

TOPIC OF A COMPETITION PROMOTING STUDENT ENGAGEMENT IN SCIENTIFIC ACTIVITIES

Topic: Development of a Miniaturized Air-Flow Sensor Based on Thermal Sensing and the 3-Omega Technique
Goal: Produce a miniaturized thermal air-flow sensor
Accurate miniaturized air-flow sensors will play a key role in the navigation of future generation autonomous vehicles. Conventional flow sensors often require complex fabrication, or moving mechanical components. Thermal flow sensing provides an attractive alternative because it can be implemented using miniaturized resistive heaters and temperature sensors, enabling small size, low power consumption, and potentially high sensitivity. The aim of this project is to design, fabricate, and experimentally characterize a miniaturized air-flow sensor that uses a microheater and 3ω thermal sensing to determine air-flow velocity. Design a miniaturized resistive microheater/sensor suitable for thermal air-flow measurements. Develop an analytical and numerical thermal model describing heat transfer between the sensor and flowing air. Investigate the relationship between air-flow velocity, heater temperature, and the 3ω electrical response. Fabricate the proposed sensor using an appropriate techniques. Develop an AC excitation and lock-in detection system for measuring the 3ω signal. Calibrate the sensor over a controlled range of air-flow velocities and evaluate its sensitivity, linearity, response time, repeatability, and power consumption. Compare experimental results with theoretical and numerical predictions. The project is expected to produce a compact, sensitive, and low-power thermal air-flow sensor capable of measuring small air-flow velocities without mechanical moving parts. Student level: third or fourth year. Required skills: Programming in Matlab and Python. Experience with electronics projects, Arduino etc..
Supervisor researcher/lecturer: Samer Hour