TRACES

TRACE RETRIEVAL, AND AUTOMATED CHARACTERISATION AND EVALUATION SYSTEM

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Presentation outline

- The collaboration
- What we have to offer
- Our core technologies
  - Easylift®
  - Spectral 360
- Conclusion

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A COLLABORATION BETWEEN:

AVATECH

EASY LIFT®

SPECTRAL360

SUPPLIED BY:

TECMAN

ADVANCED MATERIAL ENGINEERS

What we have to offer

- Forensic tape development in conjunction with TECMAN ADVANCED MATERIAL ENGINEERS
- Image processing
- Expertise in
  - database creation
  - inferential data analytics
- Deep knowledge of the forensic context

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The team - forensic expertise

- FCSFS, CSFS Council Membership and CSFS Assessor
- Staffordshire Forensic Partnership
- National Police Chiefs Council working groups – validation studies
- Forensic Science Benchmark
- Active members of UK Fibres Forum
- Video forensics with multiple police forces
- UK lead for EU-funded Internet of Things Research Collaboration
- Co-lead for a EU-funded forensic network

The technologies

- Relevant, patented technologies:
  - Easylift® – Ready for use in as SHUTTLE tool 1 (TRL 6), with further development scope available
  - Spectral 360 – Proven (TRL 6) powerful image processing system, ready for application to the image processing and database population needs of the SHUTTLE project

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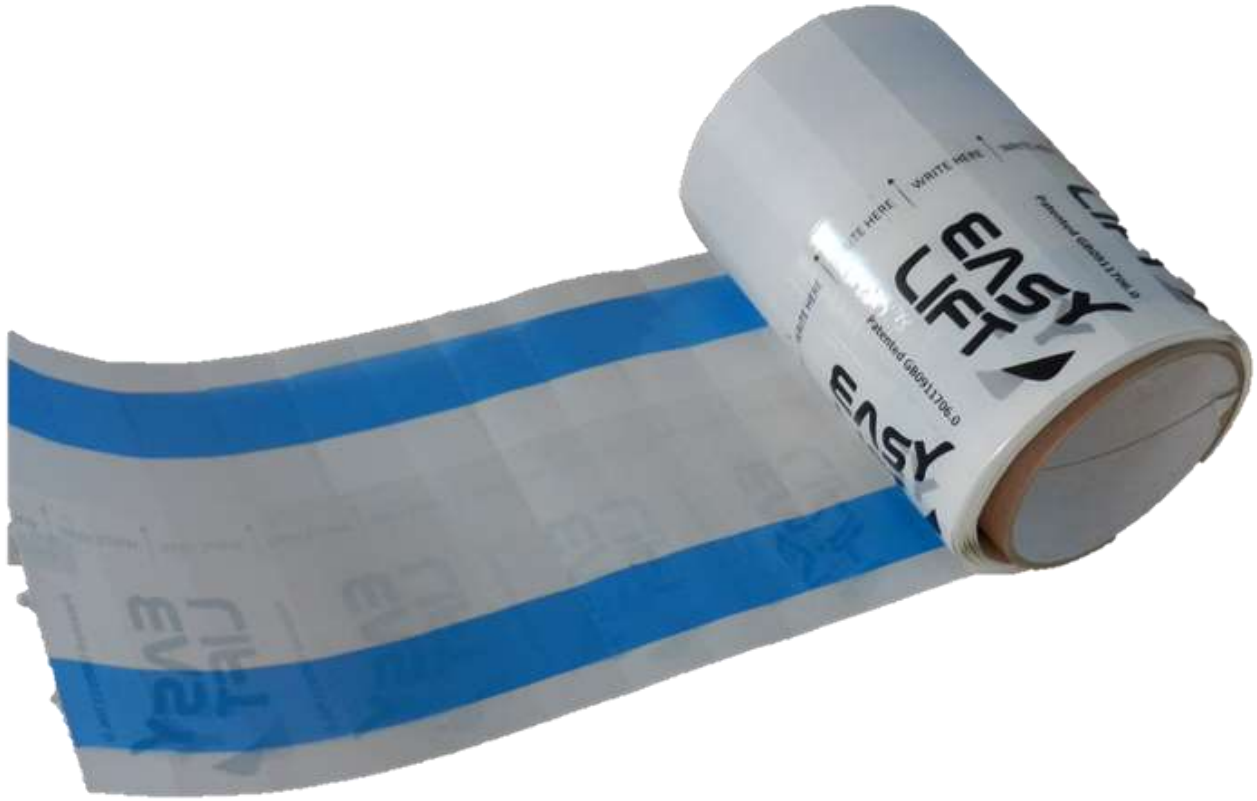
EASY LIFT®
EVIDENCE THAT STICKS



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EASY LIFT®
EVIDENCE THAT STICKS

Netherlands Forensic Institute
Ministry of Security and Justice

EASY LIFT®
EVIDENCE THAT STICKS

Ready for incorporation into the SHUTTLE toolkit

- Available at TRL 6:
  - with bespoke variation of size, labelling, adhesive strength, packaging etc
  - on roll or pre-cut
  - in small batches or in bulk
- Manufactured with strict quality control

TECMAN
ADVANCED MATERIAL ENGINEERS

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EASY LIFT®
EVIDENCE THAT STICKS

Ready for incorporation into the SHUTTLE toolkit

- Easy to use at crime scenes

BEDFORDSHIRE POLICE
fighting crime, protecting the public

Creating a safer Cambridgeshire

HERTFORDSHIRE CONSTABULARY

Scientific Services Unit

STAFFORDSHIRE POLICE

EASY LIFT®
EVIDENCE THAT STICKS

Ready for incorporation into the SHUTTLE toolkit

- Example feedback from CSIs and forensic practitioners

Ready for incorporation into the SHUTTLE toolkit

- Easy to use at crime scenes
- Ultra-low Optical Path Difference – compatible with polarised light microscopy

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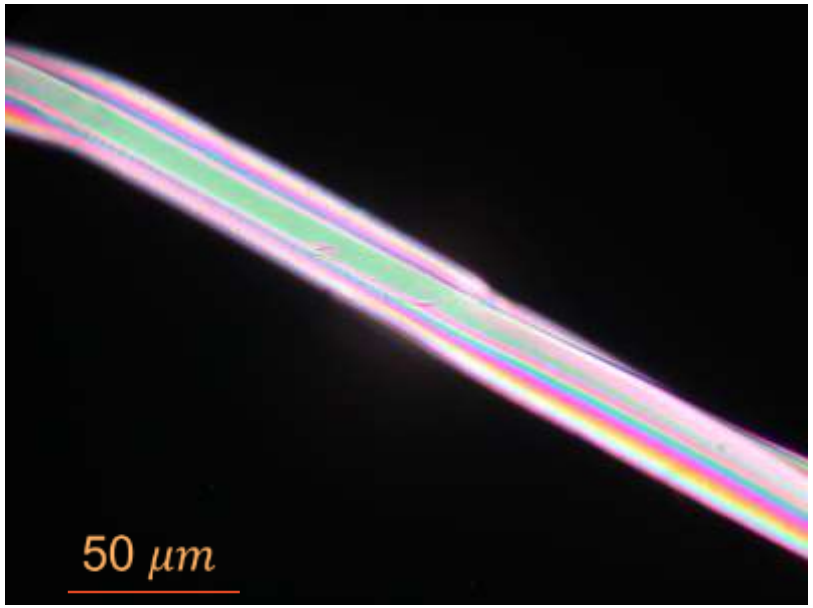
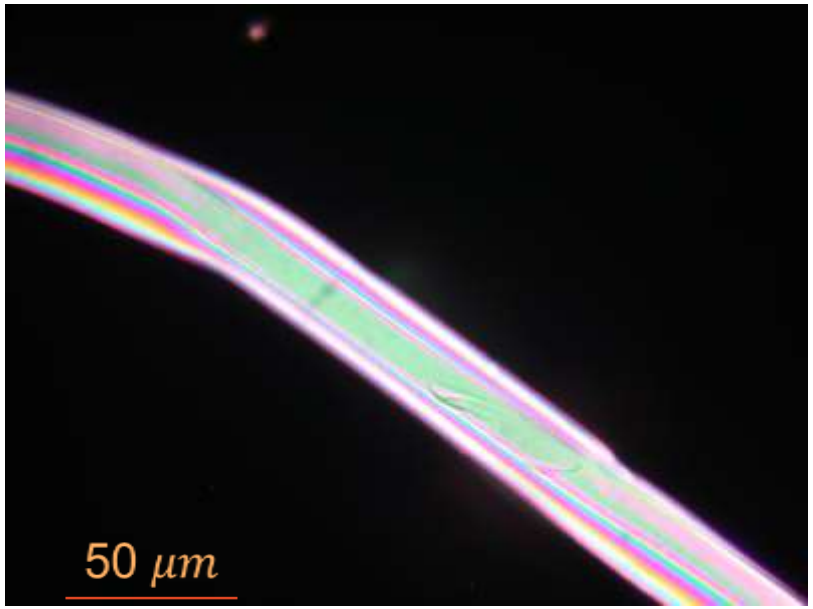
Glass slide, coverslip, entellan mountant



Plus Easylift® tape



Ready for incorporation into the SHUTTLE toolkit

- Easy to use at crime scenes
- Ultra-low Optical Path Difference – compatible with polarised light microscopy
- High optical clarity - compatible with fluorescence microscopy, MSP and confocal Raman spectroscopy

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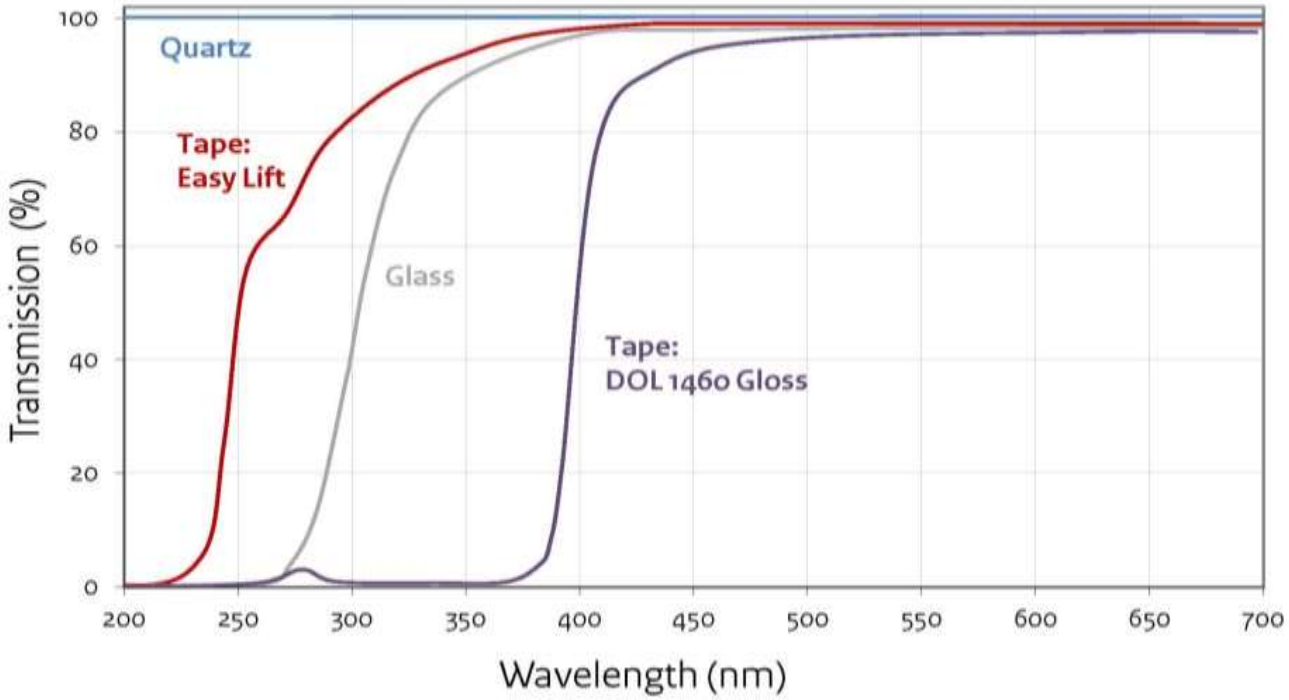
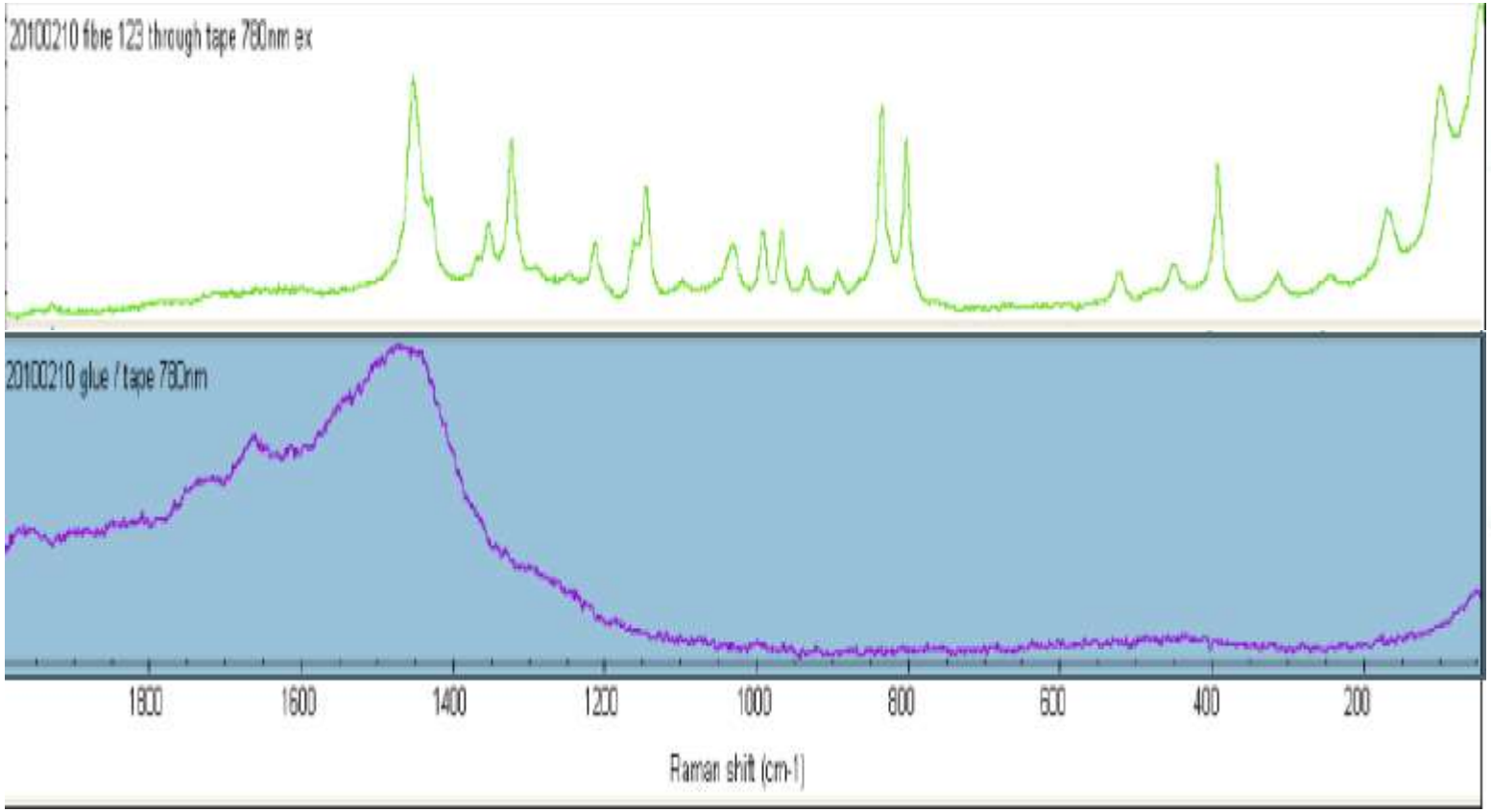
EASY LIFT®
EVIDENCE THAT STICKS

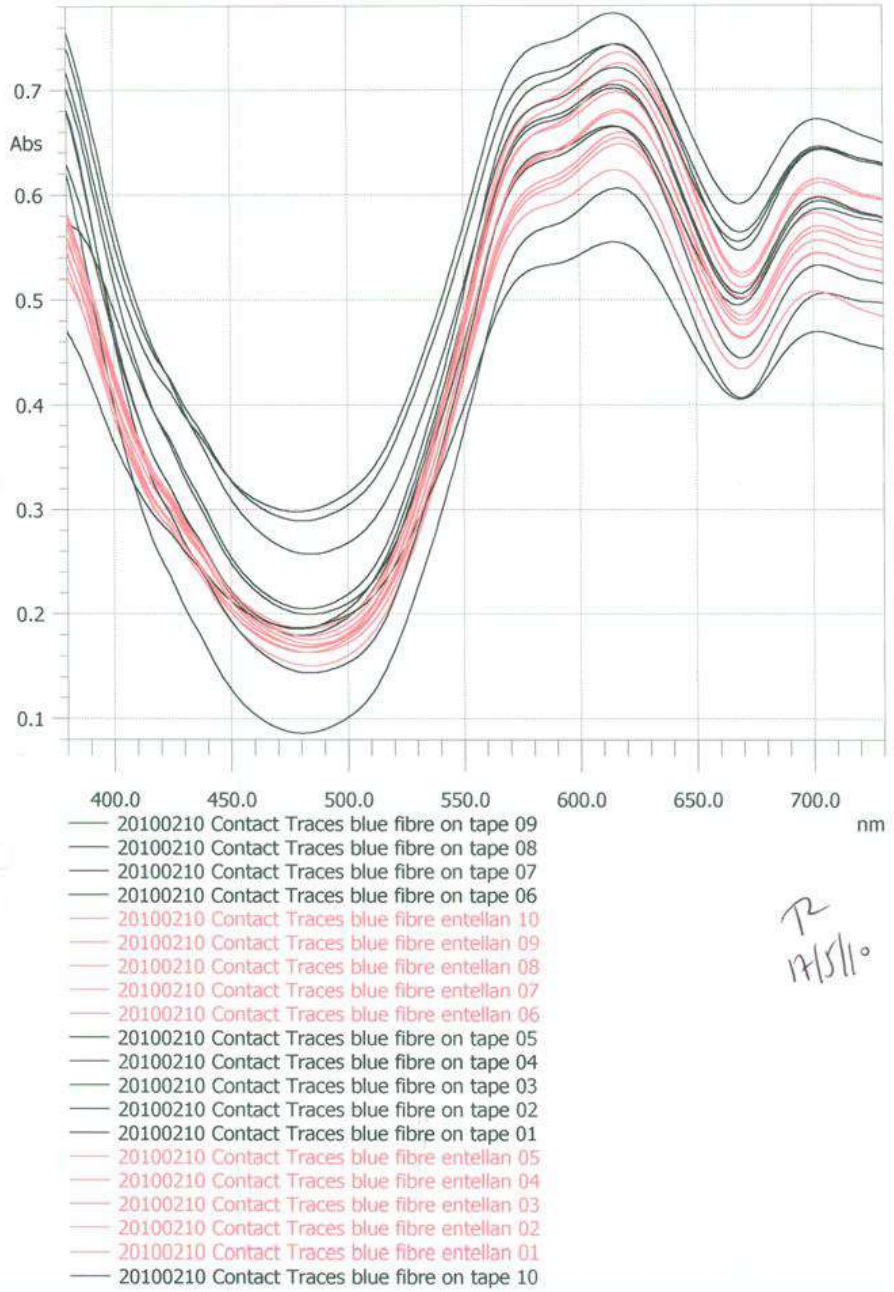
An independent blind study of the qualities of 25 tapes found two that showed acceptable OPD and fluorescence. These are Easylift® and Avery Dennison DOL 1460 gloss. The UV-vis spectra of these is shown here:

Netherlands Forensic Institute
Ministry of Security and Justice



Contact Traces
SPECIALISTS IN FORENSIC SCIENCE





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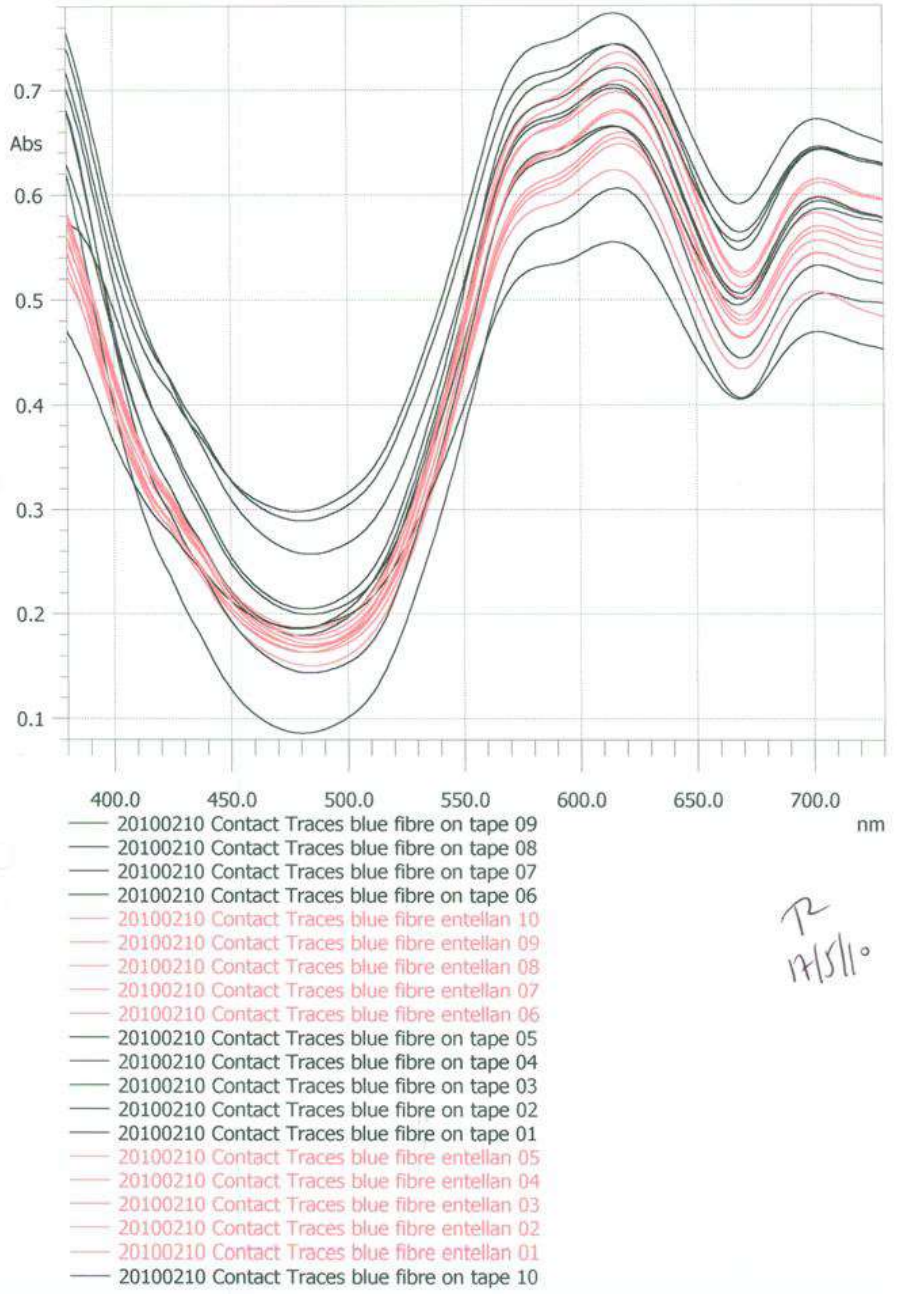
Independent examination by Tiernan C, Contact Traces

Contact Traces
SPECIALISTS IN FORENSIC SCIENCE



EASY LIFT®
EVIDENCE THAT STICKS

Ready for incorporation into the SHUTTLE toolkit

- Easy to use at crime scenes
- Ultra-low Optical Path Difference – compatible with polarised light microscopy
- High optical clarity - compatible with fluorescence microscopy, MSP and confocal Raman spectroscopy
- Easy to dissect, allowing the isolation of items of trace evidence with ultra-low residue

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EASY LIFT®
EVIDENCE THAT STICKS

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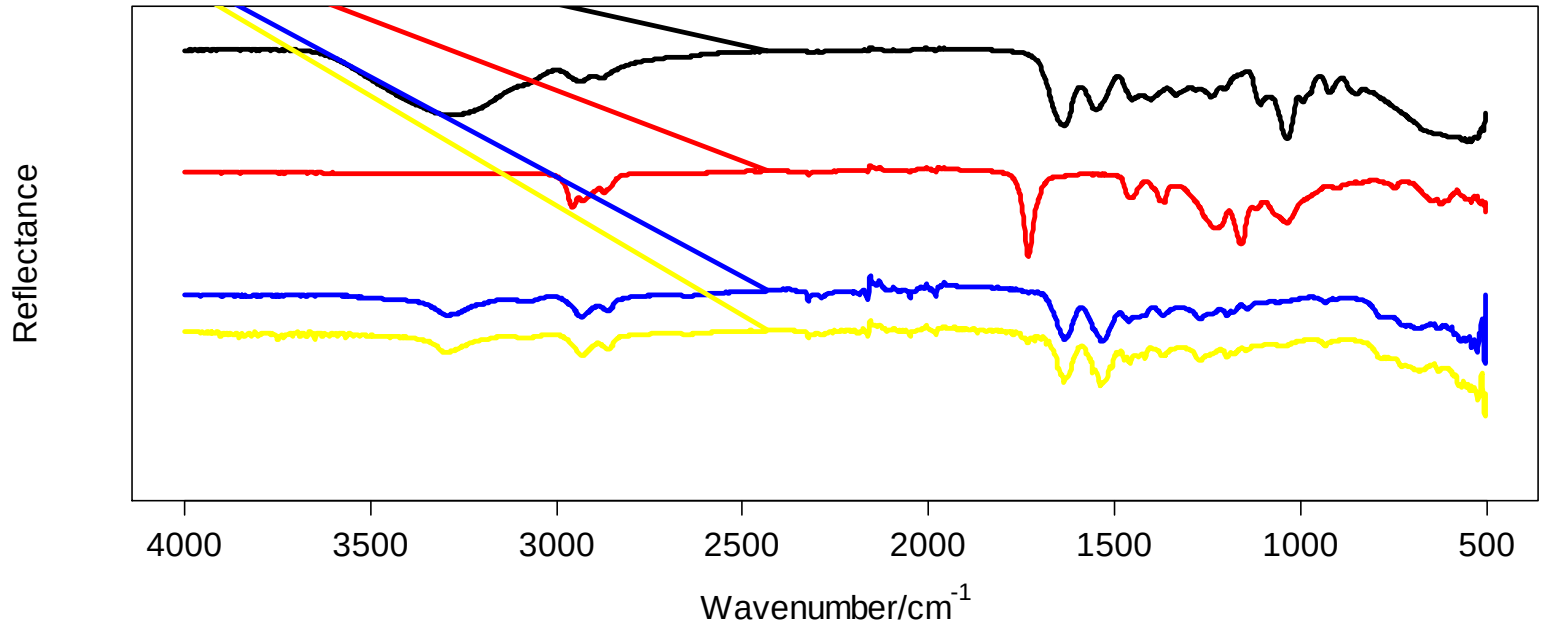
EASY LIFT®
EVIDENCE THAT STICKS

Black = Mountant, Red = Adhesive, Blue = Nylon, Yellow = Nylon dissected from Easylift



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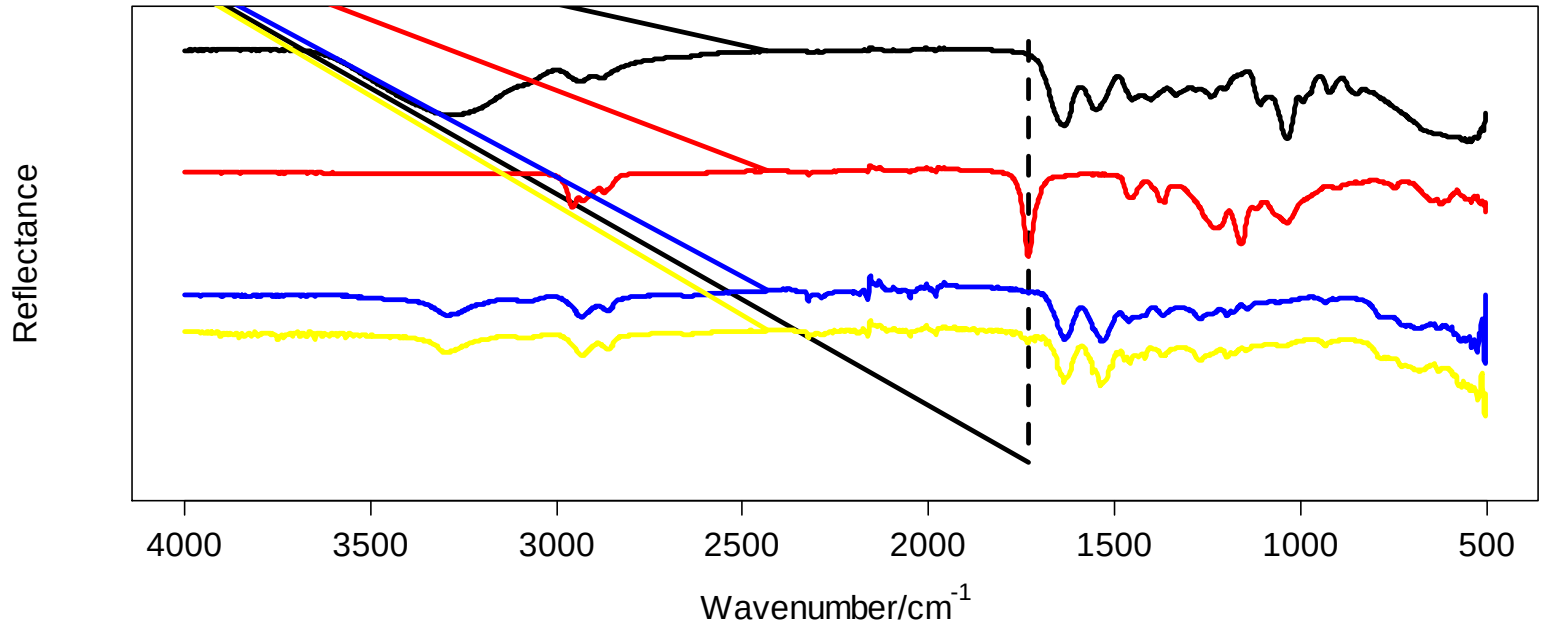

EASY LIFT®
EVIDENCE THAT STICKS

Ready for incorporation into the SHUTTLE toolkit

- Easy to use at crime scenes
- Ultra-low Optical Path Difference – compatible with polarised light microscopy
- High optical clarity - compatible with fluorescence microscopy, MSP and confocal Raman spectroscopy
- Easy to dissect
- DNA compatible – comparable with minitapes

In development

- Ultra-low OPD polymer slides
- *In situ* presumptive testing proven for blood – allowing the potential for colour development for body fluids, firearms discharge residue, explosives and drugs

EASY LIFT®
EVIDENCE THAT STICKS

Proof of concept presumptive testing for 1 in 10^4 dilution of blood using LMG

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AVADETECT AVAPROTECT AVAANALYSE AVACOUNT

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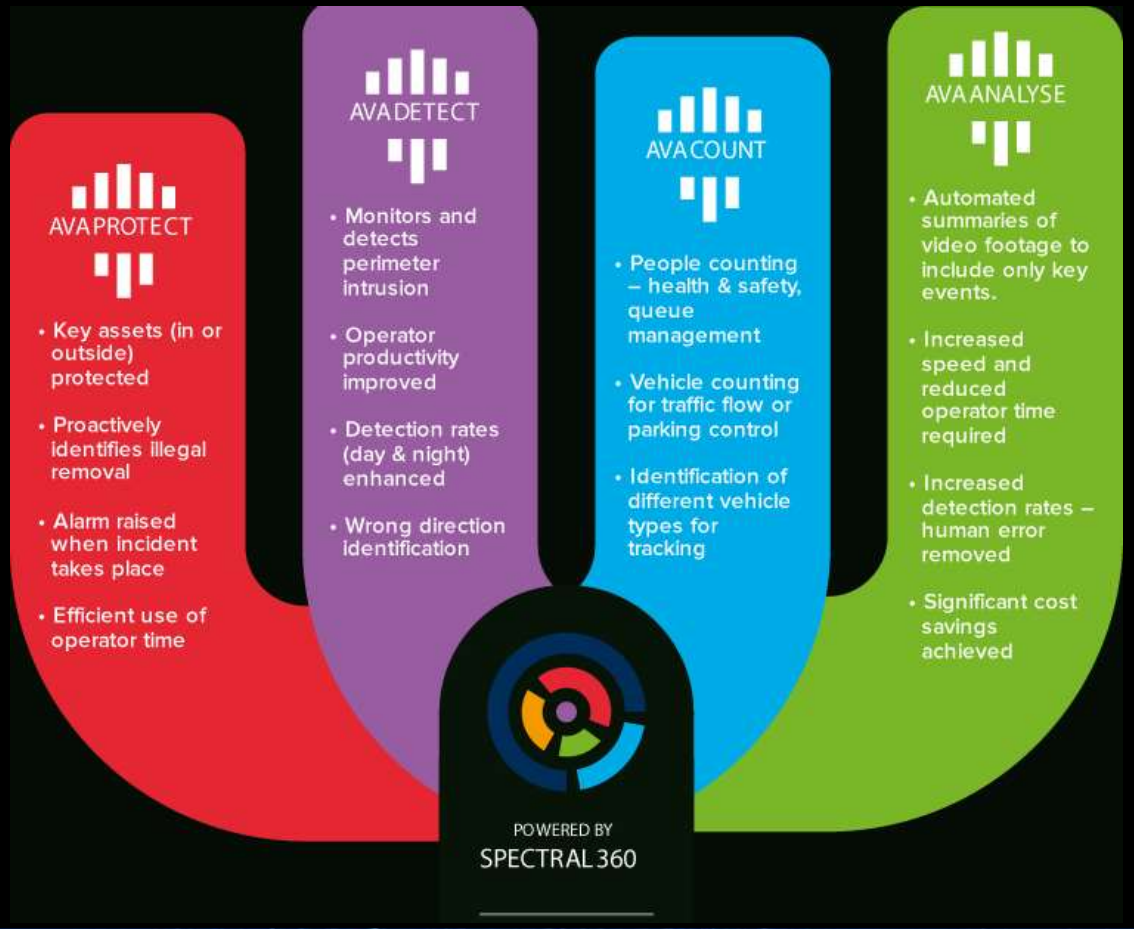

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Collaboration with industry and public bodies

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- Illumination estimation
- Spectral reflectance/transmission estimation
- Image enhancement – tone mapping
- Segmentation
- Object detection
- Localisation - Camera calibration
- Tracking
- Classification

Our Capabilities

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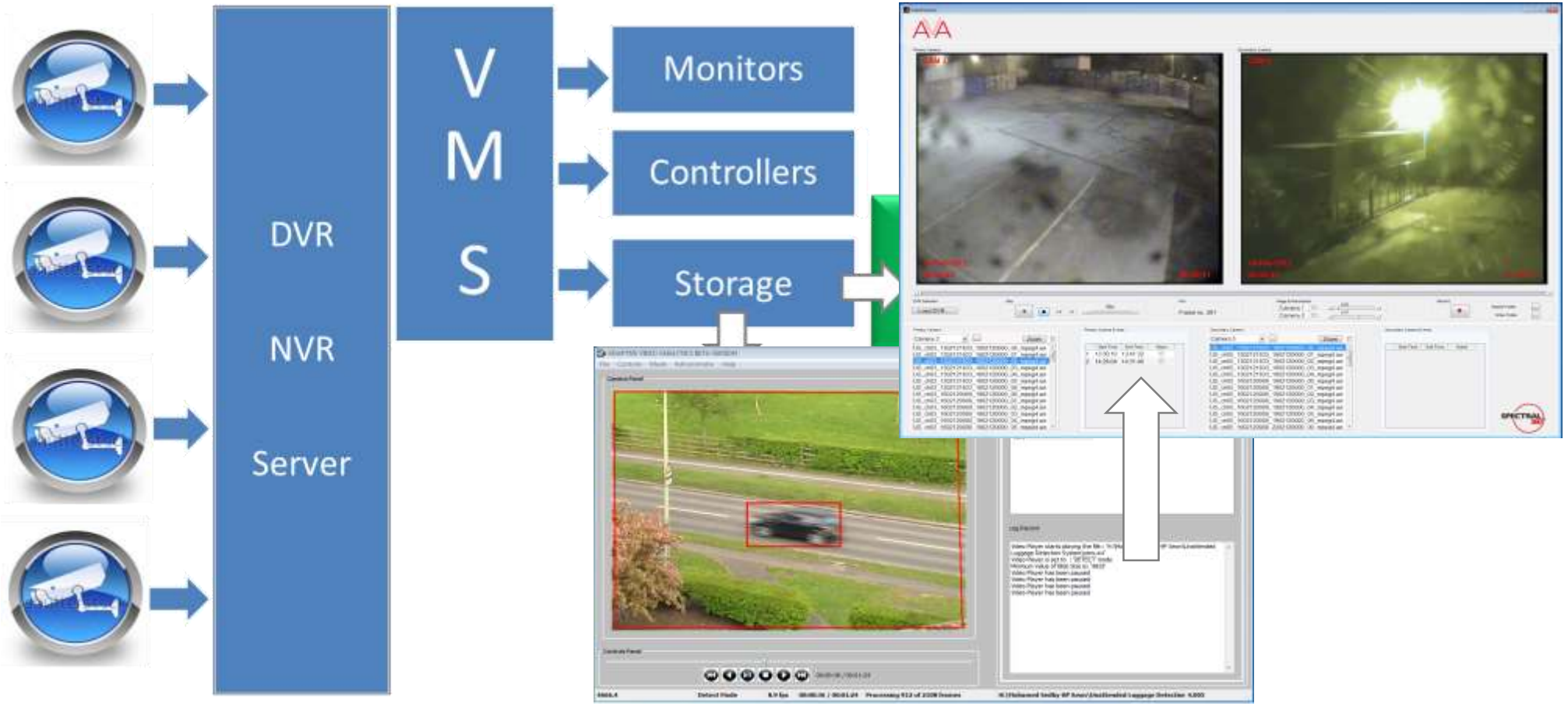

Video Forensic Solution

- Illumination variation
- Surface colour disparity
- Suitability for real-time applications
- Cost effectiveness
- Incompatibilities with other sensors

Machine vision - key challenges

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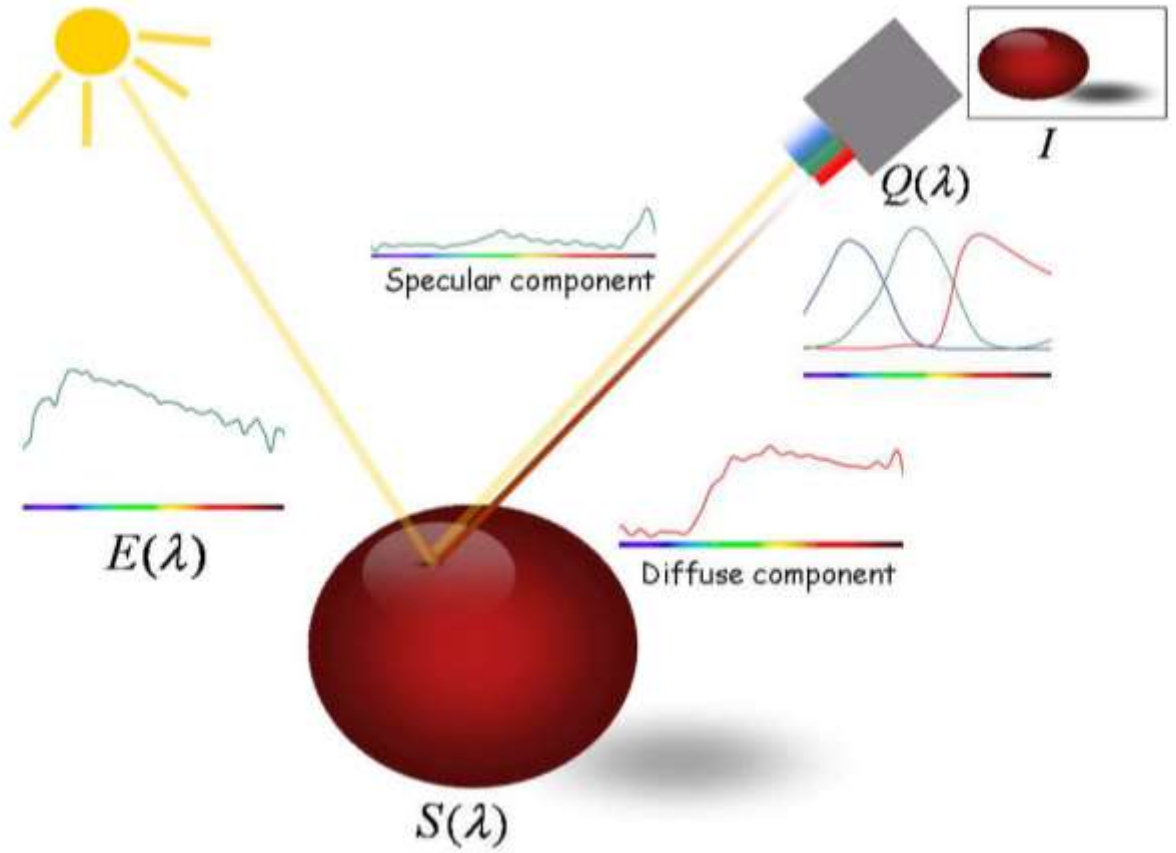

Spectral-360: physics based machine vision

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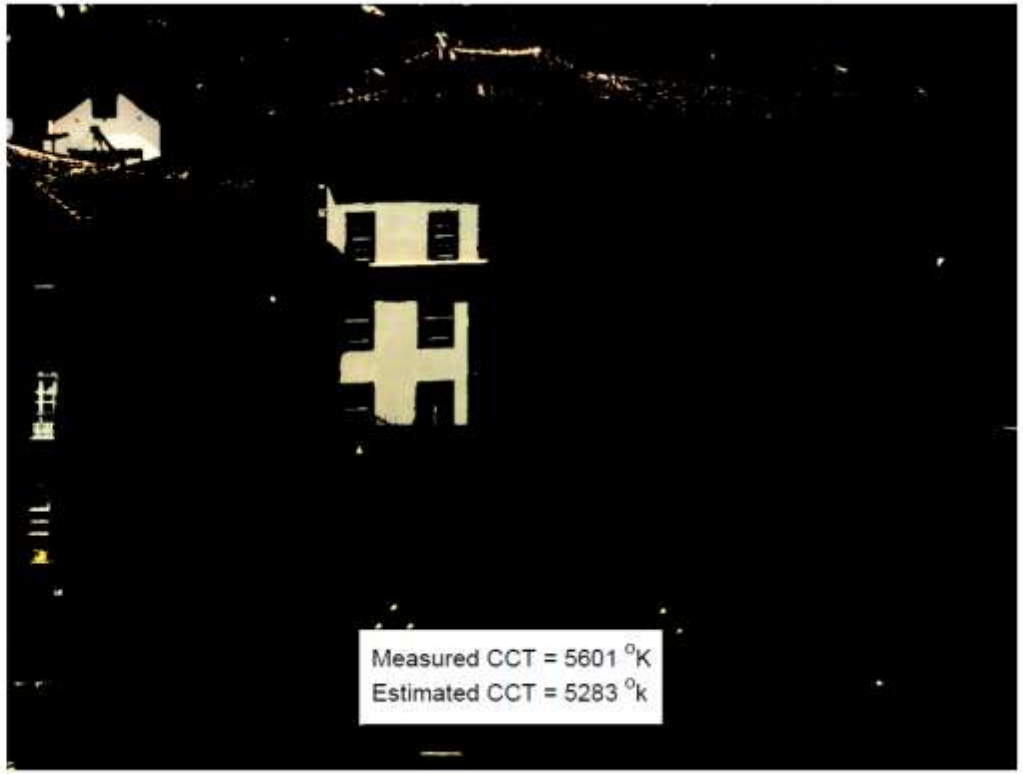

Illumination Estimation

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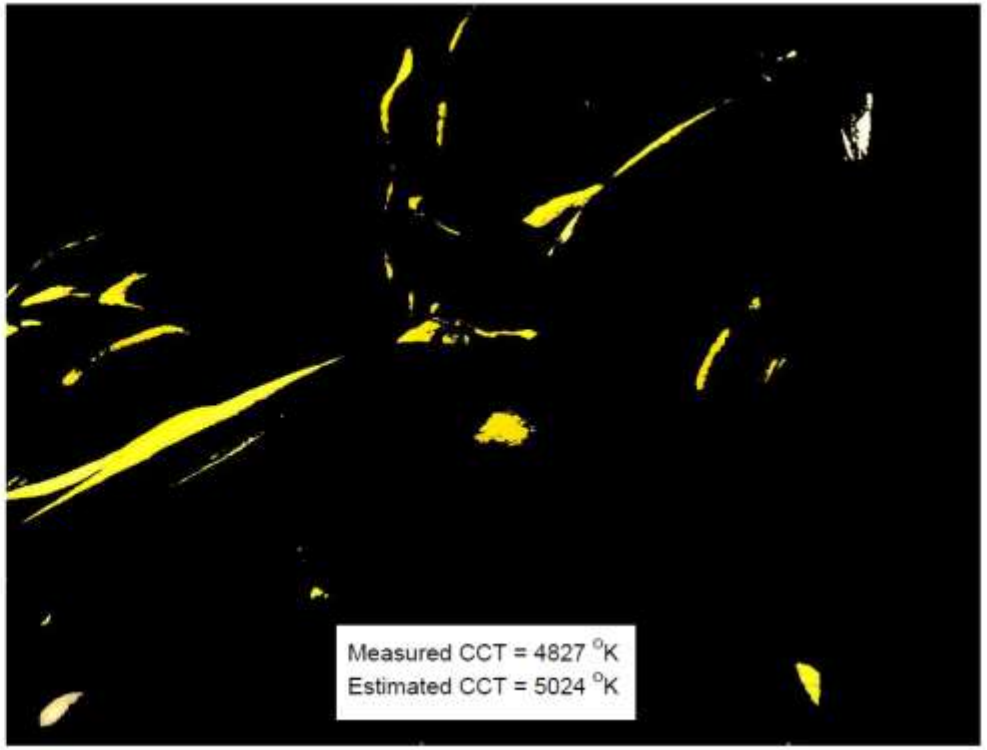

Illumination Estimation

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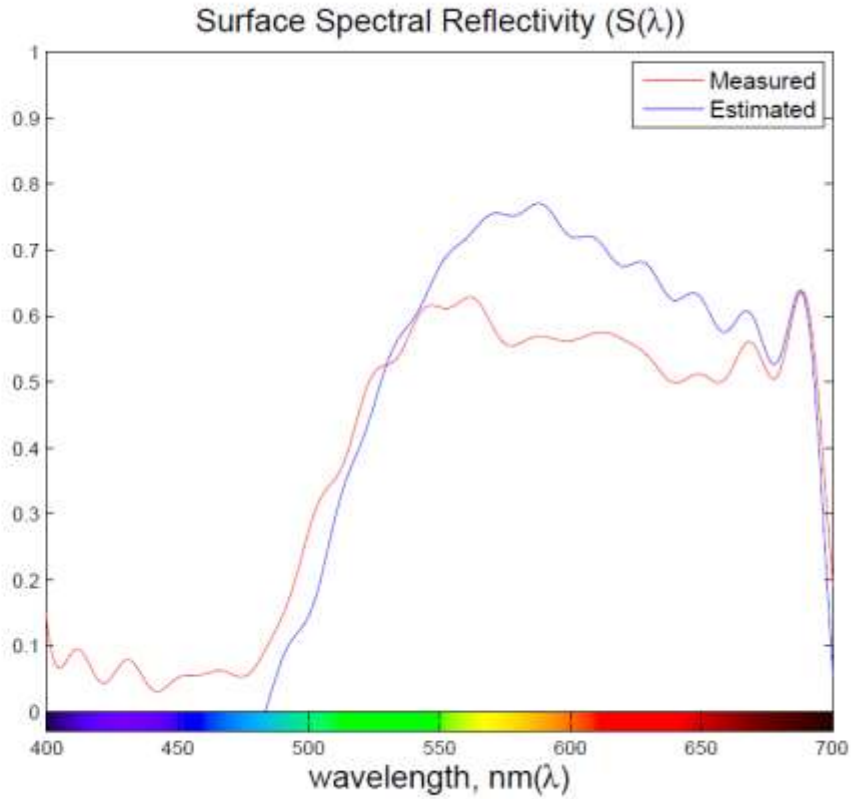

Surface Spectral Reflectance Estimation

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- Adapts itself to different complex scene structures
- Detects camouflaged objects under rapid illumination changes
- Reduces false alarm and missed detection rates

Spectral-360: physics based machine vision

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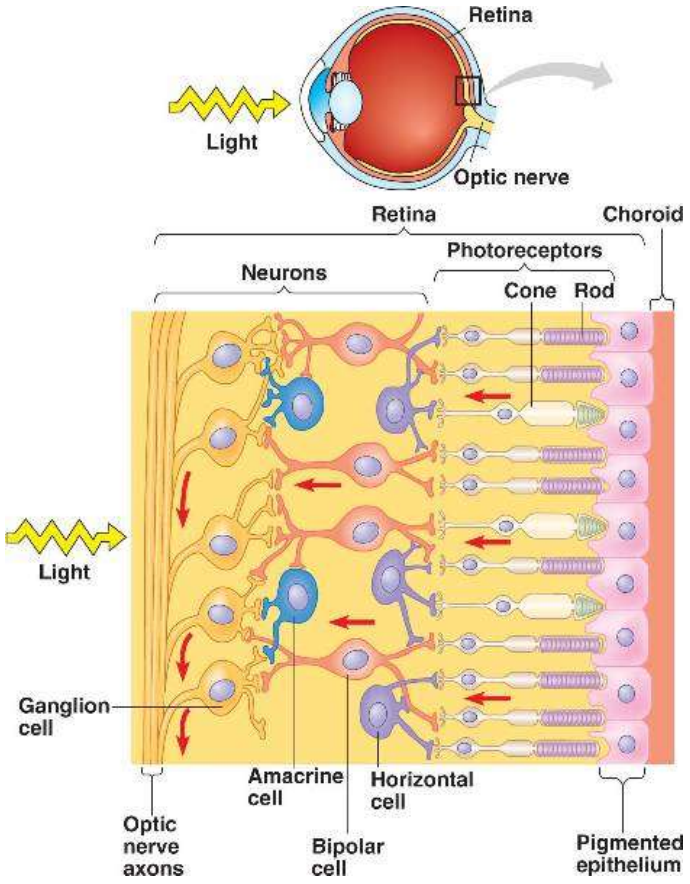

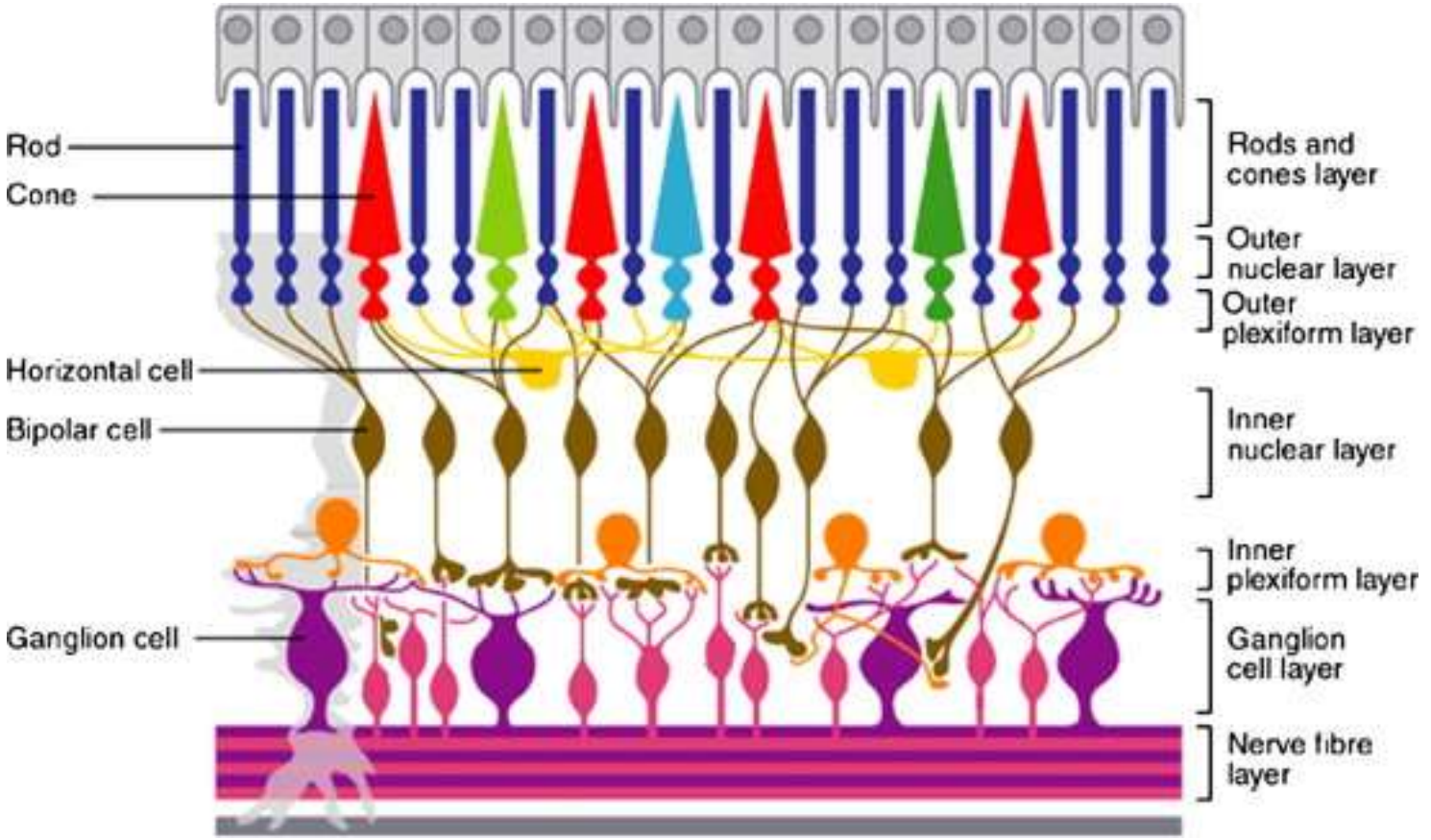

Retina-inspired Image Enhancement

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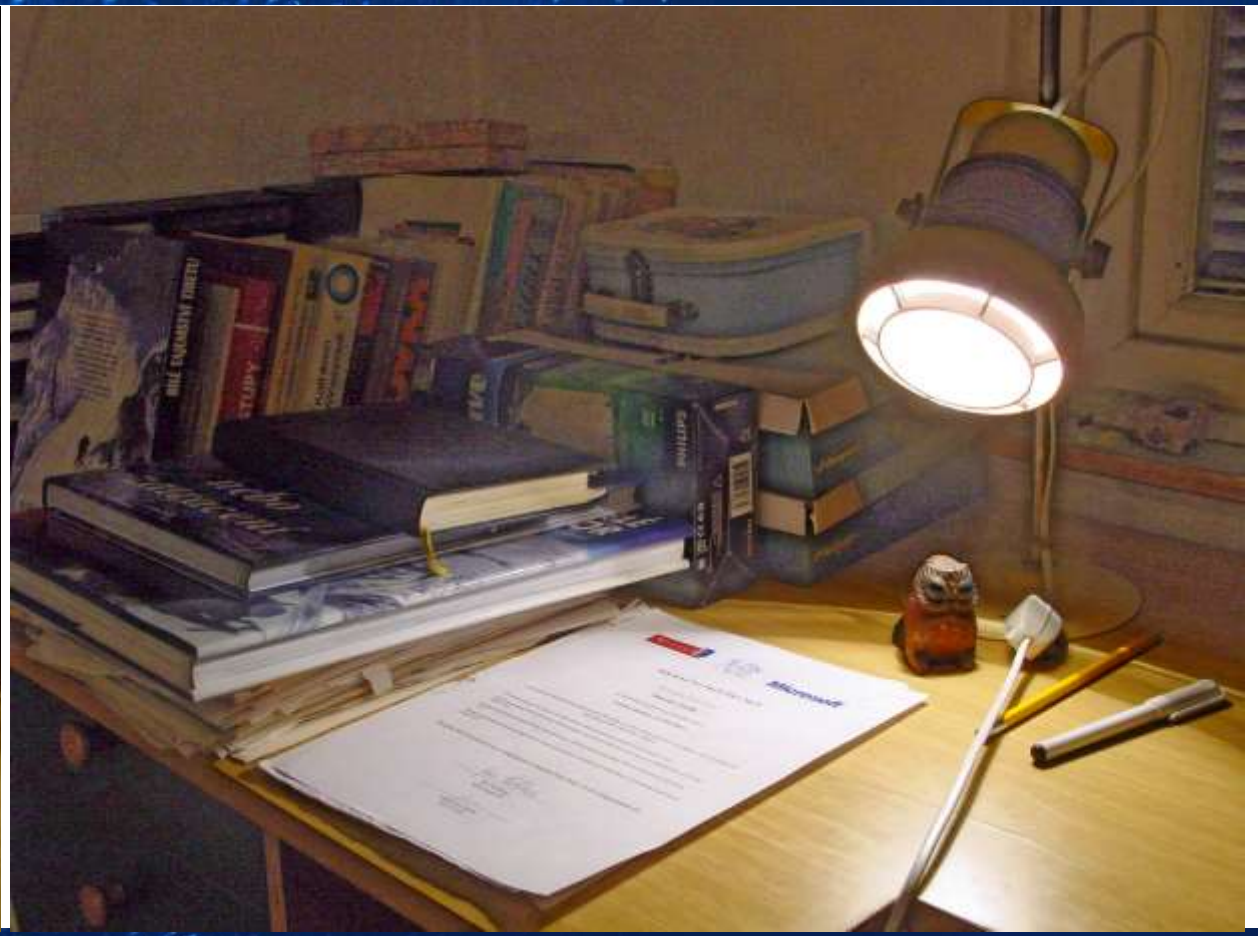

Retina-inspired Image Enhancement

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Retina-inspired Image Enhancement

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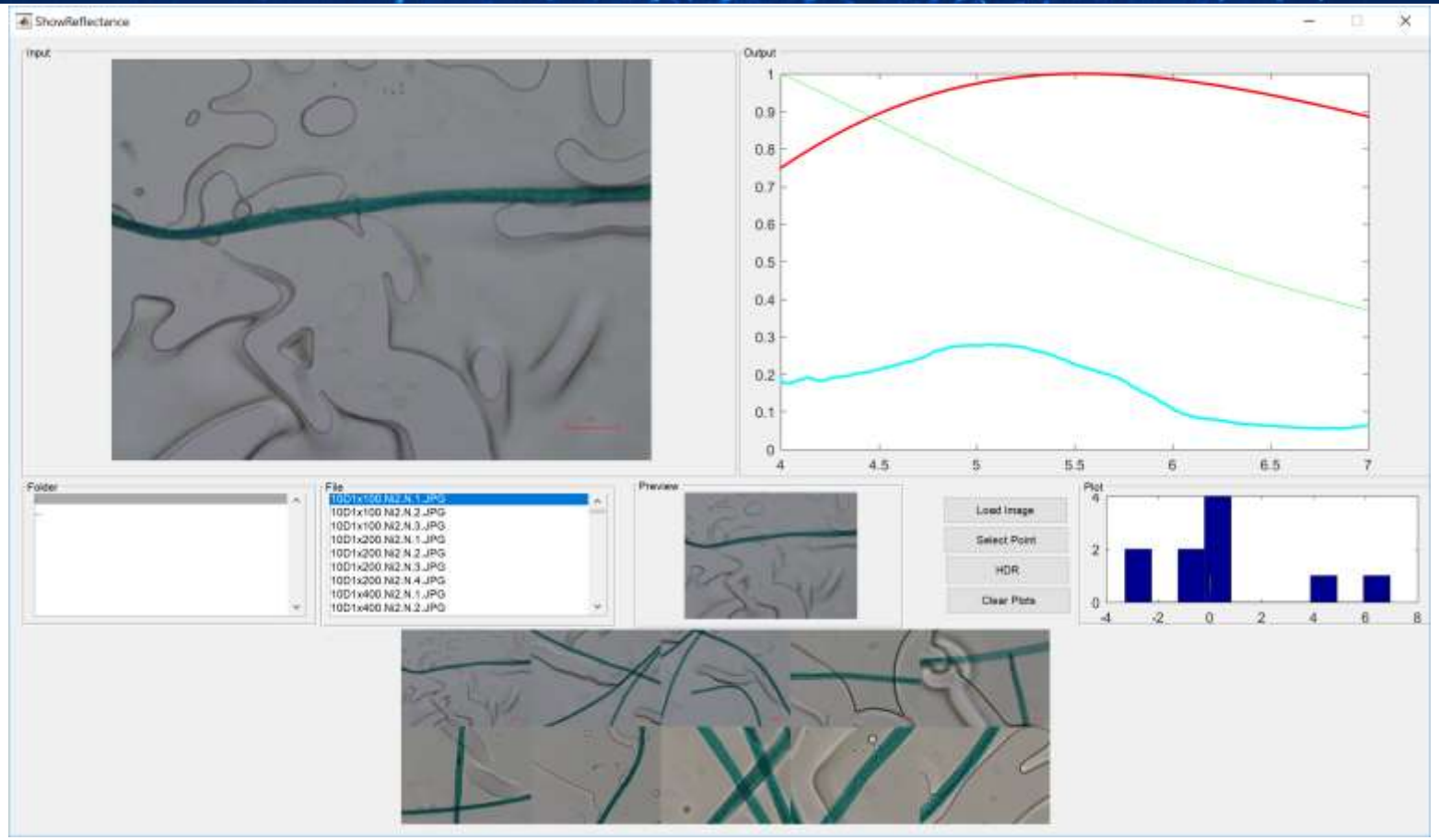

Graphical User Interface

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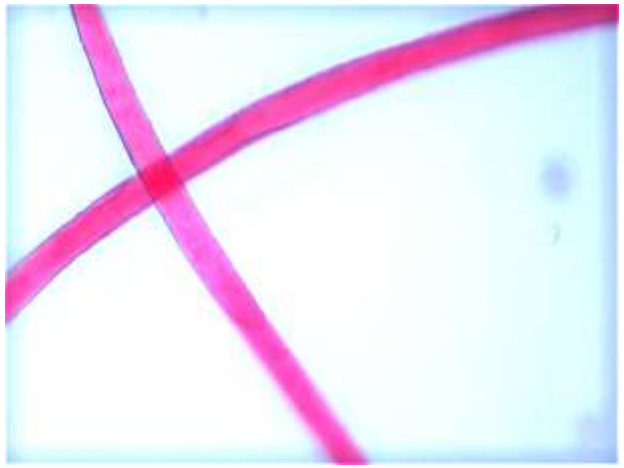
What does a human see?

- Poor image
- Two fibres

Human view

Machine view



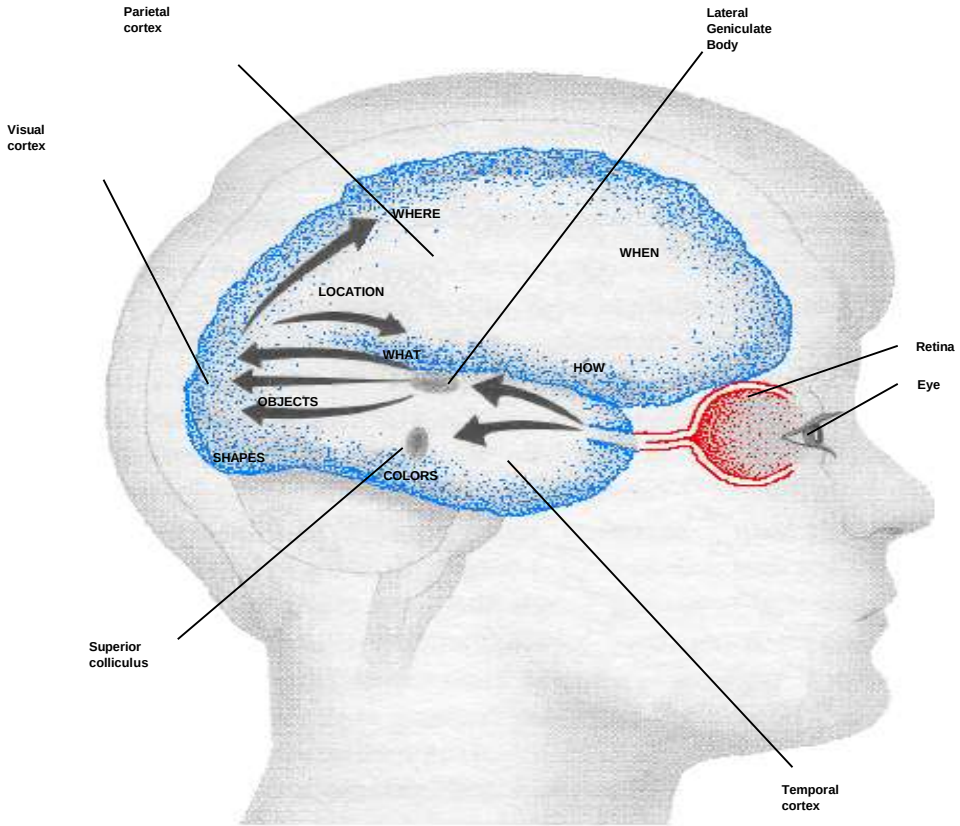
What does a machine see?

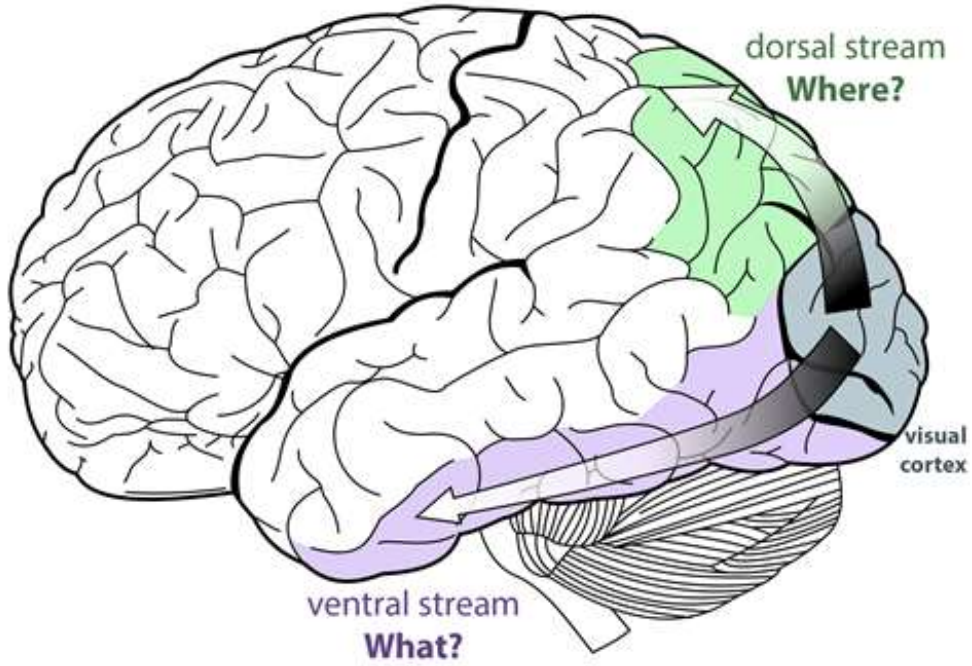
- Pixels of varying colour

With machine learning: Two fibres

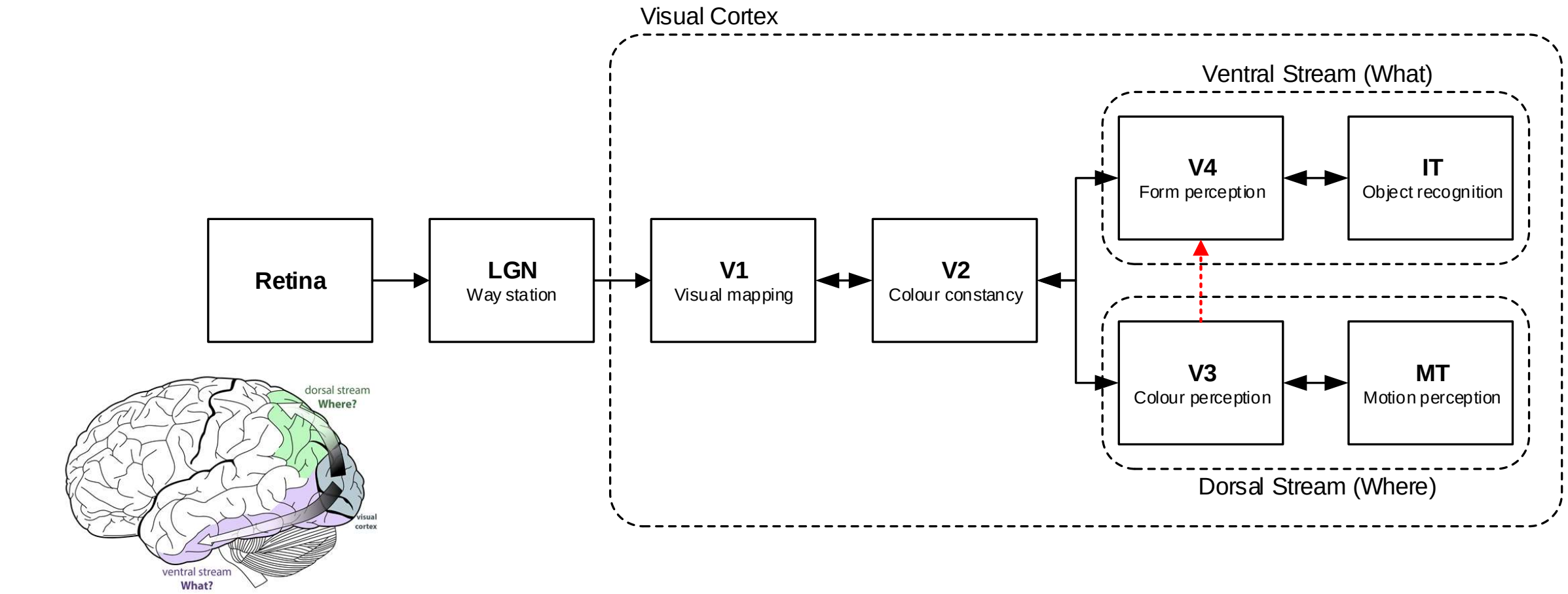
With spectral 360: Two fibres, with image improvement & illumination corrected colour values

Segmentation

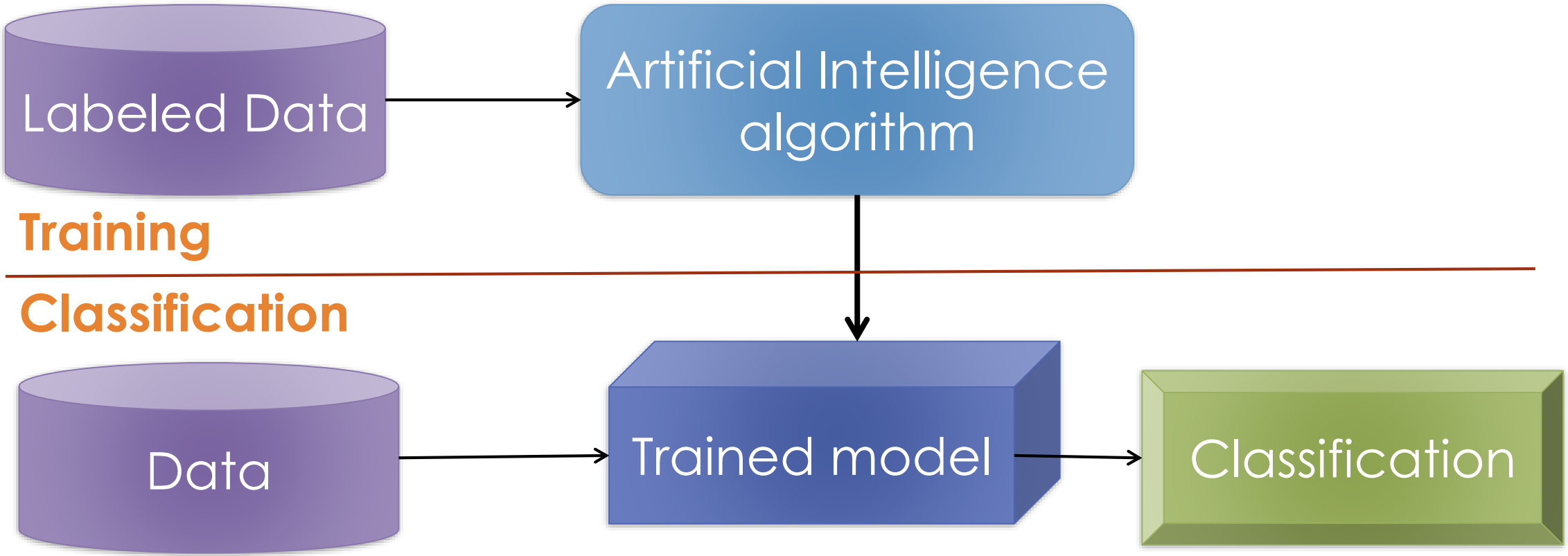




Bio-inspired machine learning models



Visual cortex – object recognition



Supervised learning

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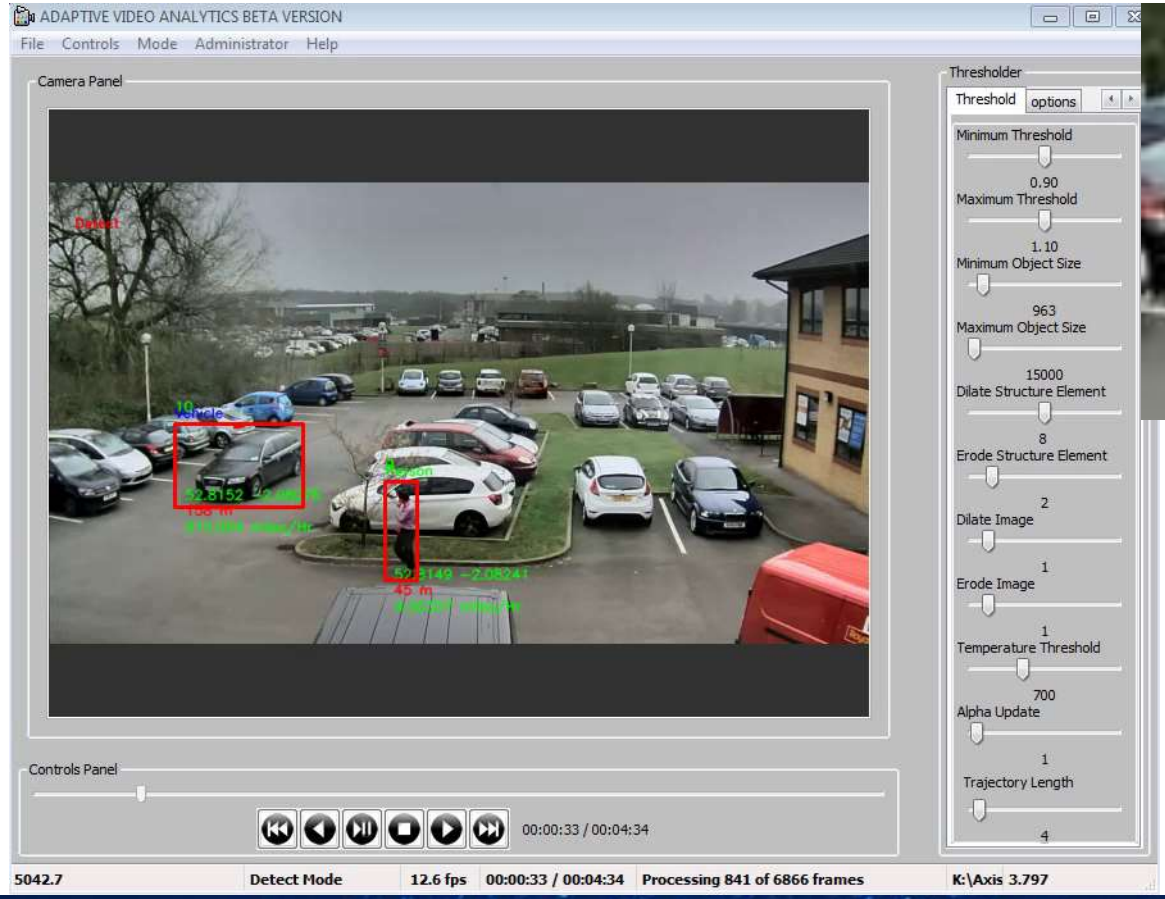

Surface Spectral Reflectance Estimation

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Training dataset

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New training dataset – transfer Learning

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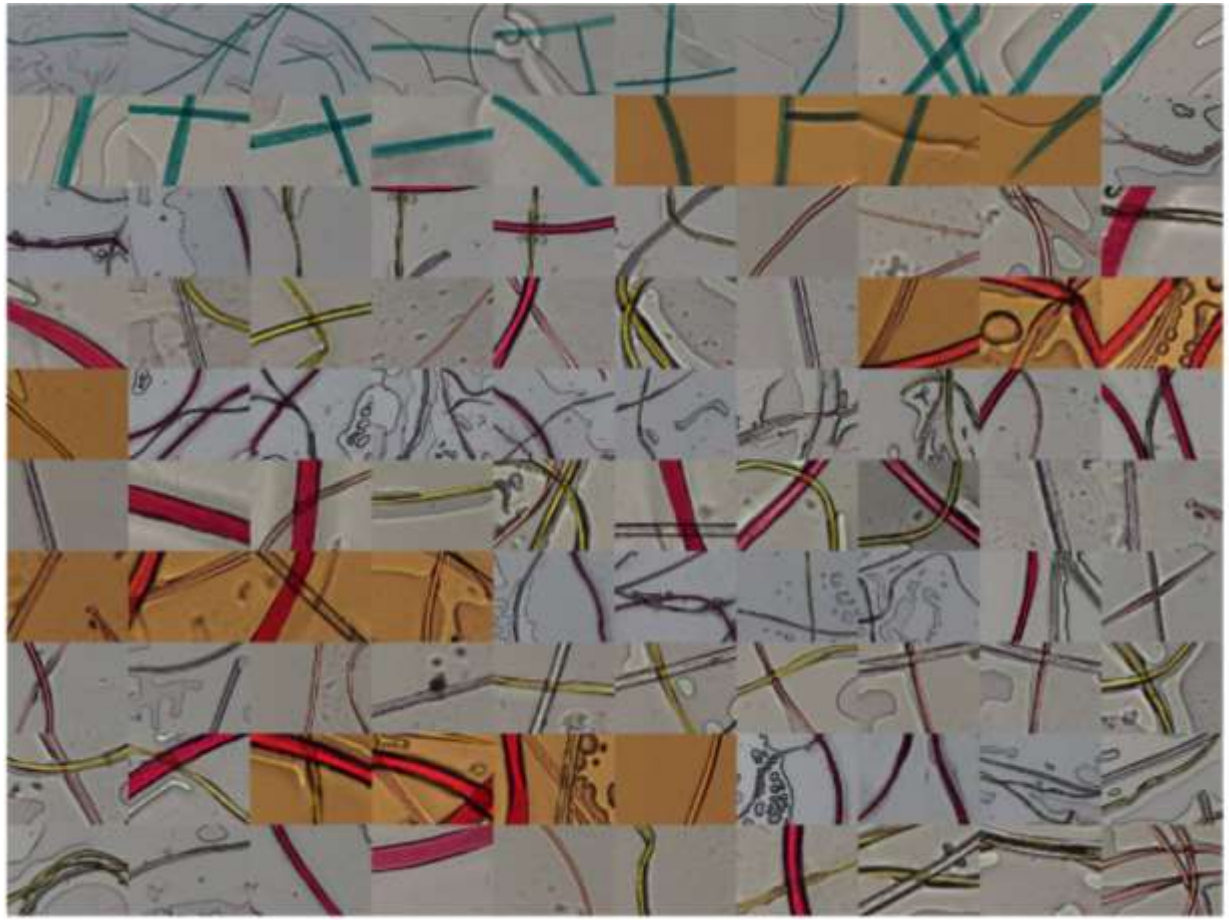

Testing dataset

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Forensic application

- Environmental prevalence
- Transfer and persistence
- Item provenance

- Intelligence
- Evidential value
- Triage/screening - value for money

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Some attributes of Easylift®

Attribute	Available now	In development
Optical clarity	Yes	
Ease of use	Yes	
Lack of fragility	Yes	
Further analysis in tape	Yes (Confocal Raman, MSP)	
Post isolation analysis	Yes (residue free dissection)	
Adhesive gentle on traces	Yes (different tack levels available)	
In situ presumptive testing		Yes
Polymer slide		Yes
Contamination free	Yes	
Adaptable to the needs of SHUTTLE	Yes	

Some attributes of Easylift®

Attribute	Available now	In development
Simultaneous recovery of fingerprint and other trace evidence		Yes

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Some problems addressed by ML and Spectral 360®

Problem	ML	Spectral 360
Data reduction via target identification	Yes	Improves segmentation of background debris and its digital removal, reduces depth of field issues
Image enhancement	No	Designed to achieve this even with poor images (out of focus, poor illumination, low pixel density etc)
Trace classification	Yes	Allows classification despite changes in illumination/microscope
Spatial mapping	Yes	See above
Modularity (interoperability between platforms)	No	Designed to solve this problem
Future proofing	Yes	Yes with ease
Spectroscopic information	No	Yes
Zoom control	No	Yes

We have the **technologies, knowhow** and **forensic expertise** needed to supply or build **three of the four tools** of the **SHUTTLE toolkit,** namely: **the tape, image processing and database**

We are keen to work with others who can complement or extend our capabilities

Please contact: Dr Mohamed Sedky, mohamed.sedky@spectral360.com