

Demonstrating the Capabilities of Hyperspectral Imaging for Dermatological Diagnostics



Researchers from the University of Greenwich have demonstrated the ability to track biological changes in a skin surrogate model using the Living Optics Hyperspectral Imaging Camera.

Identifying New Dermatological Diagnostic Techniques

Detecting changes in human skin enables the diagnosis of dermatological conditions, including early skin cancer detection. While traditional techniques such as dermoscopy and histopathology provide accurate data, they are often subjective and time-intensive. New dermatological diagnostic techniques aim to remove the need for experienced healthcare professionals to make subjective decisions while also reducing examination time.

A non-invasive imaging technique that measures reflectance differences across the visible and NIR wavelength range, Hyperspectral Imaging (HSI) is a leading candidate for monitoring biochemical changes in skin. HSI can reveal spectral signatures related to tissue composition, oxidative stress, and pigmentation anomalies, particularly relevant for skin cancer diagnosis.

Developing a Skin Surrogate Model

To prove these capabilities, researchers took a series of hyperspectral datasets using banana peel as a surrogate for human skin imaging. Both banana peel and human skin contain the enzyme tyrosinase, which regulates oxidative browning in bananas and plays a role in human melanin production. The process of oxidative browning as

bananas ripen has notable biochemical connections to skin pigmentation changes.

Leveraging this connection allows banana peel to act as a cheap and ethically viable skin surrogate for demonstrating the proof-of-concept of HSI as a potential dermatological diagnostic technique.

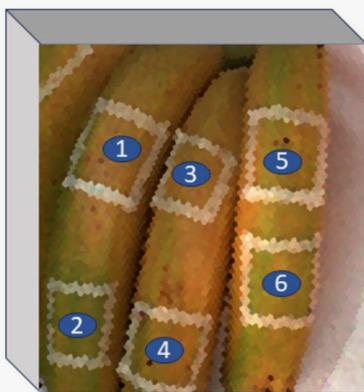
Banana Peel Pigmentation Changes as Seen by Living Optics Camera

Using the Living Optics Camera, hyperspectral images were collected over seven days, on days 1, 4, and 7. Spectral variations associated with pigmentation changes and structural transformations were observed across six regions of interest on three bananas.

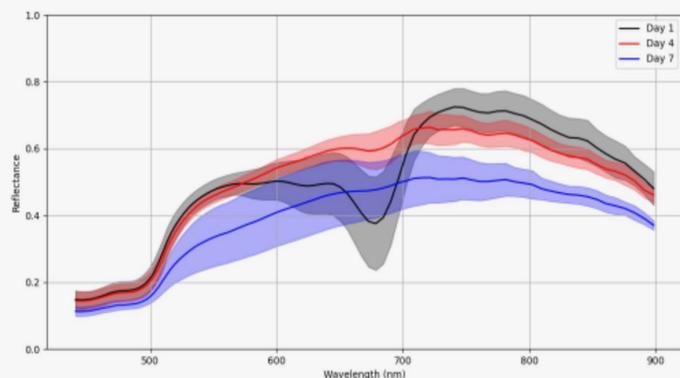
Using the Living Optics SDK, the hyperspectral images were calibrated using a white and dark reference. Evaluation metrics

were used to assess the quality of the reconstructed hyperspectral data in terms of spatial accuracy and spectral consistency.

Spectral data show the changes from day 1 to day 4 as the banana ripens and the level of chlorophyll drops, turning from green to yellow. By day 7 the banana peel is undergoing enzymatic browning, which further alters its spectral properties.



(a) Locations of the six selected regions of interest (ROIs) on HSI.

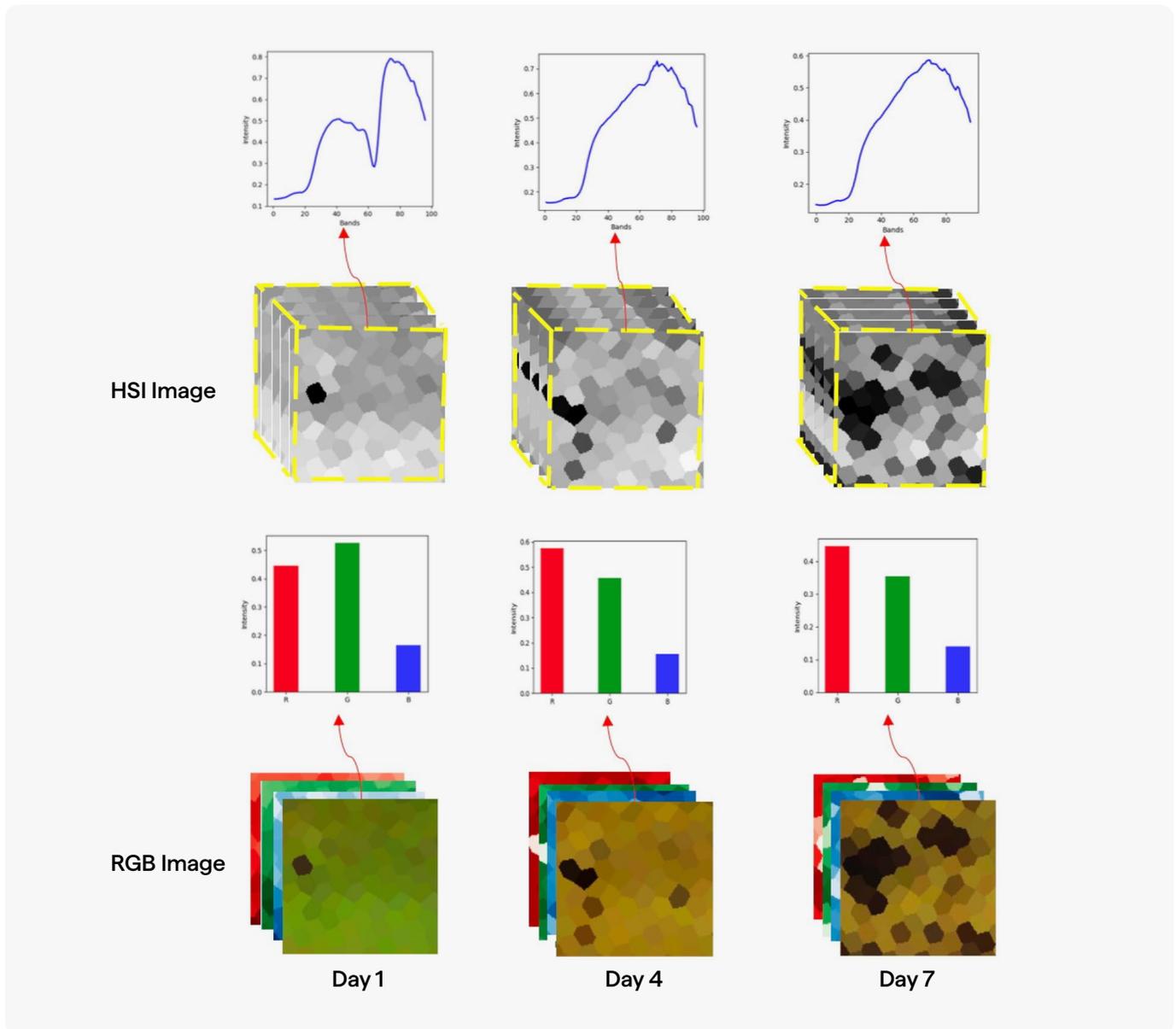


(b) Average spectral reflectance of six ROIs (solid lines) with standard deviation (shaded areas) for Day 1, Day 4, and Day 7.

Hyperspectral Imaging as a Dermatological Diagnostic Technique – A Proof-of-Concept

The surrogate model results prove that HSI can provide a non-invasive, cost-effective method of analysing pigmentation changes. The Living Optics Camera provided real-time hyperspectral datasets detailing how the

biochemical makeup of the banana peel changed over time. The plot below shows the benefits of HSI over RGB and the level of spectral insight provided compared to a basic three-channel camera.



Comparison between RGB and HS Imaging for ROI 5 across Days 1, 4, 7.

Spectral outputs from the Living Optics Camera detailed the pigmentation variation and bruising over 7 days in the banana peel. This analysis translates to dermatological conditions such as melasma, vitiligo, and

melanoma. Tracking pigmentation over time could also help enable personalised dermatological treatments and disease monitoring.

Customer insights

“By balancing high precision in capturing rich spectral data and flexibility of use, the Living Optics hyperspectral camera is ideal for exploring the unique spectral signature of biological tissues and supporting advanced AI tools for better healthcare.”

Prof. Gianluca Tozzi from the University of Greenwich