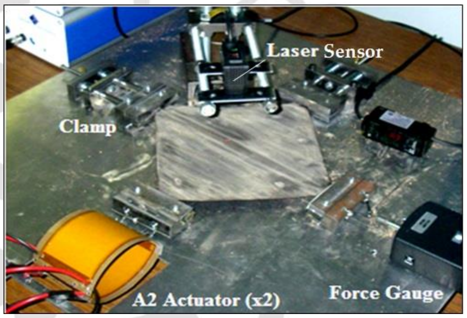
TRANSFORM

Energy Systems through Game-changing Technology

BUILDINGS | CARBON CAPTURE AND STORAGE | FUEL CELLS | NUCLEAR | POLICY | PLANNING
RENEWABLES | **SMART GRID** | STORAGE | SUSTAINABLE MOBILITY | SUSTAINABILITY ANALYSES



ENERGY HARVESTING LABORATORY

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Demand for wireless sensing units has increased in recent years, particularly for large networks of power transmission lines. Dr. Armaghan Salehian and her Energy Harvesting Laboratory team seek to design and fabricate sensing devices to measure electric current for smart grid applications. These technologies are self-contained and require minimal energy for their operation. This is done through the use of various smart materials to convert ambient vibrations and the magnetic flux of transmission lines into usable power. These sensing and harvesting units are miniature-sized and are thus much smaller than the available technologies used by hydro industries.

Although energy harvesting plays a large role for Dr. Salehian's research team, the Energy Harvesting Laboratory is not limited to this one aspect. Other areas of research include the use of smart materials in bioengineering applications, flatness control of Kapton membranes for space antenna membranes, dynamics modelling of complex cable-harnessed systems, as well as using GNSS reflectometry through micro-satellites for climate change monitoring.

The Energy Harvesting Laboratory is currently investigating the development of a pressure sensing and actuation system to apply compression to lower extremities that will improve venous blood flow. This type of bioengineering requires sensor characterization, experimental and physiological testing, and algorithm development. The ability to produce a unit that is both mobile and lightweight is a key priority for this work. Smart materials satisfy both of these criteria and the Energy Harvesting Laboratory has invested significant hours into the applicability of various types of smart materials for use in the sensing and actuation system.

Ultra-light space structures, known as Gossamer or inflatable structures, commonly use Kapton membranes. As an example a synthetic-aperture radar (SAR) antenna makes the use of Kapton membranes for the antenna surface. Despite their lightweight a common problem for these membranes is the material being susceptible to wrinkles. The Energy Harvesting Laboratory has successfully modelled the wrinkle pattern of these Kapton antenna membranes when patched by macro fiber composite actuaries (MFCs) for flatness control.

The Energy Harvesting Laboratory is also equipped with vibrations testing facility that allows the determination of the frequencies of vibration. Currently, these types of tests are being performed to validate a proposed model for cable-harnessed space structures. As space structures become increasingly lightweight the addition of power and signal cables greatly affects the dynamics of these structures. The ability to predict their vibrations behavior will have significant impacts for design considerations of these structures.

Researchers: Dr. Armaghan Salehian

Partners: Riley’s 321 Sleep, Silicone Pro, Canadian Space Agency, Lockheed Martin, U.S. Air Force