In the interest of furthering both commercial and government-funded opportunities for deep space exploration, the safety of life and equipment onboard must be absolutely certain. In this regard, the presence of any hazardous gases or combustion events onboard space vehicles must be quickly characterized and detected. Several hazardous gases of interest have absorption features in the mid-infrared range and can be detected with an infrared light source, via the principles of absorption spectroscopy. A non-dispersive infrared (NDIR) sensor that follows these principles has been developed to utilize light-emitting diodes (LEDs) for gas detection and quantification. LEDs contain a particular advantage in this situation because they have low power requirements, are robust and easily adaptable, and they are cheaper than existing laser-based systems. The design has successfully performed several laboratory, environmental chamber, and high-altitude balloon flight tests. The main purpose of these various tests was to place the sensor in challenging environments, examine the effects on sensor performance, and adjust accordingly.

The current sensor design utilizes a single 4.2\(\mu\text{m}\) LED and a rotating diffraction grating to detect both carbon dioxide (CO2) and nitrous oxide (N2O) within a single scan. These measurements were further validated using two distributed feedback quantum cascade lasers (QCL) centered at 4.25\(\mu\text{m}\) and 4.58\(\mu\text{m}\). The sensor collected data on a wavelength range of 4117nm to 4592nm. Mixtures containing the concentrations of the two species of interest varying from 0.2% to 0.8% were analyzed. The integrated absorbance data was calculated for each species and compared with theoretical predictions. The results show that the data follows the expected behavior and correlates better at lower concentrations. Subsequent work on this sensor will focus on increasing the quantity of identifiable gases and on further testing in hazardous environments.

Major: Aerospace Engineering

Educational Career:
Bachelor's of Aerospace Engineering, BS, 2017, University of Central Florida

Committee in Charge:
Subith Vasu, Chair, Mechanical and Aerospace Engineering
Louis Chow, Mechanical and Aerospace Engineering
Kareem Ahmed, Mechanical and Aerospace Engineering

Approved for distribution by Subith Vasu, Committee Chair, on March 21, 2019.

The public is welcome to attend.