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Industrial Use Case and Lessons Learned

UDRC – Deep Learning and Defence – 14th Nov 2019

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Introduction

Introduction – What is the customer problem ?

Mission & comms

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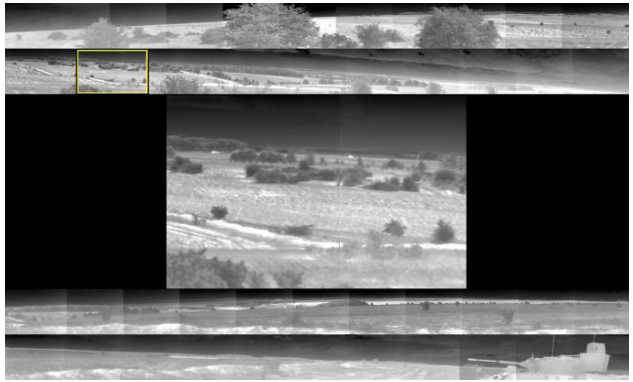

Watch this …

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Remember this …

Cognitive overload

- Multiple sensors with no spare capacity to observe and exploit

Desire to

- Automate the observation of sensors
- Look deeper into images
- Receive warnings and alerts of threats

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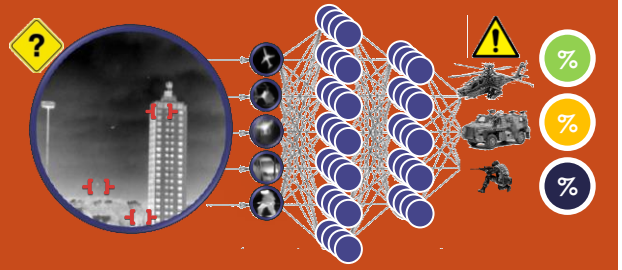
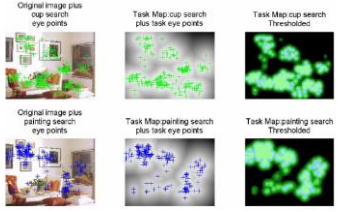
Introduction – PhD/EngD

Context and scene understanding



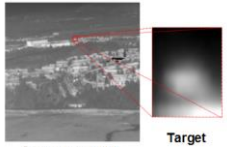
Patrick Harding, *Task relevant image content segmentation for compression* (2005-2009)

1st EngD

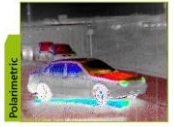


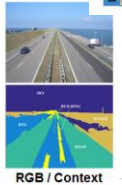
Calum Blair, *Real-time video scene analysis with heterogeneous processors* (2008-2012)

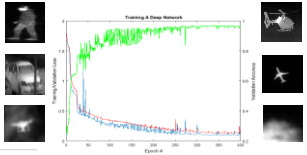
Jonathan Letham, *Context based image segmentation* (2008-2011)



Chris Dickson, *Analysis of IR polarisation signatures for vehicle detection* (20011-2015)



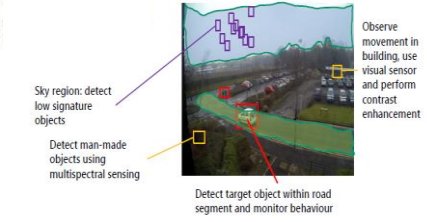


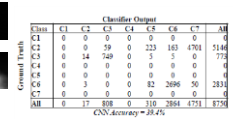


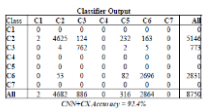
1st TI CNN

Iain Rodger, *Target classification in multimodal video using CNN and context* (2012-2016)

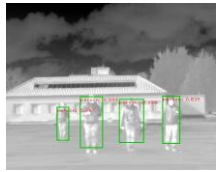
Impact on Thales AI strategy







Rachael Abbott, *Deep and intelligent scene understanding* (Queens University Belfast) (2017 -)



Object classification in thermal images – using an RGB-only trained CNN

Natalie Flaherty, *AI for land platforms* (2018 -)

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Introduction – Thales TrUE AI approach

TRansparent AI

- where users can see the data used to arrive at a conclusion.

Understandable AI

- that can explain and justify the results.

Ethical AI

- that follows objective standards protocols, laws and human rights.

AI Across Thales UK

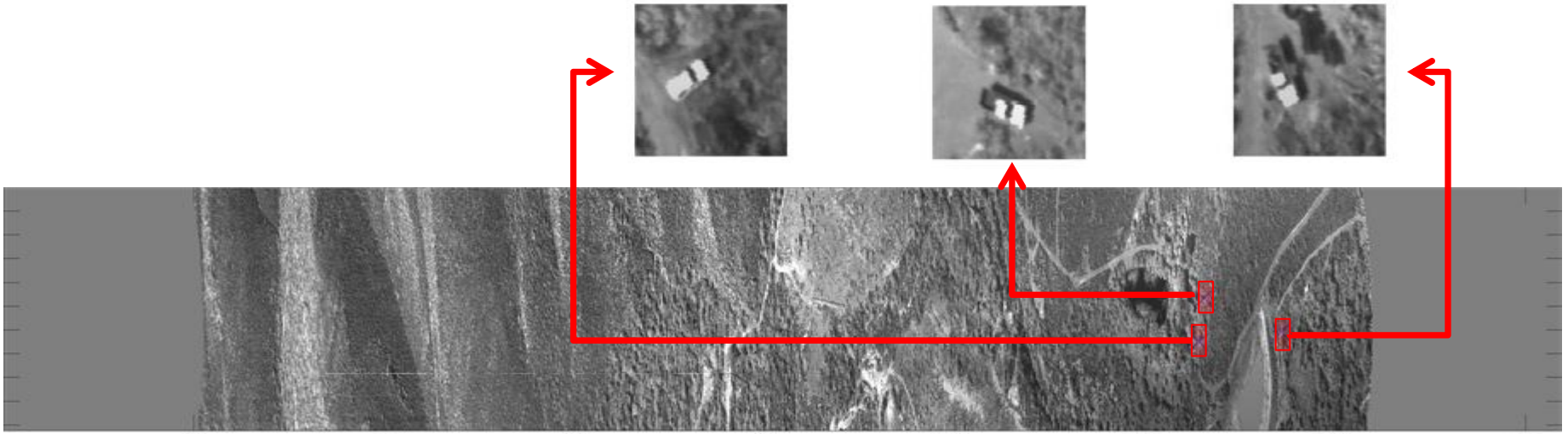
AI Across Thales UK – Impact on air to ground image analysis

Two highly trained human analysts

- 30 minutes
- 31 identified objects

CNN algorithm

- 0.5 seconds
- 36 identified objects
  - Including all 31 identified by analysts
  - Other 5 confirmed as misses by analysts



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AI Across Thales UK – Environments

Tailored Machine Learning across many domains

- Airborne reconnaissance
- Maritime
- Thermal & Visible data
- Small targets in high resolution imagery

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AI Across Thales UK – Digital Crew®

OME UK Student Demonstrates Deep Learning on Thermal Images

OME UK COMEX Briefed

Digital Crew POC pulled together

POC Shown To P Caine at Innov Days

POC Shown To Royal Navy

DASA Ph1 Contract

POC at DSEI – huge interest

POC shown to UK Army CGS/ UK MoD CSA

Trademark granted

Business Manager Appointed

Dig Crew Selected For AWE18

DASA Ph2 Contract

Dig Crew team grows to 15 Engrs

Four Dig Crew Systems at AWE18

PQQ submitted for JACKROD UK MoD

DASA Ph2 Delivery & Vehicle Demo

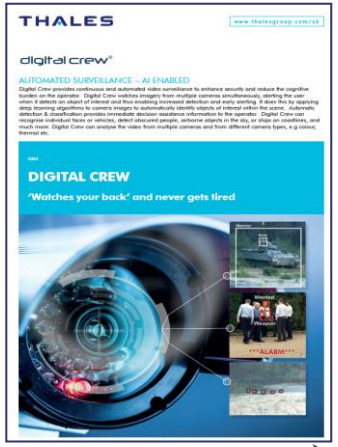
Canadian IDEaS – DC for TI

IWO UK MoD

Canadian IDEaS 1B

MILIPOL

DSEi



2016 2017 2018 2019

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AI Across Thales UK – Digital Crew®

Academia & Research

Heriot-Watt University

University of the West of Scotland

Queen's University Belfast

CENSIS

CUBICA Technology

cortAIx

Development & Users

dstl

Defence and Security Accelerator

Army Warfighting Experiment – Autonomous Warrior

Army

Royal Navy

Australian Government

Government of Canada

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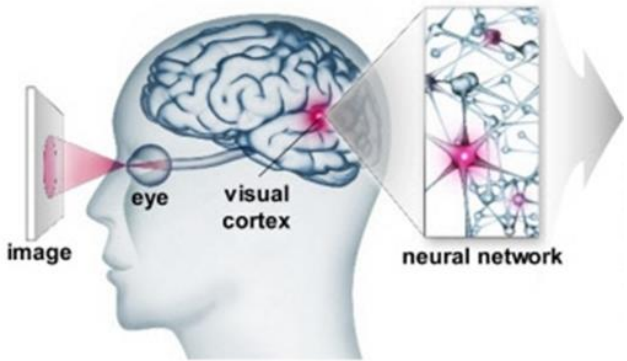
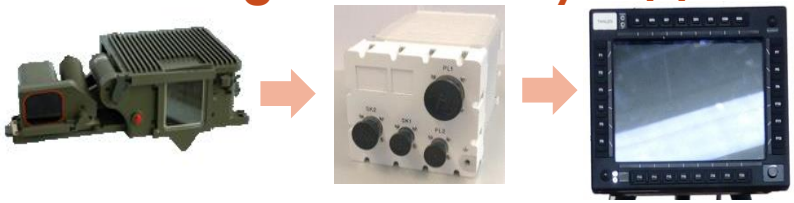
AI Across Thales UK – Digital Crew®

COTS & MOTS hardware & software, open standards



Free, permissive licences, readily available and huge community support

CNN - YoloV3, YoloV3-tiny, ResNETxx, …



Adapted for the military domain, stand alone & no external links

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AI Across Thales UK – Digital Crew®

Potential Use Case

- <Video>

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Challenges

Challenges – Performance Metrics

Need confidence in performance

- Models need to generalise to the real world
- Implies larger test sets compared to training sets → Opposite of literature?

Metrics, metrics, metrics

- Customer
- Business
- Technical

Challenges – Following Published Literature

All that glistens is not gold

- Some published methods are very hard to re-create
- Datasets may have unidentified bias
- Papers do not always provide enough explanation to reproduce results

Lessons Learned

- Deep understanding of datasets, and pro-active identification of bias
- Reproducible development environment
- Configuration control of experiments

Challenges – Adaptation Required

Open source doesn't mean the work is done!

- Domain specific use cases
- Constrained environments

Re-implementation for deployment

- Minimise Size, Weight, Power and Cost – SWaP C
- Reduce memory footprint
- Enable use of higher resolution imagery
- Increase frame-rate & reduce latency

Thank you

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