THE MAG

JANUARY-MARCH 2010

UNIVERSITAT POLITÈCNICA DE CATALUNYA
BARCELONATECH

OPEN TO INTERNATIONAL EXCHANGE AND RESEARCH

Making the invisible visible

DOCTORAL THESIS

Project title:

"Design of a new system for reconstructing spectra and viewing images in the near infrared region"

Why did you choose this research: I have always been interested in the field of optical engineering and, at the CD6, I had the opportunity to do research in this area. Also, a large part of the research deriving from this field can be directly applied to industry, and that means that we are in permanent contact with businesses.

Areas of application: Agro-food industry, security and the automotive industry.

Meritxell Vilaseca, a researcher at the Centre for Sensor, Instrument and Systems Design (CD6) at the UPC-BARCELONA TECH, has developed a sophisticated technique that renders the infrared region of the spectrum, which is invisible to the human eye, in colour. Its areas of application include safety, the food industry and detecting counterfeit banknotes.

Jack Griffin, the scientist turned into the invisible man in 1897 by the writer H. G. Wells, would find it a little harder to hide today. Wells, who was a researcher as well as a science-fiction writer, described how Griffin made the refractive index of the human body match that of the air, so that the body neither absorbed nor reflected hight: he had found the formula for invisibility.

The human eye has its limitations: we can only see colors at wavelengths of between 380 and 780 nanometers. Beyond 800 nanometers, we are unable to distinguish differences. Meritxell Vilaseca of the Centre for Sensor, Instrument and Systems Design (CD6) has made is possible to go beyond the limitations of the human eye by creating a sophisticated system that shows in color the infrared energy that the human eye cannot see.

"Being able to access wavelengths beyond the detection limit of the human eye opens up new technological possibilities in many areas, such as safety and verifying the authenticity of banknotes". To prevent forgeries, the notes need only be marked with infrared signals that, while invisible to the human eye, would be rendered in color by the new system that has been developed.

The research by Vilaseca, however, also opens new avenues of study in the food industry, where it could provide more precise information on the composition or state of conservation of certain foods, as it will be possible to alter the infrared energy they reflect depending on these characteristics. "Even in the food industry", adds the researcher, "we can use this technology to better detect the changes in the growth process of crops or to provide early detection of alien species and plagues, as it will make it possible to study the ranges of pseudo-coloring of the infrared radiation".

The system consists of a digital camera (CCD) sensitive to NIR (near infrared), five infrared filters and a stabilized light source. With these three elements, the system captures five different monochrome infrared images of a specific sample. The images are recorded and shown on a monitor.

The system assigns the images pseudocolors within the red, green or blue range, that is, the hypothetical colors that the sample might have within the visible spectrum, as thinking of colors within the invisible spectrum makes no sense. The colors have to be assigned arbitrarily and the researchers have done this in two ways: by boosting the color differences in the original sample or by following the model of human vision. In this way, it is possible to render the different colors visible in a sample that would be impossible to see with the naked eye.

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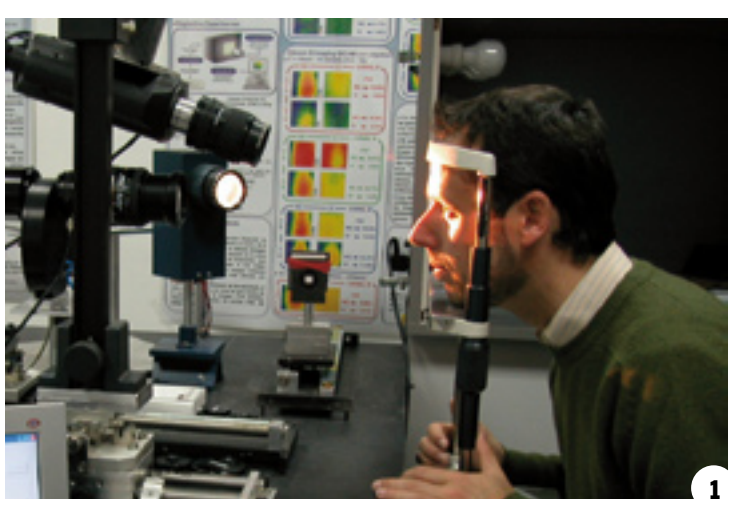
With the right optical equipment and the pseudocoloring technique, it is possible to obtain spectral (color) information within the NIR zone and to increase discrimination of the characteristics of a sample that would be hidden to the naked eye.

1 *The system captures five different monochrome infrared images of a specific sample.*

2 *The new optical engineering technological equipment was presented at the International Colour Conference at the EUETIT.*



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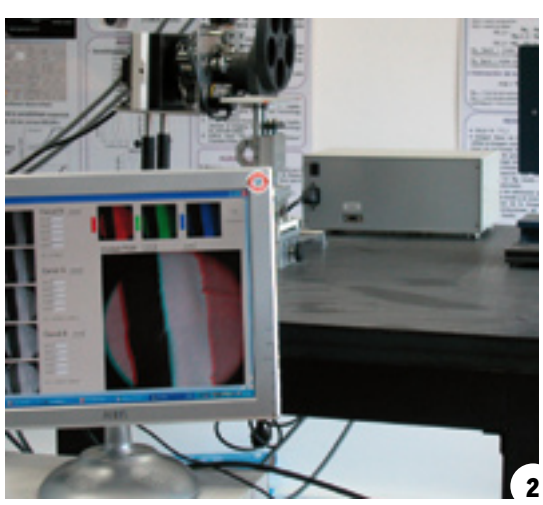

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