

Handheld spectral imager for remote sensing, food quality and medical applications

Heikki Saari⁽¹⁾, Eero Hietala⁽¹⁾, Christer Holmlund⁽¹⁾, Jussi Mäkynen⁽¹⁾

⁽¹⁾VTT Optical Instruments, P.O.Box 1000, FI 02044 VTT, Espoo, Finland

VTT Technical Research Centre of Finland has developed a new low cost handheld staring spectral imager for applications previously blocked by high cost of the instrumentation. The concept of the spectral imager has been published in the SPIE Procs. 7474, 7668 and 7680. The 1st prototype fitted in an envelope of 100 mm x 60 mm x 40 mm and its weight was ca. 300 g. Major limitations of the 1st built prototypes were the limited wavelength range, low f-number of the optics and relatively low dynamic range (10 bits) of the sensor. To improve the system performance on these parameters a second generation prototype has been designed, built, calibrated and used for agriculture and food samples. A 5 Mpix CMOS Image sensor MT9P031 from Aptina is used in the present device. The pixel size of this sensor is 2.2 μm x 2.2 μm . It can be operated at different resolutions from 640 x 480 pixels to 2592 x 1944 pixels. The measured readout noise of the device is ca. 3 electrons per pixel. The on-chip ADC has a 12 bit dynamic range. The wavelength range of 400 – 1000 nm was selected because it is adequate for most remote sensing, food quality and medical applications. By splitting the spectral range with a dichroic beam splitter into visible (400 – 650 nm) and VNIR channel (650 – 1000 nm) image sensors the number of spectral bands measured with one exposure can be increased to 5. The design and calibration results of the hand-held VIS-VNIR spectral imager will be presented. The first meat and wine tree leaf sample measurements made in co-operation with a Spanish AINIA research institute are also shown.

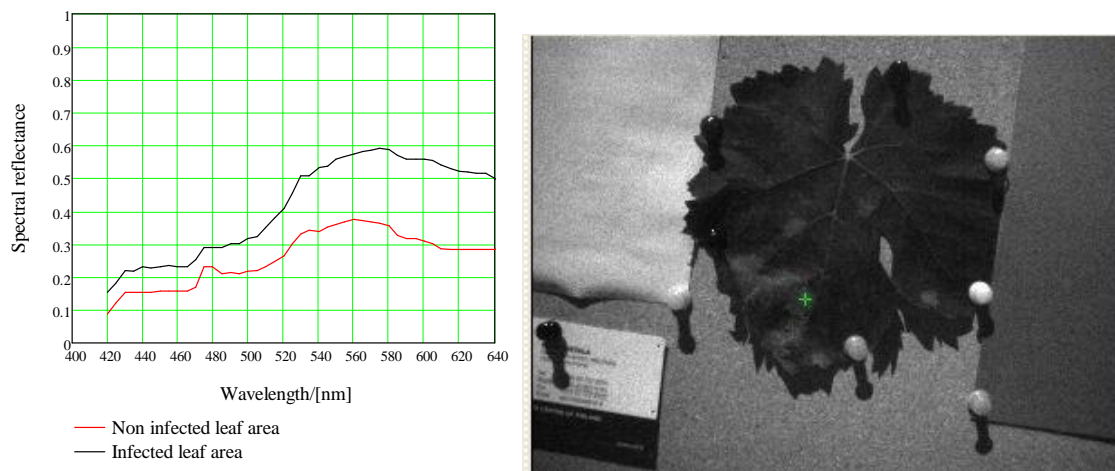


Figure 1. Spectral reflectance data of non-infected and infected wine tree leaf areas.

[1] Saari, H., Aallos, V., Akujärvi, A., Antila, T., Holmlund C., Kantojärvi, U., Mäkynen, J. and Ollila J., “Novel Miniaturized Hyperspectral Sensor for UAV and Space Applications”, Proc. SPIE 7474 (2009).

[2] Saari, H., Aallos, V., Holmlund, C., Mäkynen, J., Delauré, B., Nackaerts, K., and Michiels, B., “Novel Hyperspectral Imager for Lightweight UAVs”, Proc. SPIE 7668 (2010).

[3] Saari, H., Aallos, V., Holmlund, C., Malinen, J., and Mäkynen, J., “Hand-Held Hyperspectral Imager”, Proc. SPIE 7680 (2010).