

Next Generation Spectral Scanner and Artificial Intelligence Engine for Agri-Food Applications

Graduation Project 2021/ 2022

Description:

Optical spectroscopy is a highly flexible and competitive form of analysis, which can be applied to a broad range of research and industrial process applications. It is becoming popular within industrial markets as a cost-effective tool for measuring materials to optimize processes and manage costs. The method makes use of the molecular vibrations of the matter and its interaction with the electromagnetic radiation. By measuring light scattered off and through a sample, the reflectance spectra can be used to quickly determine the compositions of the material properties without altering the sample. Conventionally, spectroscopy analysis is carried out in laboratories using bench top devices. Recently, the introduction of micro spectrometers revolutionized the market and enabled in-field testing and in-line monitoring.

The purpose of this project is to realize a novel and advanced spectral sensor with ultra-compact size and high performance integrating multi-range optical spectral sensors (visible and infrared) and multi function sensors module – such as camera, temperature, humidity, and physical proximity) and leveraging novel ways of design and data analysis using machine learning. Examples of applications include feed analysis, milk/dairy industry, food freshness testing, grain nutrition value analysis and others.... Modern design techniques including free-form optics, response surface methodology and machine learning will be explored and advanced signal processing techniques will be implemented. The appropriate human machine interface/industrial design will be implemented together with highly integrated optical solution for light handling. The expected outcome of the project is a prototype for a device that is foreseen to have a promising business case and huge market potential and presents a success story that inspires others in Egypt and worldwide.



Expected tasks:

- Literature survey and market analysis
- Engineering definition of the target product, tasks population and project management - System analysis and engineering specifications extraction
- Sensors selection, characterization and integration
- Design, development and characterization of optical heads applying novel light recycling concepts with multi-range spectral sensors



- Design and characterization of novel power and mother electronic boards overcoming thermal management and data integrity challenges
- Design and realization of sample scanning and referencing accessories
- Industrial design and prototyping meeting reliability qualification requirements
- Characterization of components/systems and validation through laboratory experiments
- Signal processing and machine learning algorithms for novel design methodologies and data handling
- Developing artificial intelligence for calibration models in some applications
- Scientific publications and project documentation

Expected outcomes:

- Engineering prototype for a novel market competing scanner
- Novel designs and algorithms
- Results demonstration
- Project documentation and technical papers/posters

Qualifications:

- Open minded for exploration and ability to provide innovative solutions
- Self-starter with demonstrated quantitative analysis and problem solving skills -
- Able to pro-actively communicate with different teams and work under pressure -
- Effective verbal and written communication skills
- Solid technical background
- Knowledge of MATLAB while other languages such as Python is a plus
- Knowledge of Zemax tool is a plus, knowledge of machine learning is a plus, knowledge of Autodesk Inventor is a plus
- Knowledge of Raspberry Pi, LabVIEW, is a plus

Sponsorship:

- Si-Ware Systems Company in the form of close guidance and follow-up from Si-Ware Systems Functional Managers (System, Optics, Electronics and Mechanical engineering), accessing licensed tools and usage of the laboratories and components under supervision.