Snapshot Report

AUSTRALIAN MEAT PROCESSOR CORPORATION

Carcase inspection with Rubens sensor

Proof of concept of the Rubens sensor for the end-of-line carcase inspection – Stage 2

Project Code	Prepared by	Date Submitted
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Project Description

The aim of this Proof of Concept (PoC) project was to evaluate the capability of the Rubens spectral scanner to detect contaminants in red meat. The Rubens scanner, developed by Rubens Technologies to assess fruit quality and maturity, is based on a combination of absorbance and fluorescence spectroscopy, from the UV to the near-infrared spectral range.

The utilisation of optical fluorescence has been proposed as a tool to evaluate meat quality, authenticate beef, and detect faecal contamination in carcases. This motivated this project, with the aim of verifying that a handheld spectral system can be used to detect contaminants, and of building a roadmap of extending this technology to line scanners.

The project objectives are:

1. Demonstrate to AMPC staff the working functionality of the concept(s) through pilot test of our current hand-held scanner on carcases to identify what contaminants can be detected and at what level.

2. Demonstrate the applicability of pilot results (obtained with a hand-held device) to a line scanner detection system (on paper and through simulations/animations)

3. Develop indicative targeted $RRP

4. Draft a Stage 3 application submission, which includes an indicative indication of Stage 4+ and commercialisation plan. The draft will specifically address the R&D required to translate the concept to line scanners and the path towards future concept automation

5. Provide literature that substantiates that the proposed platform is likely to succeed.

Project Content

This project has been carried out with the assistance of Cedar Meats Australia, which provided trimmed samples from lamb and mutton carcases. The samples had a variety of contaminants, including Faeces, Urine, Grass Seeds, Ingesta and Wool. The samples were sourced in two occasions from Cedar Meats facilities, and scanned at Rubens Technologies' premised on the same day of collection.

The data was acquired using the Rubens sensor, a handheld spectroscopy device developed by Rubens Technologies. The scanner is capable of detecting optical fluorescence, visible light reflectance and near-infrared reflectance with a single spectrometer.

The data was reduced by identifying wavelength bands in the fluorescence and absorbance spectra, that contains features that are specific to each contaminant or group of contaminants. In this way, the reduced data can be used directly for rapid contaminant identification. In addition, and perhaps more importantly, identified bands in the spectra could be used to design optical filters for a future line scanner based on a combination of spectral sensing and machine vision.

The results outline the ability of the Rubens scanner to detect the vast majority of contaminants, in the range of samples that was measured. Detection of ingesta, grass seed, and wool appears to be possible from the spectra alone, after identification of the relevant bands. Specific fluorescence bands for urine and faeces have also been identified, but are not sufficiently separated from other features to enable full identification from spectra alone. The spectral data shows candidate bands that suggest a good identification is possible, and can be used in conjunction with a vision system for fully automated identification of contaminants in a line scanner.

Project Outcome

The key project outcomes are as follows:

• Meat and meat contaminants samples have distinctive spectral features in absorbance and optical fluorescence.

• These distinctive features can be used for contaminant identification in the lamb and mutton samples that were scanned with the Rubens sensor.

• Rapid identification of contaminant can be achieved by defining appropriate contaminant indexes, which quantify the amount of fluorescence (or absorbance) in the relevant wavelength band for each contaminant.

• Many contaminant features significant chlorophyll fluorescence, which can be readily detected by the Rubens sensor.

• The contaminant indexes, calculated in post-processing on the spectral data, provide full discrimination of ingesta, wool and some grass seed contamination using spectral data alone. The discrimination of urine and faeces using contaminant indexes on spectral data is only partial and it will require imaging in addition to spectroscopy.

• The definition of contaminant indexes can be translated into a practical way of developing a line scanner, based on the selective acquisition of specific wavelength bands using optical filters and conventional cameras.

• The concept of a line scanner, which take advantage of the key learnings of this project has been proposed and a roadmap for further development has been outlined.

Benefit for Industry

The results obtained in this Proof of Concept project outline the concrete plan of transferring the handheld technology to a line scanner that could be deployed at processor facilities. The concept developed during this work can address the requirement of automated contaminant detection in carcases as outlined in the AMPC initial call for proposal.

A line scanner system would enable quick and automated contaminant identification, improving the efficiency of the inspection process, use of labour, and reducing the amount of trimming required.

We anticipate that the actual prototype will be developed in close consultation with processors, to make sure the approach is fit for purpose and provides the functionalities required to alleviate labour costs and maximise return on investment. We have however discussed how the system will achieve the objectives of 1) Cost-effectiveness, 2) High-speed and sensitivity, and 3) manageable size of the data produced, for both data processing and for auditing purposes.

The approach delineated here also ensures system modularity. Multiple units can be deployed and their results pooled together for further analytics and reporting, providing additional benefit to the processing operation. Another advantage of the modularity is the ability to upgrade the system, for instance adding different machine vision modules (i.e. lamb vs beef), specific optical filters and remote operation support.