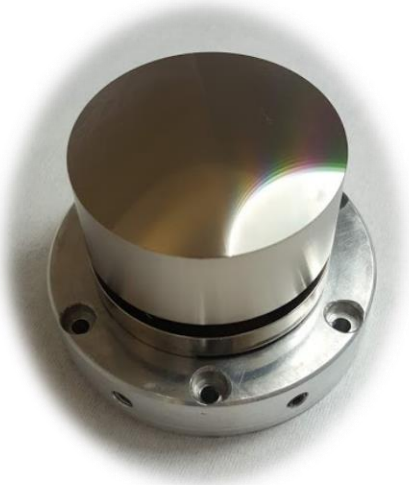
CEOI Pathfinder Project
"Freeform Gratings for Ultra-compact Spectrograph Designs"



CEOI Project Showcase

Monday 10th December

ECSAT, Harwell

Presenter : Cyril Bourgenot

Ariadna Calcines – Ray Sharples

dpo durham precision optics

CfAI Centre for Advanced Instrumentation

Durham University

Project's objectives

1. Can diamond machined metallic freeform gratings be a **viable solution** for remote sensing spectrographs on an airborne or space platform ?

Manufacturing limitations?	Optical performances?	Choice of material ?

2. What particular activity in EO will benefit most from a multichannel imaging spectrograph?

Green house gas monitoring ?	Agriculture ?	Pollution monitoring?

3. Can multi-channel imaging spectrographs offer a new capability compared with previous hyperspectral imager designs?

Metallic gratings advantages ?	Compactness ?	New design possibilities ?

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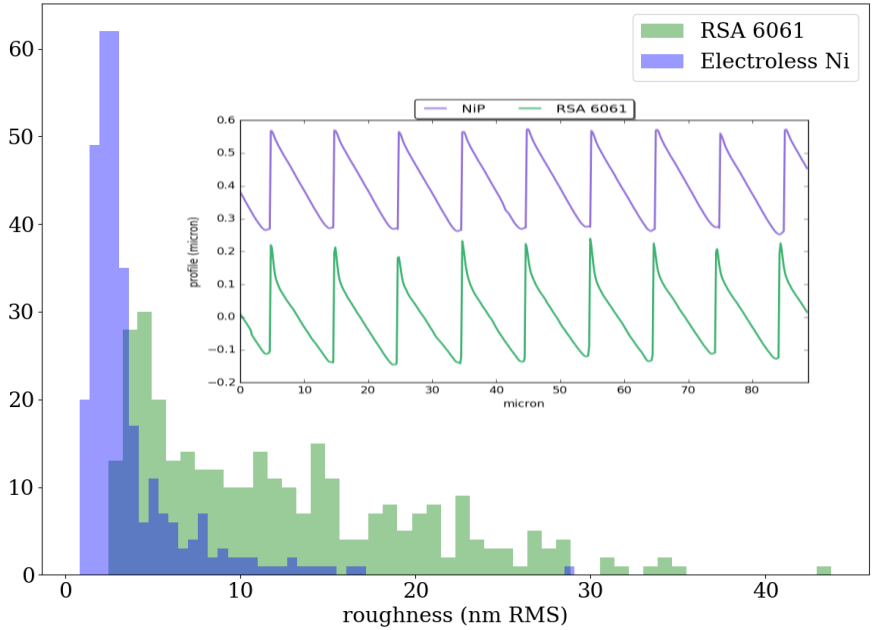
Technology developments and achievements

- Manufacturing process optimisation
  - ➢ Cutting parameters
  - ➢ Choice of material

- Multiblaze freeform grating development

- Design of an innovative compact spectrograph based on :
  - ➢ An image slicer
  - ➢ A freeform grating array
  - ➢ A compact layout using a multichannel capability with a single common sensor



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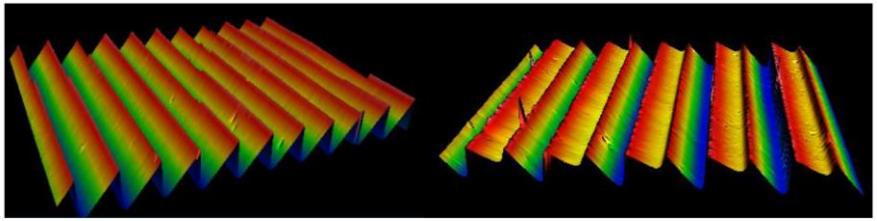

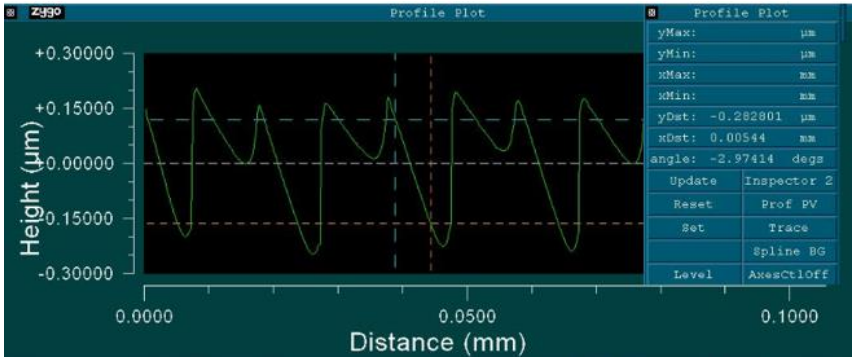

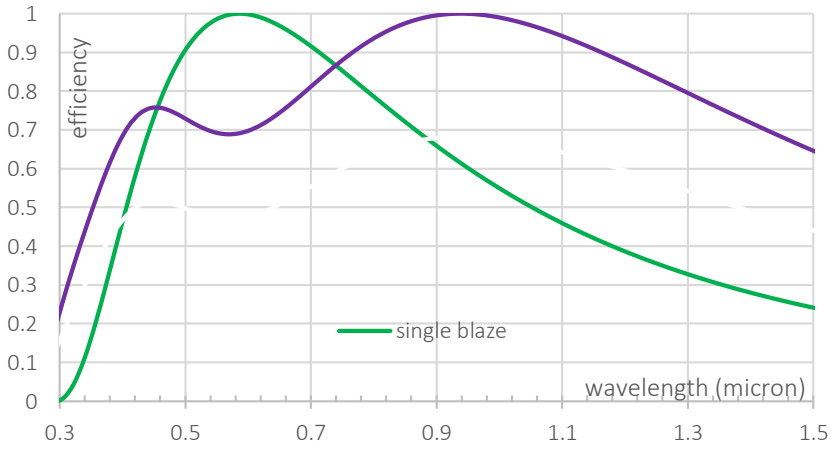

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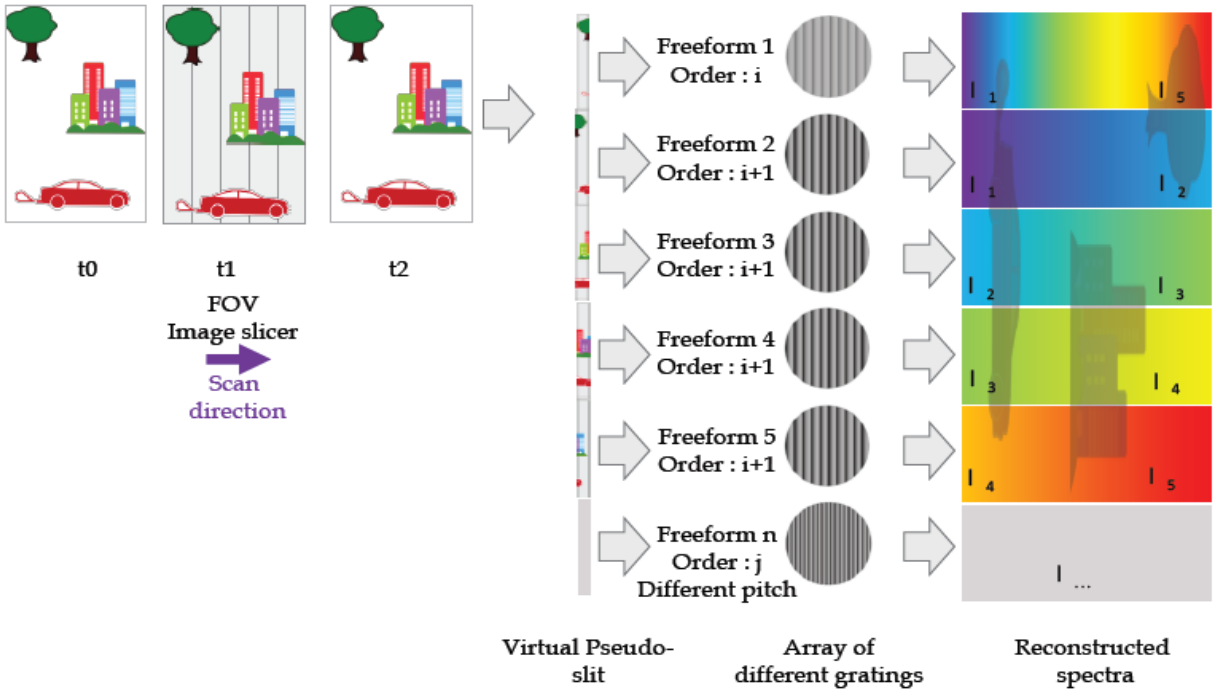

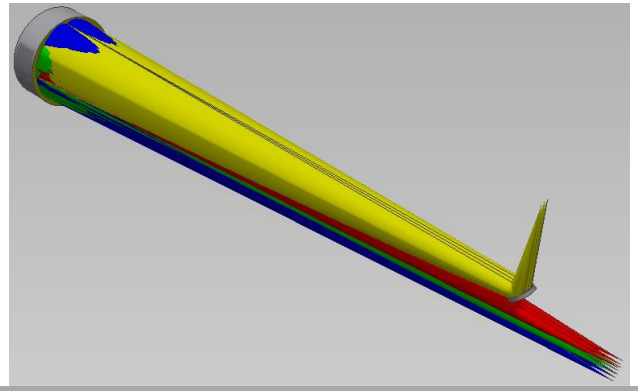

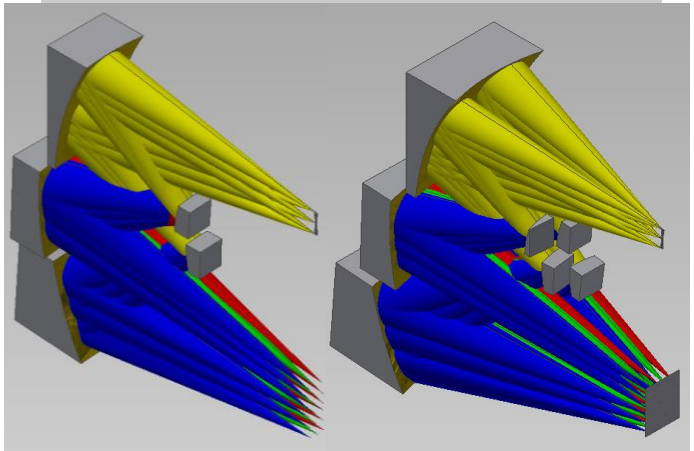

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Technology developments and achievements

- Viable solution for remote sensing spectrographs?
- Applications ?
- New capability of hyperspectral imager?

Science requirements	validation
Field of View	✓
Wavefront error	✗
Spatial resolution	✓
Spectral resolution	✗
Surface roughness	✓
Stray Light/Ghosts	-
Form of the groove (NiP)	✓
Pitch	✓

Technology developments and achievements

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- similar to the Orbiting Carbon Observatory on nanosatellites to target narrow spectral bandwidth at mid to high spectral resolution.

- chlorophyll fluorescence related to photosynthetic efficiency [600-677nm]
- red edge spectrum [677-740nm]
- surface moisture with water absorption band at 1.4µm.

Technology developments and achievements

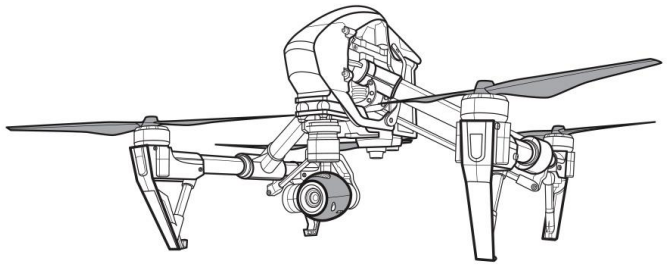
- Viable solution for remote sensing spectrographs?
- Applications ?
- New capability of hyperspectral imager?

- Most pushbroom scan systems use a single dispersive element which restricts either the waveband coverage or the spectral resolution.
- Most pushbroom systems incorporate multiples optical elements.

This new capability will allow multiple wavebands and spectral resolution to be imaged on a single detector, significantly simplifying the system while maximising the throughput.

Additional benefits

- EPSRC fellowship : A novel hyperspectral imager for precision agriculture


- Partnership :

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