Knowing the state of an aerospace vehicle in real-time is crucial for maximizing its performance, assuring its reliability, and completing successful missions. This is especially true in harsh or combat environments. A departure from traditional technology is necessary to increase the performance and capabilities of next generation aircraft, particularly UAVs.

The Stanford Structures and Composites Lab (SACL) proposes a new approach to integrate material, sensors, electronics, signal/data processing and algorithms, as well as a multi-scale fabrication technique that will allow devices in nano/micro scales to be integrated into macro-structures and materials. Efforts are focused on how to create and build a bio-inspired sensory network with large arrays (i.e. millions) of sensors, actuators, signal processing elements and memory neuron units, and electronics, expand it more than 10,000%, and then fabricate it into composite materials to cover large areas of aircraft structures.

In this research an expandable sensor network is being developed. It is ultra-thin, highly expandable. Temperature and PZT sensors are integrated into the network so it can realize real-time distributed temperature sensing and impact monitoring. To read nodes data accurately and efficiently, the network communication strategies are being developed. Both thin film diodes (TFDs) and thin film transistors (TFTs) based switching methods are being studied for nodes information acquisition.

In order to embed the network into composite panel, the sensor network should be able to survive during the composite curing process in which high temperature and pressure are applied. To address those issues, packaging process has been designed to protect sensors and electrodes.

An artificial electronic skin based on the stretchable sensor network techniques has been developed and integrated with diagnostic, state awareness and control subsystems into a robotic arm system. To demonstrate the sensing, decision-making and control concept for autonomous vehicles.