Processing Data using Artificial Intelligence on-board an Earth Observation Satellite

Aidan Duggan (aidan.j.duggan@mycit.ie), Ted Scully, MTU

Introduction

- Satellite industry has experienced a renaissance in recent years, as technology advancement has resulted in the miniaturisation of satellites.

- Development time and launch cost has been driven down the and opened up the remote sensing market to both commercial and research interests.

- Thousands of satellites have been launched, with many more planned for the future.

- The quality and the quantity of data being produced by earth observation satellites has grown significantly which has created a lot of opportunities along with significant challenges.

- The traditional process of transferring all the data to ground stations on earth for data analysis is struggling to cope with the exponential data growth

- Deep learning has become the tool of choice when it comes to identifying hidden data patterns, mimicking the brain to identify objects and make decisions

Opportunities

Some of the advantages of on-board processing are:

- Reduction in data to be transferred results in

- Bandwidth available for other possibilities such as downloading specific time or location images

- Communication consumes a large amount of power which is a scarce resource on a satellite. Less data transferred saves power. This can be used for other tasks or result in less power generation required which saves weight and cost

- Data processing on board can produce faster outputs. These can be delivered directly to the intended consumer and decisions made. This will have highest impact on time-critical use cases such as

- Fire or Flood / Tsunami Detection

- Maritime surveillance (eg poaching, smuggling)

- Oil spillages or other event detection

- Reconfigurable mission – some processing platforms can be reconfigured in-situ so it's possible that the satellites mission could be changed during its lifetime

PhD Proposal

- Deep learning has been utilised to analyse remote sensing data on the ground but to date has had a very limited footprint within the satellite itself because of a lack of on-board hardware resources.

- This PhD aims to change this by researching the most optimal deep learning model design strategies to adopt a very resource hungry process onto a resource starved platform.

Challenges

- Resources – Satellites are typically limited in terms of processing capability and power generation potential. This has improved in recent years but represents the biggest hurdle in using deep learning on-board

- Designing and creating a Deep Learning Model that will be effective on such a resource limited device

- Training Data – there is very little labelled satellite imagery available which is a pre-requisite for Deep Learning