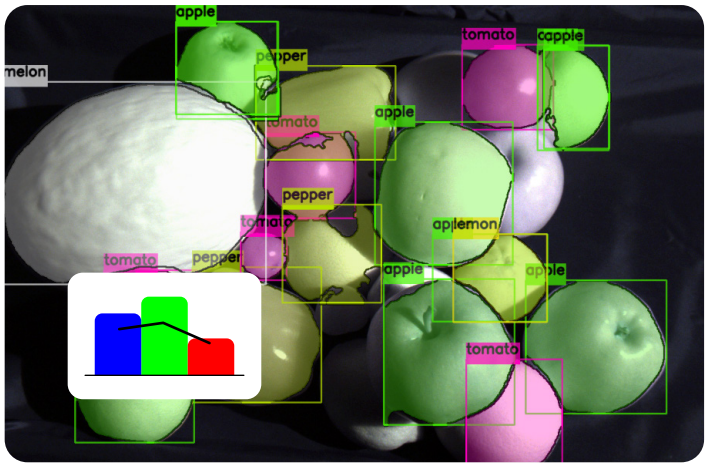
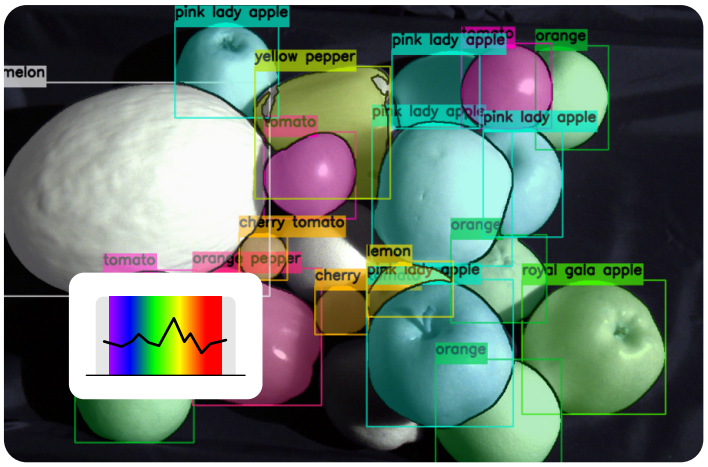
Living Optics

# Machine Vision with enhanced detection using Hyperspectral Data

**Enhance detection beyond the state of-the-art. Classify object sub-class. Generalize with minimal training data and significant reductions in compute.**




## The problem with Machine Vision

Conventional RGB imaging hardware is insufficient to unlock reliable machine perception.

- Machine learning models trained on RGB images require prohibitively large datasets and painstaking labelling.
- State-of-the-art algorithms e.g. YOLO demand substantial compute power.
- Detection algorithms rely largely on shape information, and often fail to identify occluded objects.
- There are significant domain limitations for RGB computer vision as it is limited to human like perception.

### Hyperspectral Imaging (HSI)

HSI a passive sensing technique that sees colour at many more wavelengths than conventional (RGB) cameras. With both spatial and spectral information, it is possible to recognize objects from their inherent material properties. HSI has yet to step-up to enable advanced machine vision performance, until now.

## Living Optics' data driven solutions

Combining Living Optics' cutting-edge proprietary technology with data-driven approaches leads to improved performance across a variety of metrics, as well as making previously impossible applications possible.

Detect more than just broad object categories. Hyperspectral data allows for:

- The detection of specific sub-classes of objects.
- Building models with minimal training data.
- Significant reductions in computational cost.
- Distinguishing between categories that are invisible to the naked eye.
- Locating of anomalies not previously possible.
- Recognition of objects or materials that only occupy a single pixel in a scene.
- Correlation of physical and chemical properties of organic material. With explainability rooted in our understand of the world.

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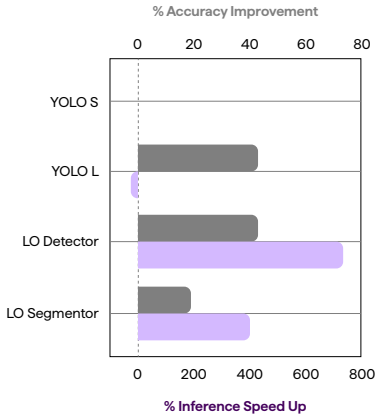
## RGB vs LO HSI comparison

Detecting fruits in orchards with dynamic lighting conditions and heavy occlusion poses significant challenges. Traditional RGB imaging methods, even when using advanced models like YOLO, often struggle under these conditions. In contrast, Hyperspectral Imaging (HSI) offers a superior alternative with remarkable efficiency and accuracy.

Below is a performance comparison highlighting the advantages of Living Optics spectral detection techniques against SOTA object detection techniques.

| Criteria | RGB YOLO | LO detector |
|---|---|---|
| Training data | 4500 | 4500 |
| Training time | 4 hours | 10 minutes |
| Training cost | Moderate | Negligible |
| Inference compute | Standard | 10x reduction |




## Living Optics data offering

Living Optics is collaborating with industry leaders to build up the world's most extensive hyperspectral data offering. Including industries such as agriculture, national security and industrial inspection.

### Get access to our datasets

Our public dataset can be accessed through hugging face and more available on request. Reach out to us for more details at livingoptics.com/contact-us.

### Datasets

- Hyperspectral Fruit: livingoptics.com/huggingface
- Hyperspectral Orchard: 4 TB of HSI data captured with the largest orchard grower in the UK. Containing 6000 annotated instances.
- Hyperspectral Vineyard: 3 TB of HSI data captured at a small batch vineyard.
- Security: containing 50+ environments and across various security use cases, including anomaly detection, tag and track and object identification.

## Development Kit

Providing the full stack of tooling: hardware, software and examples for a rapid start to specific use case exploration.

Combines the latest M models for traditional imaging and hyperspectral material identification using synchronized data streams from the LO camera. Packaged with a Python development environment and NVIDIA GPU in a portable processing unit, users can evaluate algorithms and live-stream outputs to any networked device.

## About Living Optics

Living Optics is on a mission to make hyperspectral imaging widely accessible. Our cutting-edge technology captures data inaccessible to the human eye and conventional cameras, delivering information in an affordable and portable solution for a diverse range of industrial and consumer applications.

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