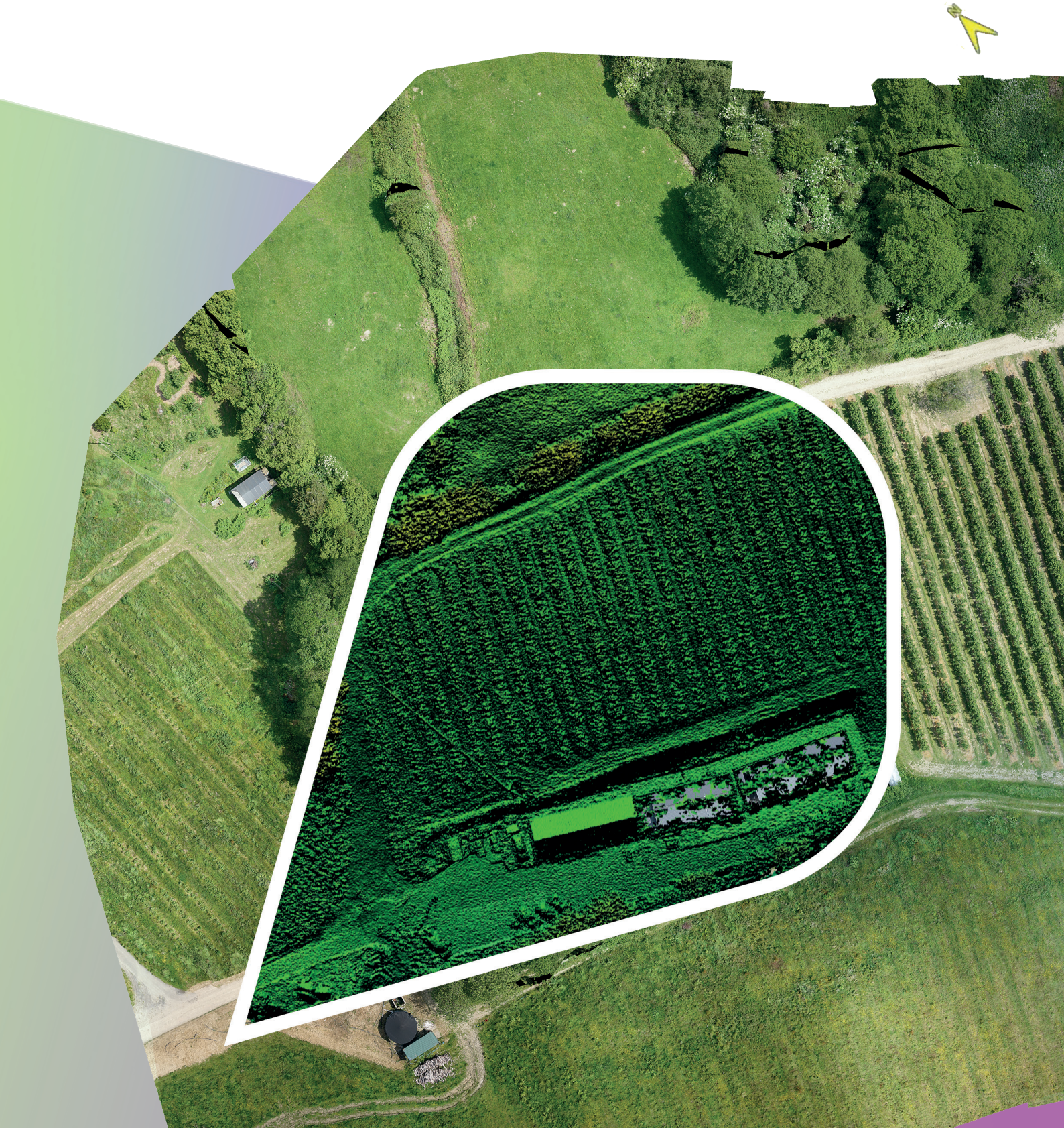
UK Agri-Tech Centre

Spectral imaging for agri-tech development



UK Agri-Tech Centre Pathway for Intelligent Agriculture using spectral imaging.

Spectral imaging as a general concept combines characteristics of imaging and spectroscopy technologies. Optical spectral imaging particularly makes use of visible, near infrared and short-wave infrared spectral range of light and has been demonstrated to be a very powerful tool in transforming phenotyping and identifying, classifying, and mapping specific targets.

Spectral imaging is especially useful in the agricultural domain, where its ability to detect minute changes in the light reflected from a target can be used to form a unique spectral profile or fingerprint. This profile can be correlated with phenotypic observations to detect and automate:

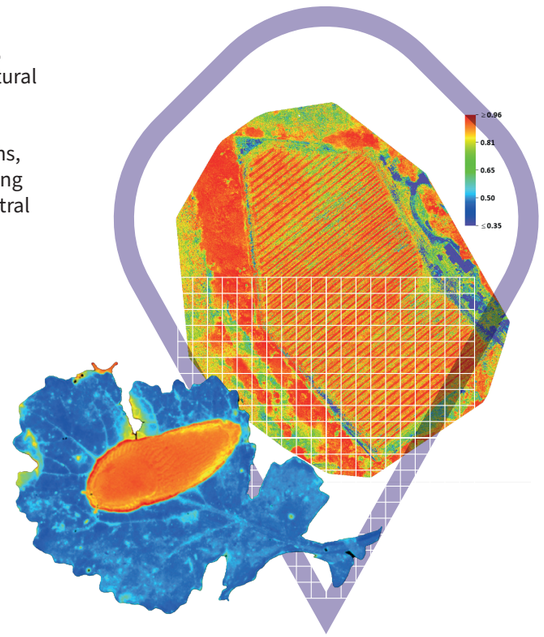
- Species identification.
- Disease/pest detection even before visible symptoms appear.
- Stress detection.
- Productivity indices.
- Non-destructive chemical analysis.

Spectral imaging technologies, including multispectral, hyperspectral, and fluorescence imaging, offer advanced tools for addressing agricultural challenges by extending human vision beyond the visible spectrum.

Multispectral imaging captures data across a few discrete wavelengths, making it a cost-effective option for assessing plant health, such as using the Normalised Difference Vegetation Index (NDVI). It captures all spectral data in a single frame, making it efficient for specific applications and allowing a specific cost-effective solution to be developed.

Hyperspectral imaging goes further by capturing hundreds of narrow wavelengths, providing detailed spectral signatures akin to a “fingerprint”. This detailed data can reveal subtle features that multispectral imaging might miss, making it ideal for precise analysis in agriculture.

Fluorescence imaging detects emitted light from objects excited by specific wavelengths, filtering out reflected light. It is particularly useful for detecting chlorophyll and specific molecular compositions, such as phenolics, which are crucial for monitoring plant health and disease.



Thinking about spectral imaging?

We offer a comprehensive suite of services designed to take your spectral imaging ideas from initial concept through to a fully commercialised product. Our process spans from understanding system requirements and identifying potential pitfalls, to implementation, unit testing, and ultimately, market demonstration and commercialisation.

1. Understanding product needs

Our journey begins by understanding the specific needs of the agricultural product. We utilise our extensive farm network to gather real-world data and insights; collaborate with trusted partners who bring specialised knowledge, and draw upon our in-house expertise in agricultural technology and intelligent agriculture. This is crucial to ensuring that the product development process is grounded in the practical challenges and opportunities that exist within the agricultural sector and ensure we can guide to a working solution.

2. Laboratory testing and spectral imaging exploration

Once the product requirements are well understood, we can take our ideas into a controlled laboratory to explore the potential detection of a spectral signal in a controlled environment. Our advanced laboratory facilities at the Digital Phenotyping Lab are equipped with cutting-edge hyperspectral and multispectral imaging systems that allows for precise image capture, detecting minute differences in samples. Our Hyperspectral SWIR 3.0 Camera, or multispectral Ximea, Videometer seed lab help in identifying the unique spectral characteristics of crops, soil, and other agricultural materials, crucial for developing targeted solutions.

3. Controlled glasshouse trials

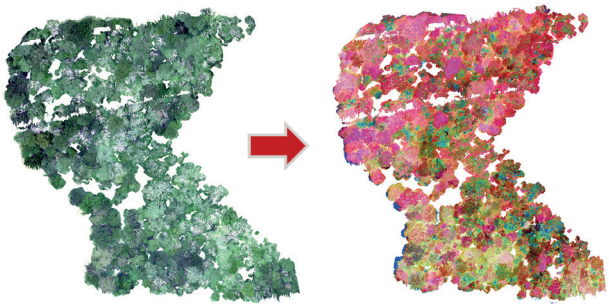
Following the success of the lab tests, we scale up the experiments in our glasshouse facilities from our advanced glasshouse facility to our spectral imaging gantry integrated glasshouse or even our Innovation Hub for Controlled Environment Agriculture (IHCEA). These controlled environments allow for larger-scale testing, where we can monitor the impact of different variables on spectral signature, plant growth and physiology under more realistic conditions. These trials are essential for validating lab results and understanding how the product performs in a semi-natural setting.

4. Remote sensing capabilities

With insights from the lab and glasshouse trials, we then move to field testing. Our UAV (Unmanned Aerial Vehicle) capabilities allow us to conduct large-scale surveys, gathering data across various terrains, conditions which allows us to study organisms difficult to assess in the controlled environments such as forestry and livestock. We have a range of sensors that can be mounted to our collection of UAVs. The multispectral MicaSense Altum Sensor, our Coaligned VNIR and SWIR multispectral cameras and Headwall Solar Induced Fluorescence which has the unique capability of being able to be used on the ground or be mounted to a UAV. This stage is critical for assessing the product's performance in real-world agricultural environments, where variables are more complex and less controlled.

5. Data processing, analysis and AI

At all stages, we process and analyse the collected data using our advanced software tools. This analysis is crucial for drawing meaningful conclusions, which in turn inform the refinement and finalisation of the product. By understanding the spectral signatures and other data collected during the laboratory, glasshouse and field tests, integrated with our centralised data systems we can optimise the product to meet the needs of intelligent agricultural solution. These data can then be used to train random forest AI classifying models.



6. Commercialisation and market demonstration

Once the product is refined and we agree it's ready for market entry, we focus on commercialisation and demonstrating its value to potential customers and partners to help grow within the sector. This involves developing a go-to-market strategy, identifying key agricultural segments, and creating demonstration projects which showcase the product's capabilities in real-world settings such as our smart farms and farm network. By engaging with industry stakeholders, potential customers, and investors, we ensure that the product not only meets market needs but also gains traction quickly.

Grow with Us

At every stage of this pathway, from initial understanding to final product development, the UK Agri-Tech Centre is dedicated to fostering innovation through, intelligent agriculture and growth. By integrating advanced technologies such as spectral imaging with our robust network and expertise, we are driving the future of sustainable agriculture. Join us in this journey to cultivate smarter, more sustainable agricultural practices.

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