# High performance of a low-cost visible near infrared spectrophotometer

**Marc Meurens and Emmanuelle Moons**

*Université Catholique de Louvain - Croix du Sud, 2 (8), B-1348 Louvain-la-Neuve, Belgium.*
*E-mail: meurens@bnut.ucl.ac.be.*

## Introduction

The miniature visible near infrared (vis-NIR) spectrophotometer, Ocean Optics S2000, has been used for experiments in light transmission measurement through whole apples in order to develop a low-cost (< $5000) control system for sorting fruit.

## Material and methods

A halogen–tungsten lamp (100 W) was used as the light source which illuminated the fruit on the left side (Figure 1). The transmitted light was collected on the right side by an integrating sphere and guided by a fibre optic (diameter = 400 μm) to the fixed grating and the coupled charge device (CCD) detector of the vis-NIR Ocean Optics S2000 spectrophotometer (Dunedin, FL, USA) which was connected to a PC. Absorbance (log1/*T*) spectra were acquired by transmission measurement through more than 100 sound and defective apples.

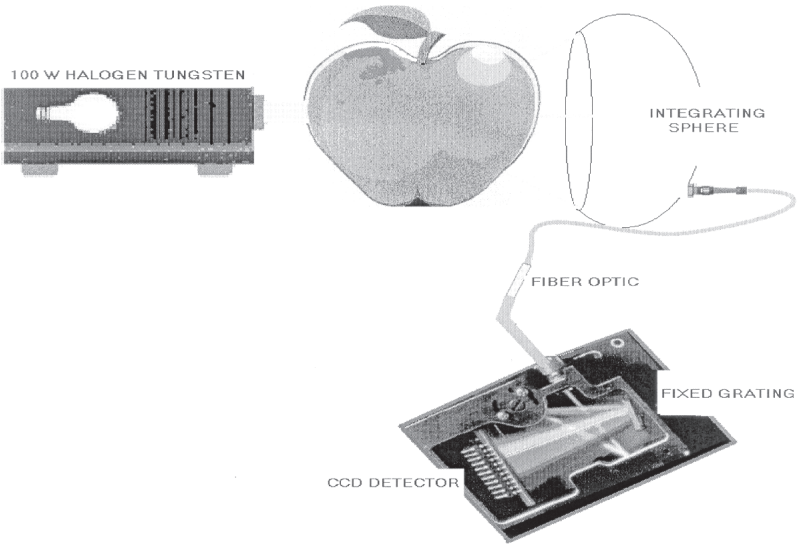


**Figure 1. Illustration of the light source, the sample presentation, the fibre optic probe and the vis-NIR spectrophotometer (Ocean Optics S2000) used in fruit sorting.**

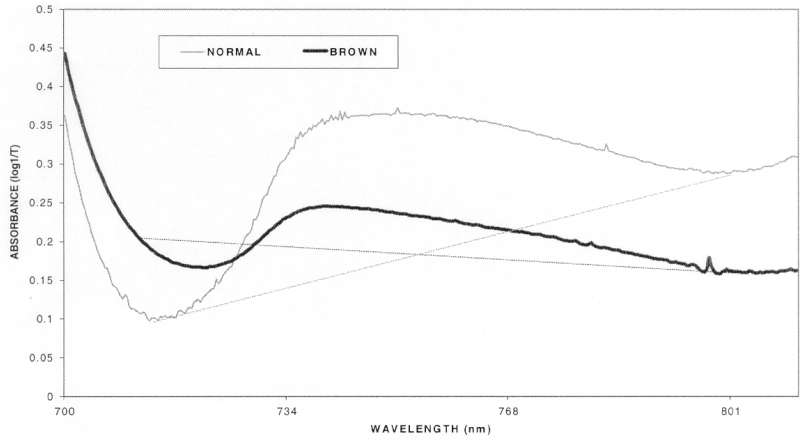


**Figure 2. Vis-NIR spectra of two representative apples. The sound apple indicated as normal is without internal defect, the other apple, indicated as brown (thick line), has an internal defect of a brown core.**

## Results and discussion

Figure 2 shows two representative vis-NIR spectra acquired within one second by transmission measurement through Boskoop apples with the S2000 spectrophotometer.

In comparison with the spectrum of the sound apple, the spectrum of the defective apple shows, between 700 and 800 nm, a profile difference corresponding to the presence of a brown core inside the fruit. Fast apple sorting, based on the detection of this internal defect, is now being developed using stronger light sources than the 100 W halogen–tungsten lamp. Those light sources should enable a good spectrum to be acquired within a few milliseconds. This would mean that several apples per second could be sorted by complete control systems including, notably, the artificial neural net box ILB-25 (ROVI-TECH, Belgium) for data treatment and fruit discrimination.

## Acknowledgement

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