

PhD Topic: Optical remote sensing of insects and environmental Monitoring
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Abstract: The proposed PhD project will have two phases. The first phase of the project will focus on developing an optical remote-sensing technique for insect-monitoring applications. Remote sensing is the extraction of information from a distance without making physical contact with the object under investigation. This can be a passive or an active technique depending on the way that the information is collected. The use of natural radiation (sunlight) as the illumination source is an example of a passive technique; laser techniques, such as LIDaR and radar, can be considered as examples of active remote sensing. Optical remote sensing, which will be implemented in this project, entails both passive and active monitoring.

Sweep netting and trapping are examples of the most commonly used techniques to study insects. However, it is impossible to determine the flight direction, speed, distance and life stages of insects using these techniques. It is also difficult to answer questions like what the activities of insects during the day or night are, what the prey-predator relationship is and what the flight situation compared with the direction of the wind is. Other techniques, such as radar, have also been used for such applications but these are very costly and it is difficult to implement them in small-scale research.

The main goal of this project will be to introduce less-expensive techniques that can do a similar job. To achieve this, it will be important to develop a low-price and efficient optical remote-sensing technique. The author is currently involved in a project entailing the development of an optical remote-sensing technique for insect-monitoring purposes. This project will continue as part of the author's PhD project and will be co-supervised by Lund University, Sweden. The second phase will focus on the development of laser techniques for environmental applications. The aim of this will basically be to assess the capabilities of surface-enhanced Raman scattering (SERS) for organic-pollutant monitoring, specifically polycyclic aromatic hydrocarbons (PAHs). These cause severe health problems when inhaled or ingested. These pollutants also decrease the productivity of resources. This could lead to unsustainable resource utilisation, which would endanger the future.

To mitigate this kind of problem, effective environmental-monitoring techniques, such as SERS, play a key role. These techniques combine knowledge of nanotechnology and laser physics to create a new knowledge system for environmental application. The signal collected using SERS provides a fingerprint of individual molecules. Its high sensitivity, specificity and value as a tool for analysing a mixture makes SERS a robust technique. Monitoring pollutants via this method needs a relatively simple experimental procedure and reasonably affordable instrumentation compared with other techniques. Air and water monitoring via a SERS technique showed great potential in achieving accurate information of environmental situations. This project will be performed in collaboration with a research group from the University of Pretoria, South Africa.

Disciplinary history: BA in Physics, Mekelle University, Ethiopia; MA Combustion Physics, Lund University, Sweden

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