Single-exposure materials classification for portable threat detection

Tamzin Lafford, PhD

t.lafford@ibexinnovations.co.uk, www.ibexinnovations.co.uk

16th May 2018

What and how?

- Portable, practical, field-deployable X-ray security inspection system

- Effective materials classification in a single exposure

- IBEX materials classification technology

- Simple, fast, materials classification and absorption contrast image every time in a single exposure
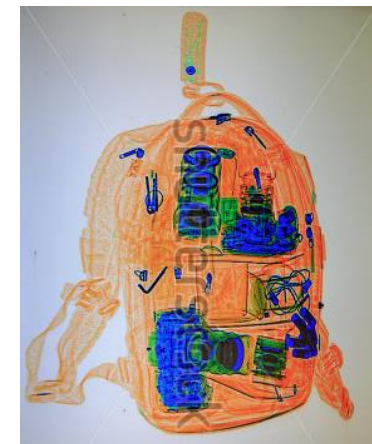
Illustrative images from the internet

The issue and the IBEX solution
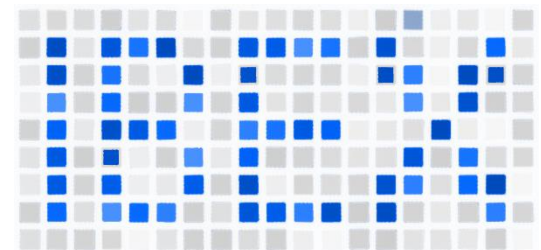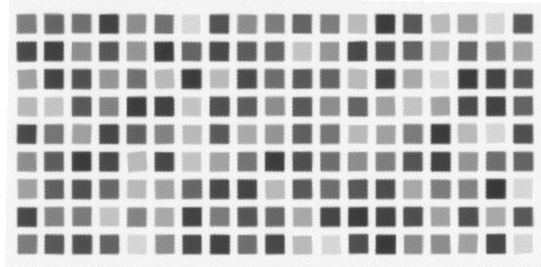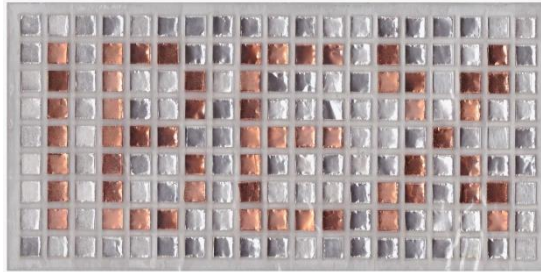
- Conventional X-ray absorption imaging gives no materials discrimination

- Dual energy or spectroscopic techniques require multiple scans or multiple sources or multiple/ spectroscopic detectors

- IBEX technology delivers materials classification using a *single sample exposure* at a *single kV$_P$* using a *single, conventional detector* (e.g. silicon flat panel…)

- Faster results more simply

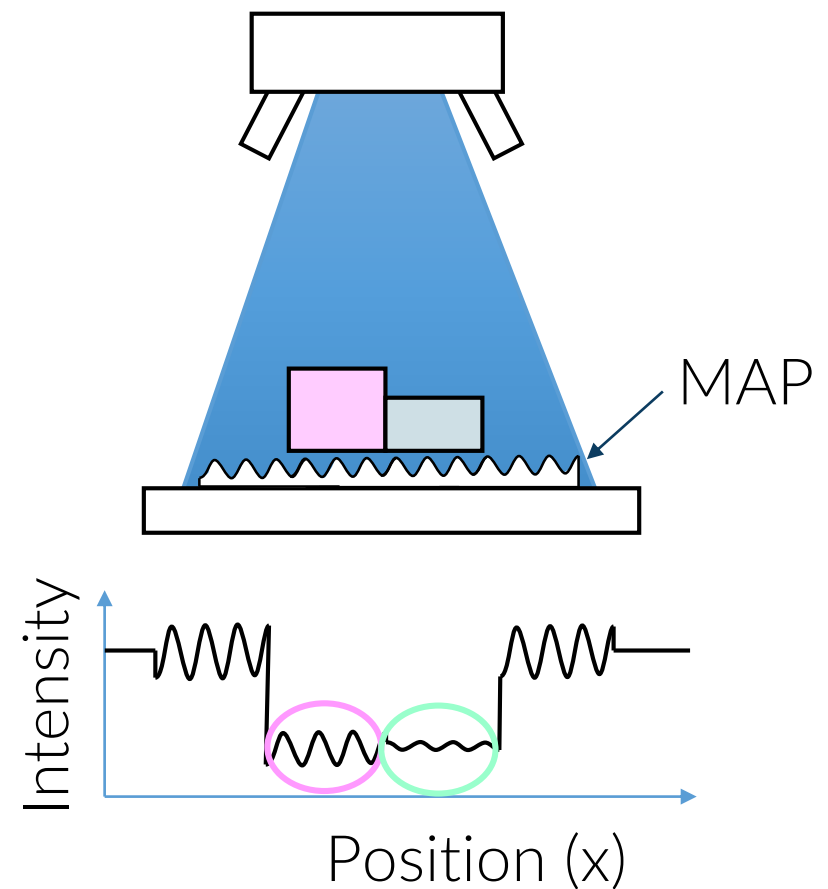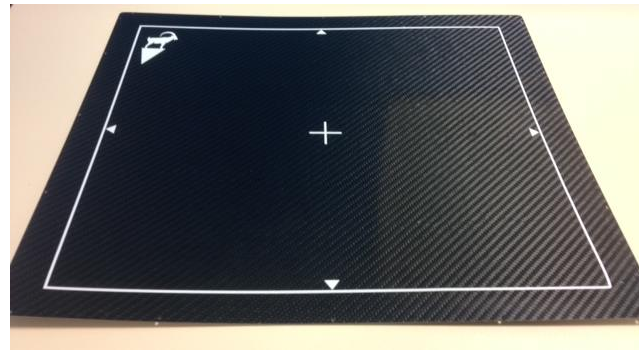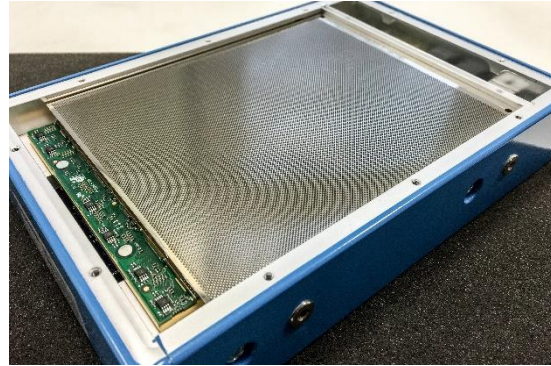# IBEX MAP technology
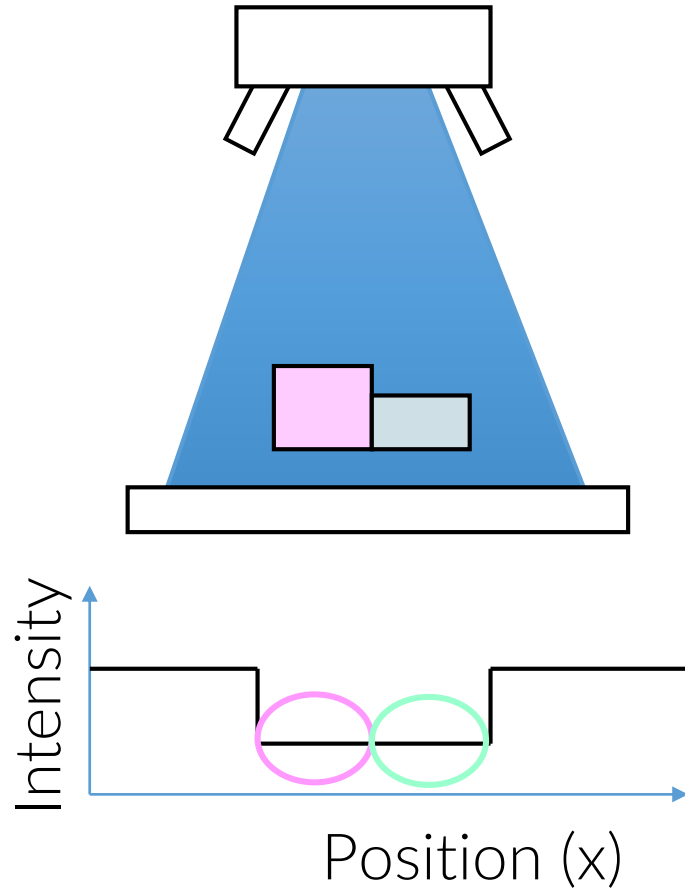
IBEX MAP (Multi-Absorption Plate)

- MAP: structured filter in front of detector
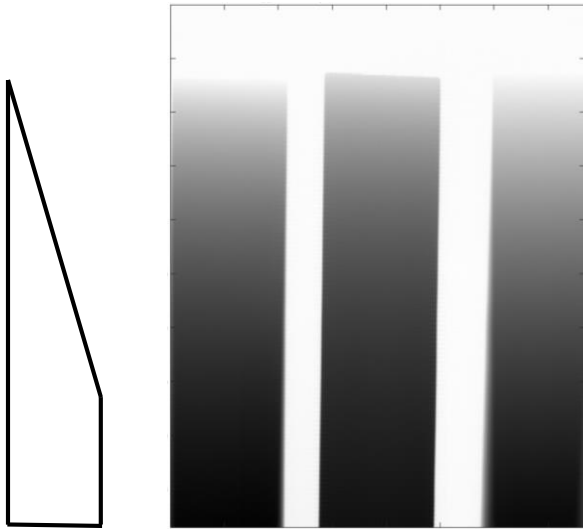
- May be incorporated into detector cover-plate

Multiple patents worldwide
http://www.ibexinnovations.co.uk/technology/patents/39
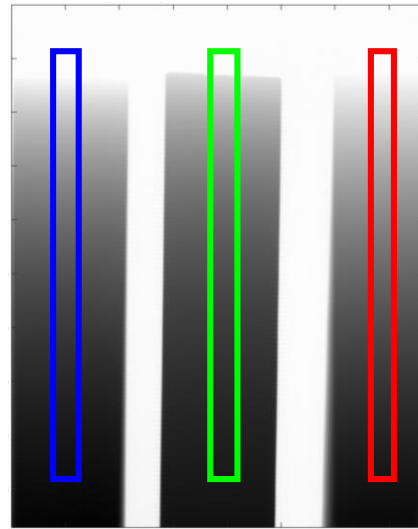
Illustration only
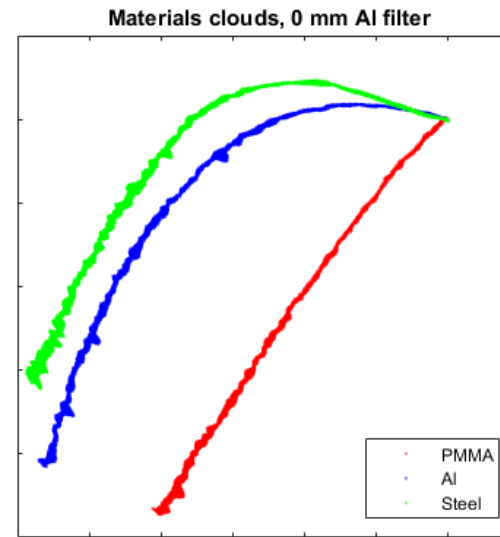
IBEX MAP technology and analysis in action

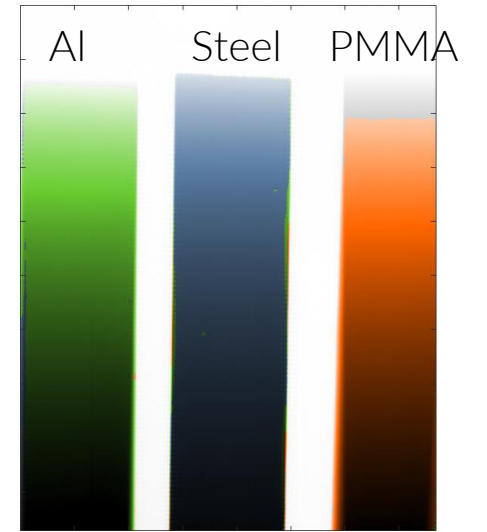Conventional X-ray absorption does not tell materials apart

Train the system - select regions of interest (MAP present)

➔ Generate "materials clouds" in IBEX "materials space"

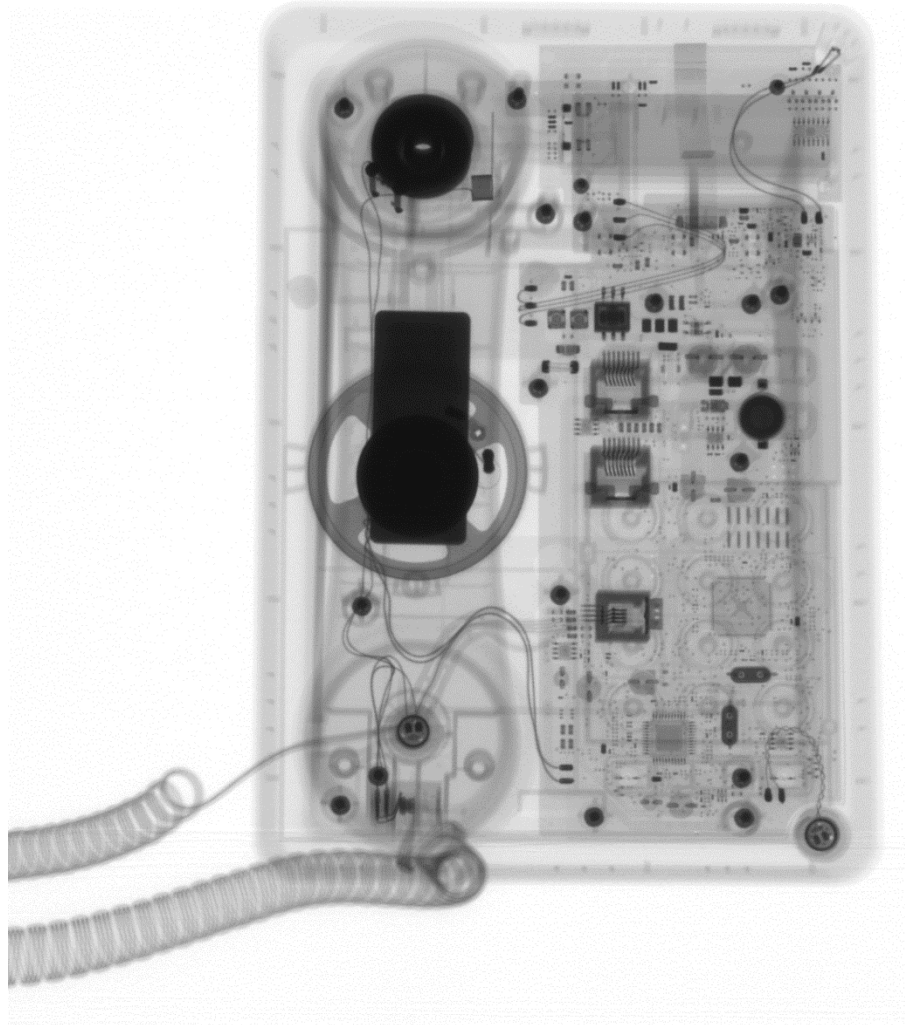IBEX technology classifies materials

Materials clouds, 0 mm Al filter

.	PMMA
.	Al
.	Steel

Al   Steel   PMMA

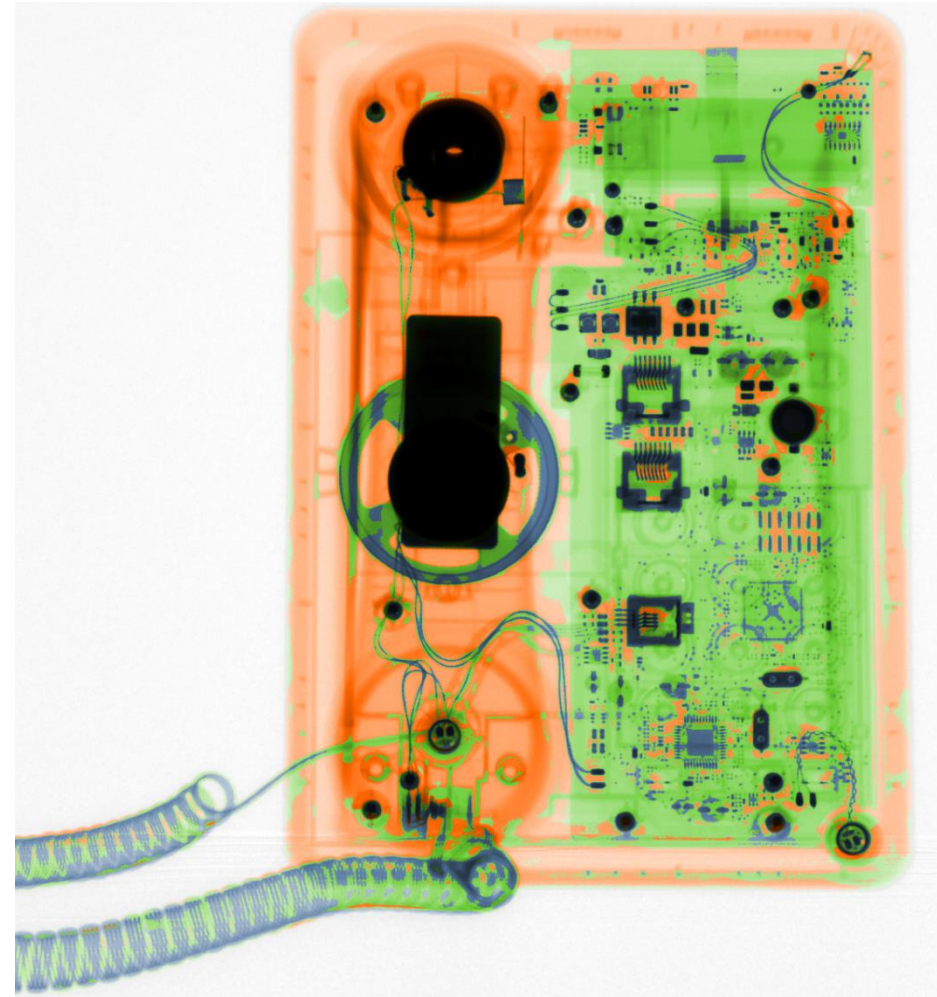Apply "classification limits": do not classify where there is uncertainty
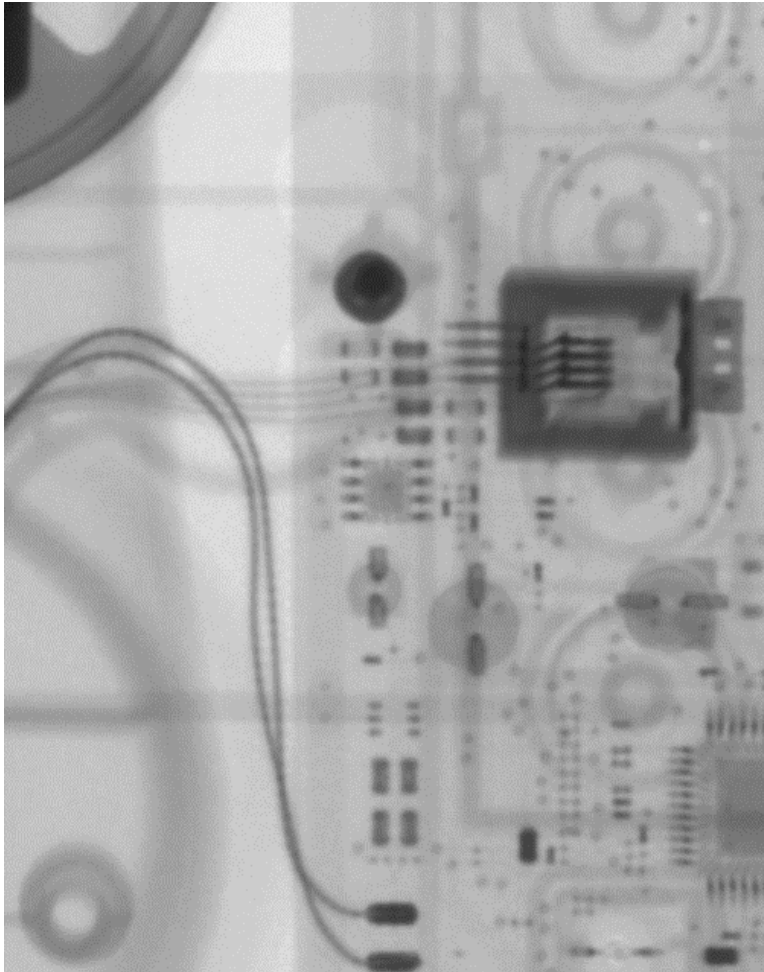
Example results in the security domain
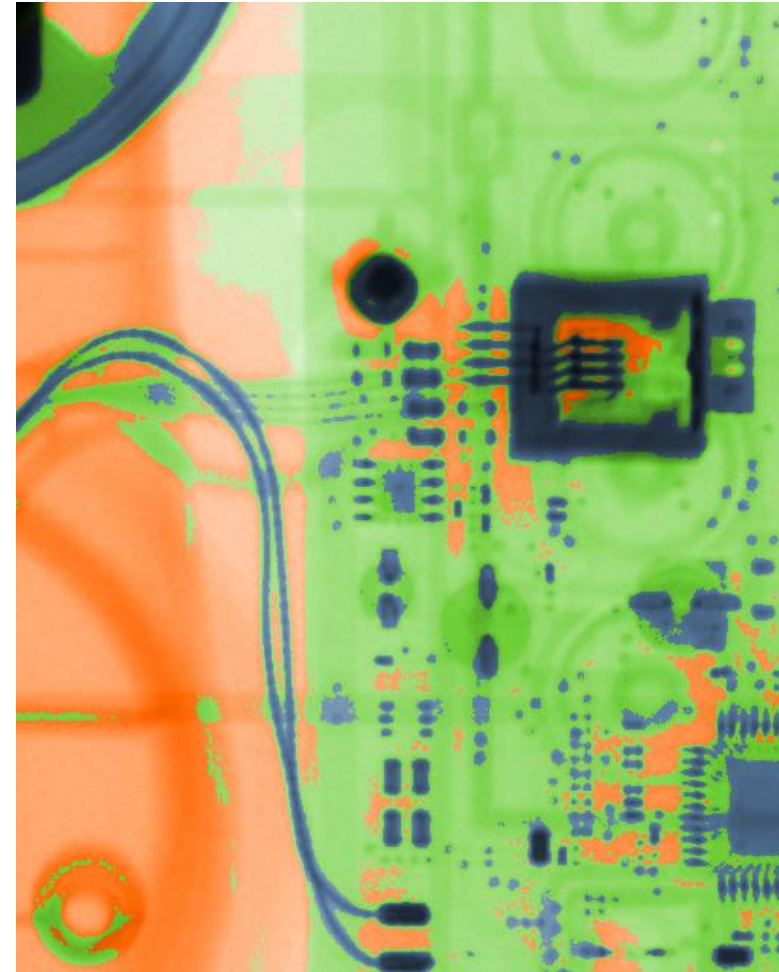
MAP-stripped absorption contrast image
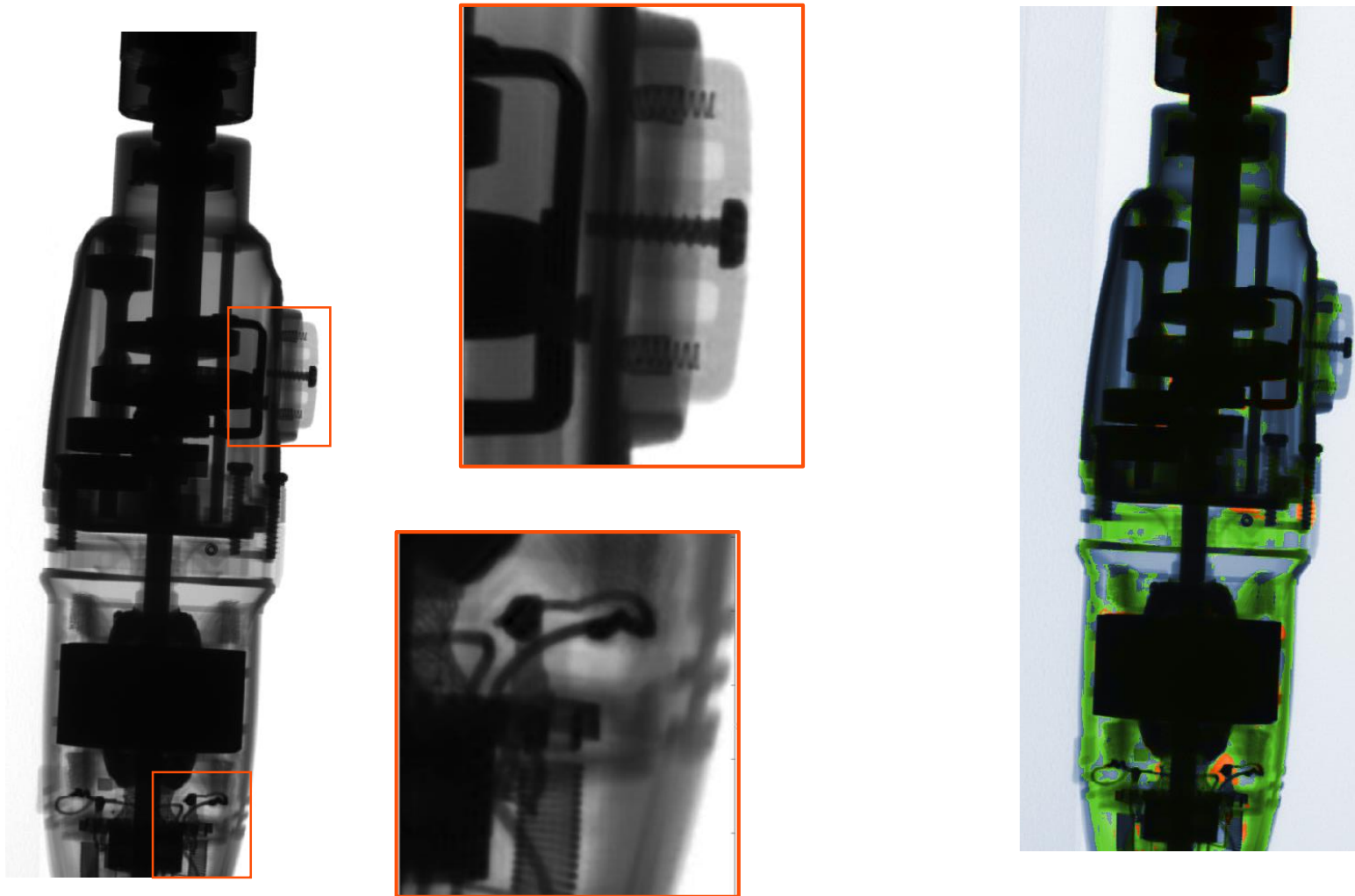
Materials classified overlay image

Zoom in

MAP-stripped absorption contrast

Materials classified overlay

Drill

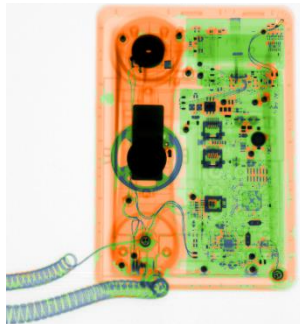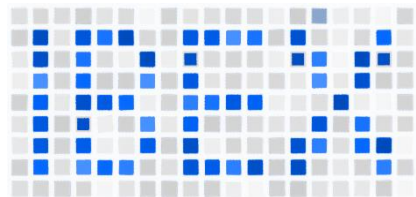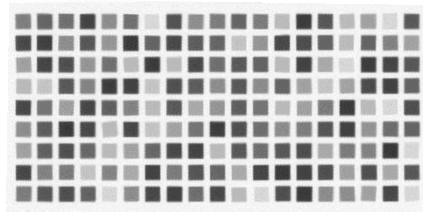MAP-stripped absorption contrast

Materials classified overlay

Summary
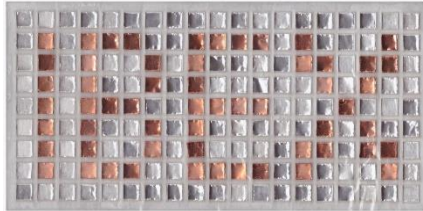
- IBEX Trueview^{TM} technology delivers materials classification
  - Single sample exposure
  - Single kV$_P$
  - Single, conventional detector fitted with MAP
  - Every scan

- High resolution conventional absorption contrast image also produced
  - Shadow of MAP stripped from data
    - ➔ clean absorption contrast image

See what's really there with

IBEXTrueview™

IBEX Innovations Ltd.
Explorer 2, NETPark,
Sedgefield, TS21 3FF
UK

Registered in England and Wales: 07208355
enquiries@ibexinnovations.co.uk   www.ibexinnovations.co.uk
+44 (0) 1740 617770

Supporting back-up slides

Who are IBEX Innovations?

- High-tech start-up
  - 2010; venture capital funding 2011; InnovateUK and Horizon2020 grant funding

- Founded on patented MAP (multi-absorption plate) technology

- 19 personnel, of whom 7 have PhDs; another 2 studying for PhDs

- On the North East Technology Park (NETPark) in County Durham, UK

- Trueview™ trademark
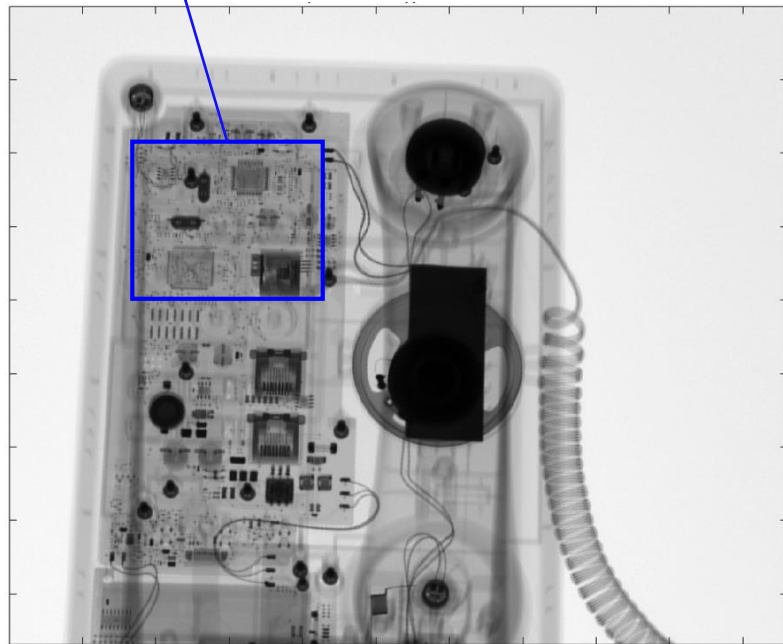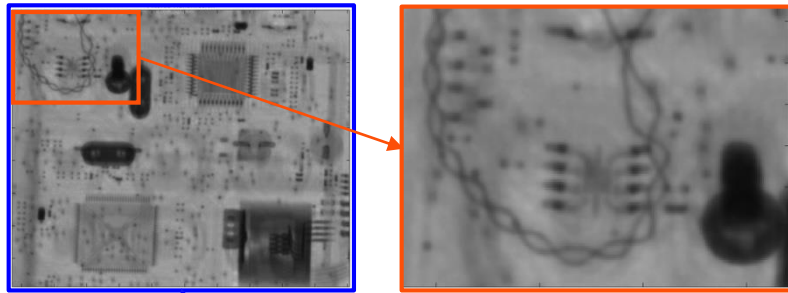
- www.ibexinnovations.co.uk

Patents

- For up-to-date patent information, see www.ibexinnovations.co.uk, http://www.ibexinnovations.co.uk/technology/patents/39

- US9519068, US9784851

- GB2498615, GB2532634, GB2532897, GB2533233

- Taiwan I586991

- Japan 6196227

- Other patents pending

Desk telephone

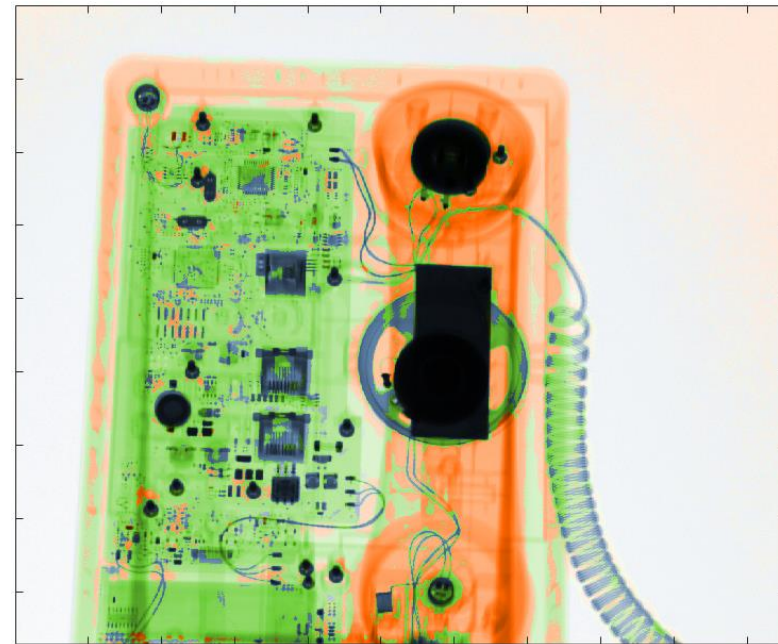IBEX retains high resolution absorption contrast images

- 150 kV pulsed source

- 139 μm detector pixel size

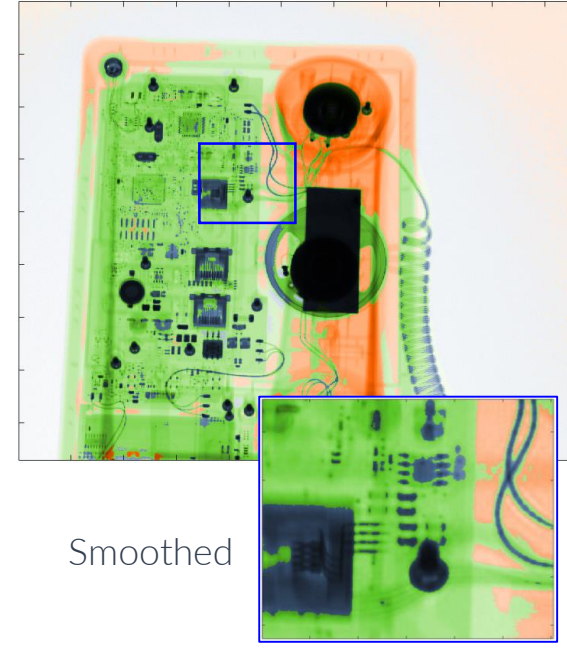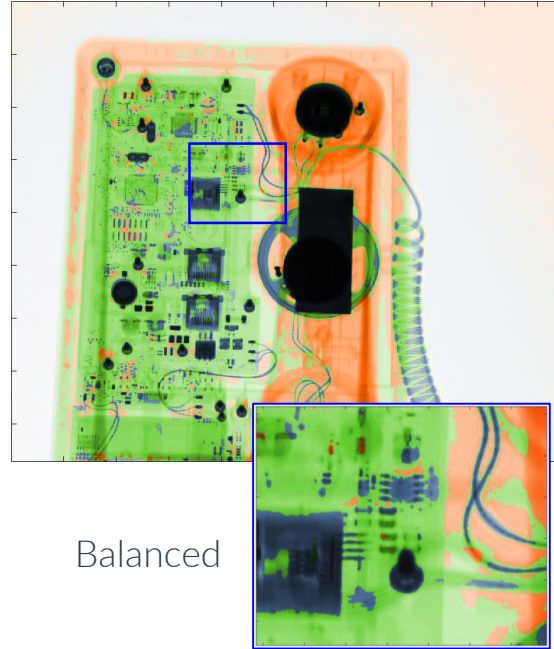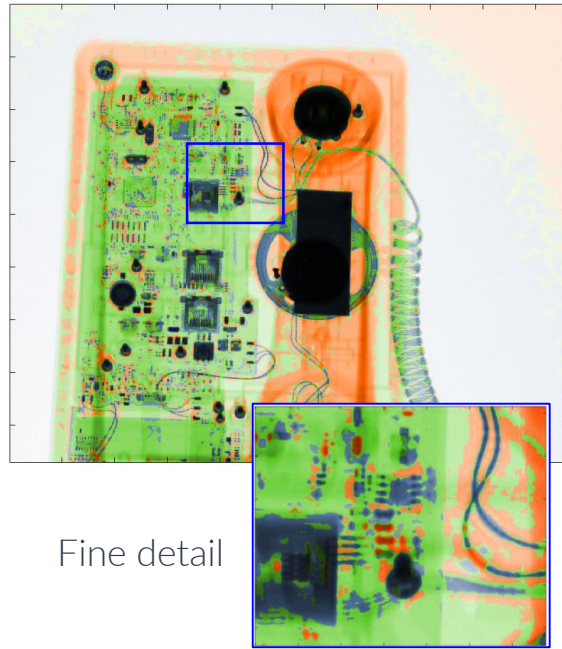Materials classification is overlaid
onto the high resolution image

Absorption Contrast

IBEX Materials Classification

Variable presentation of materials classification

Fine detail   Balanced   Smoothed

- Materials sensitivity can be adjusted by the user after data acquisition
    - Optimise appearance of classified image
    - Highlight specific areas of interest
    - Resolution of absorption contrast image unaffected
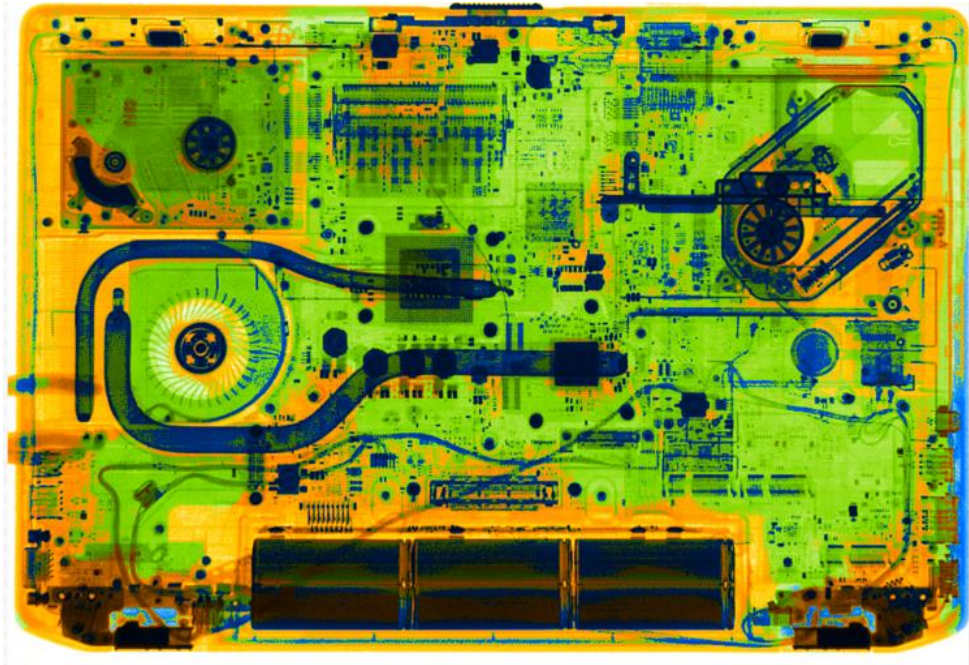
PCB
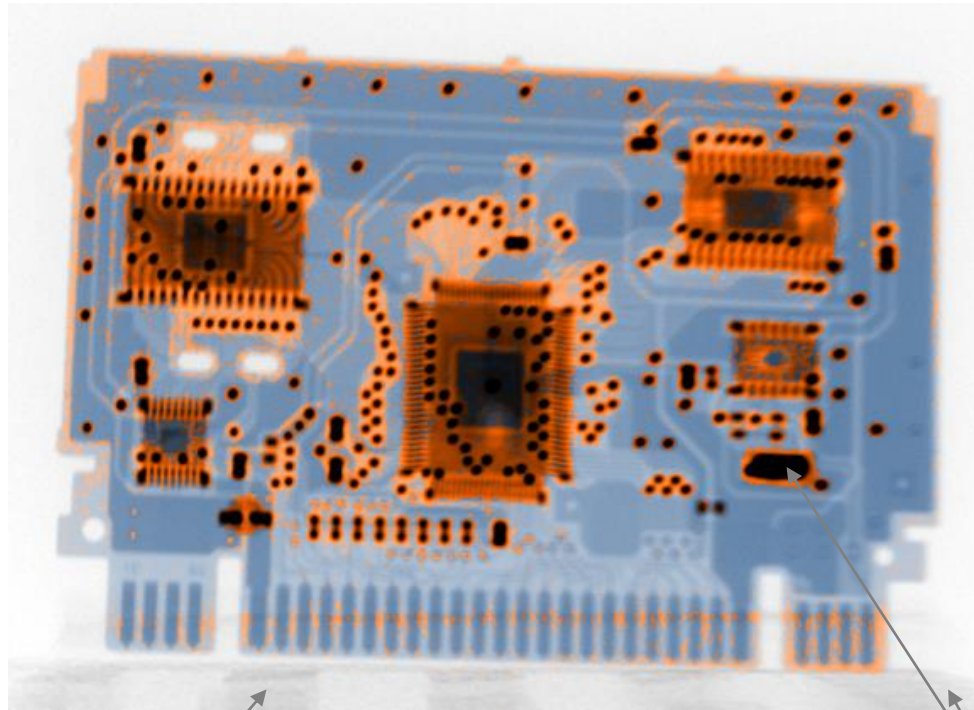
- Portable pulsed X-ray generator, 100 kV$_P$, 1 mAs

- Flat panel detector, 127 μm pixel size

Expanded foam support

Organic
"Poor" metal (none in this image)
Metal
Not classified (beyond trained limits)

Laptop

Organic
"Poor" metal
Metal

- Portable, continuous X-ray generator, 120 kV$_P$

- Line scanner detector

- Classification limits not applied

See what's really there with

IBEXTrueview™

IBEX Innovations Ltd.
Explorer 2, NETPark,
Sedgefield, TS21 3FF
UK

Registered in England and Wales: 07208355
enquiries@ibexinnovations.co.uk   www.ibexinnovations.co.uk
+44 (0) 1740 617770