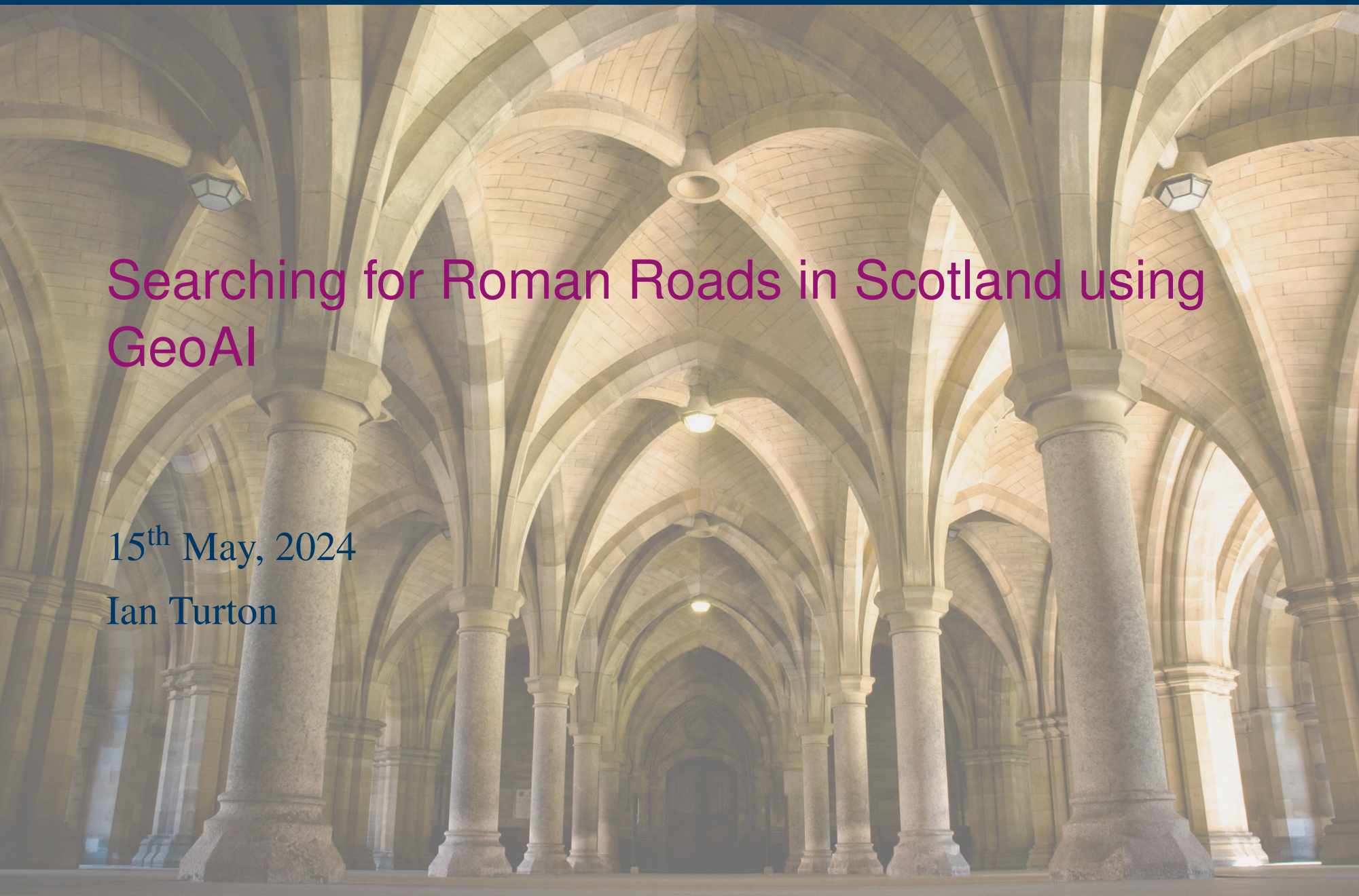
University of Glasgow



Searching for Roman Roads in Scotland using GeoAI

15th May, 2024

Ian Turton

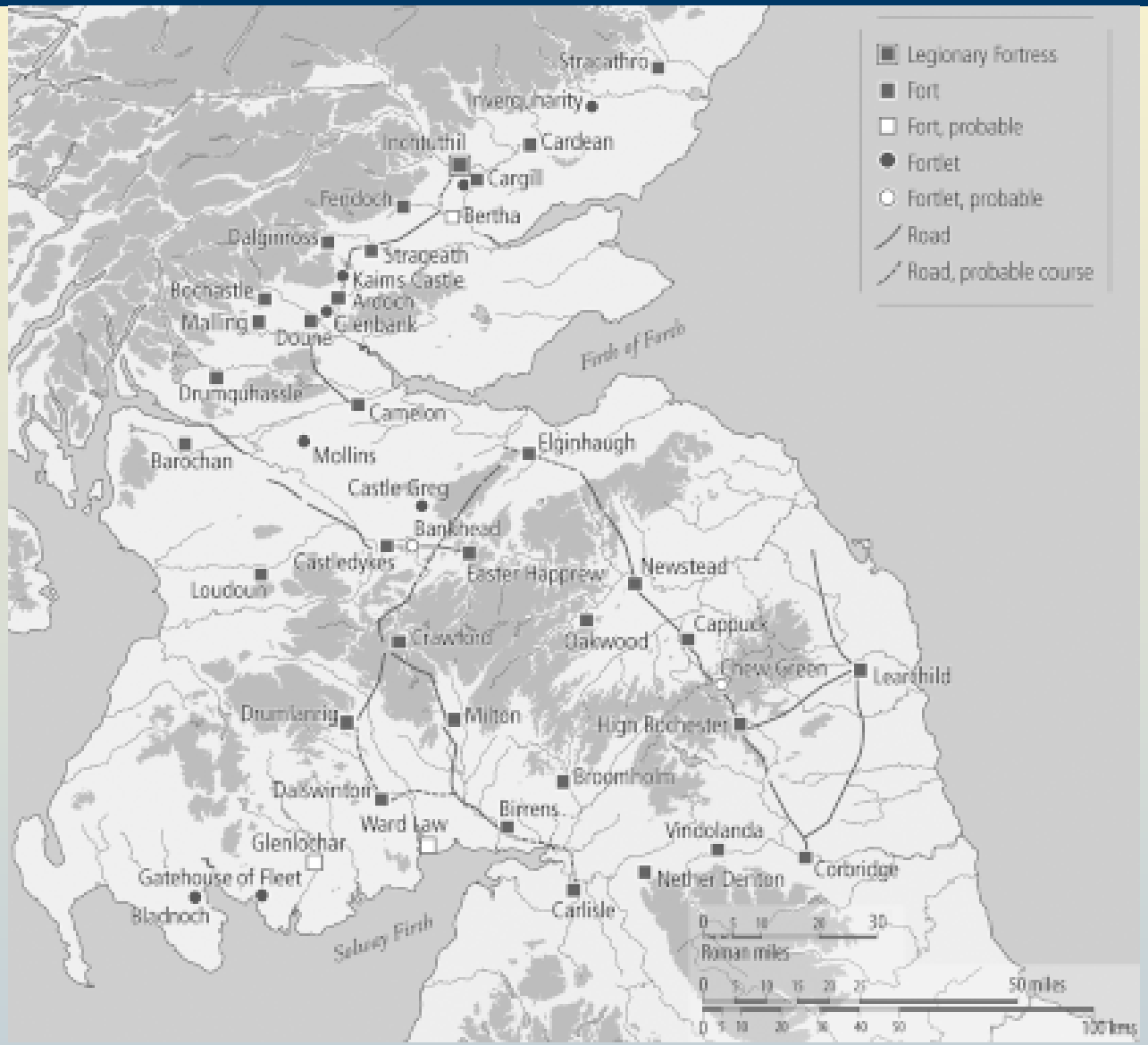
Romans in Scotland?

But we all know the Romans only got to Hadrian's Wall!

Antonine Wall (and further north)

In fact by the time of the construction of the Antonine Wall in 122CE there were roads as far north as Stonehaven.

Known and Presumed Roads in Scotland



Known and Postulated Roman Roads in Scotland, after Hanson et al. (2019)

Roman Roads

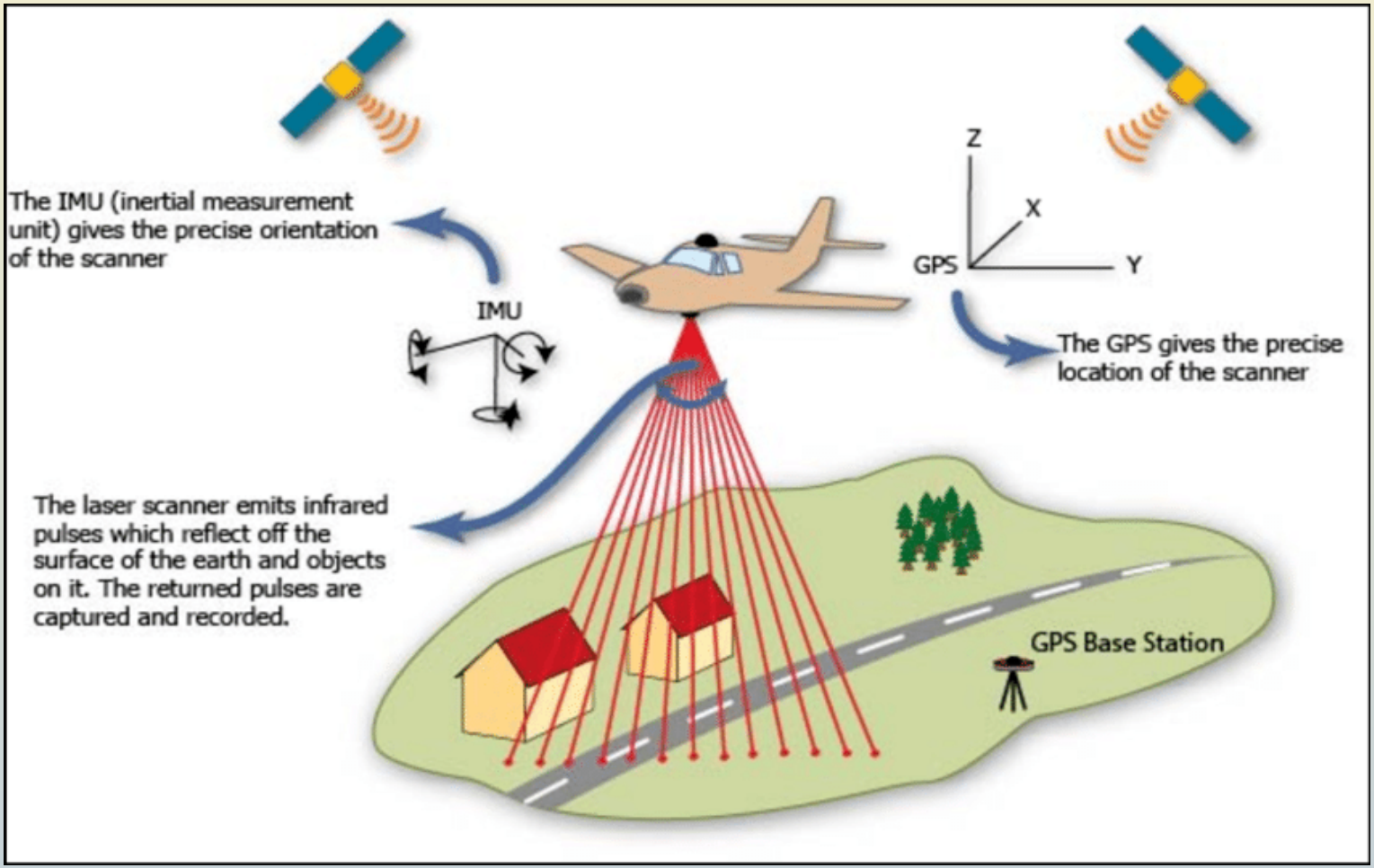
- A carefully planned system connecting centres of occupation
- Designed to provided fast communications to neighbouring centres
- Hierarchical classification:
  - Main roads (e.g. Ermine Street) 15-20 metres wide and 1-2 metres high
  - “B-Roads” 3-6 metres wide
  - minor roads 3-4 metres wide
- A ditch on each side for drainage

Roman Roads in the Modern World

- Many of the major Roman Roads are still in use today (e.g. M74, A68, A7)
- Smaller and minor roads are mostly lost
- Straight edges to parishes and fields are often clues to their route

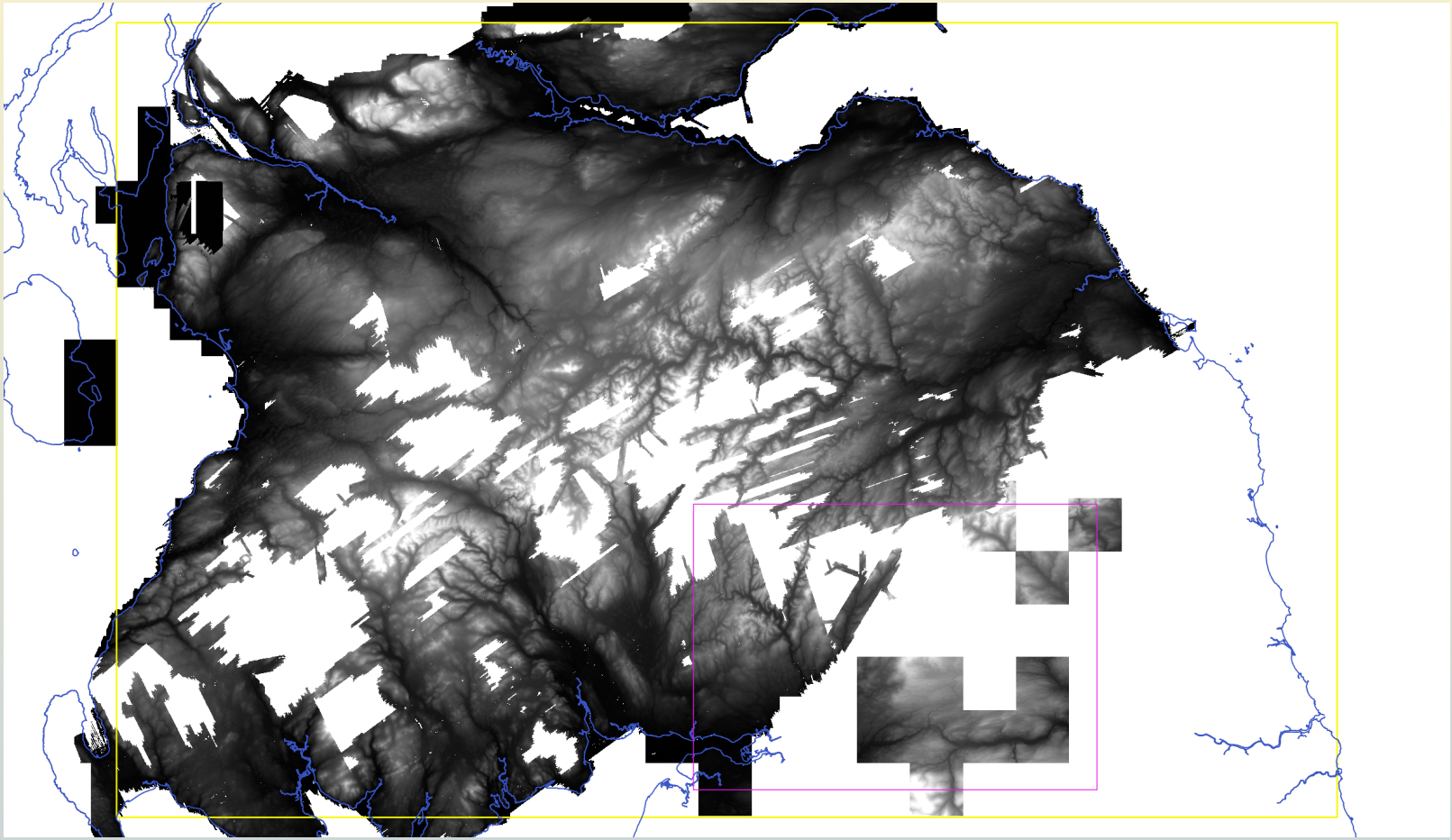
What is LiDAR?

- Light Detection and Ranging
- Used to make high accuracy topographic maps



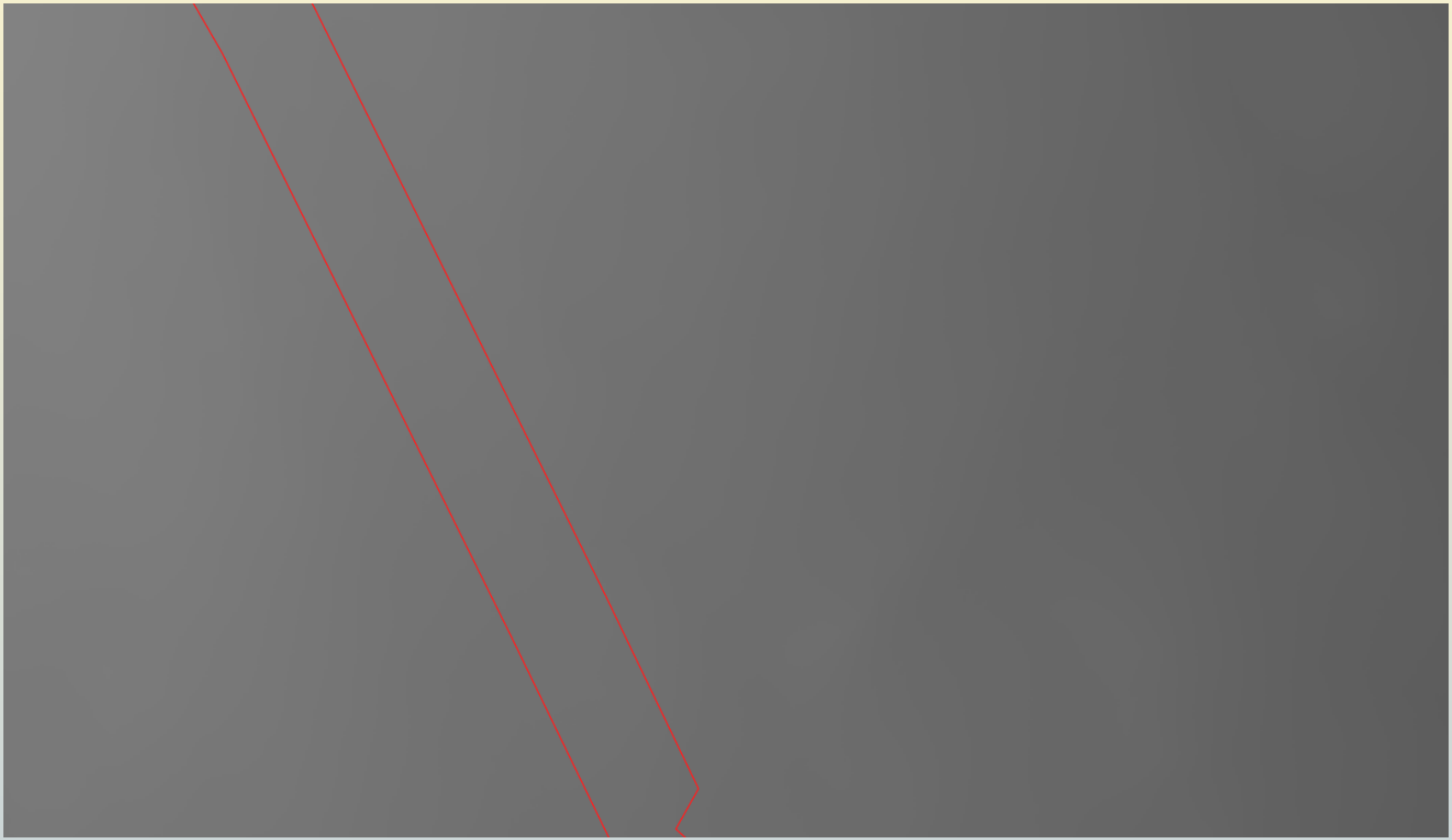
From He (2016)

Coverage in Scotland



SEPA and DEFRA LiDAR Data

What does a Roman Road Look Like?

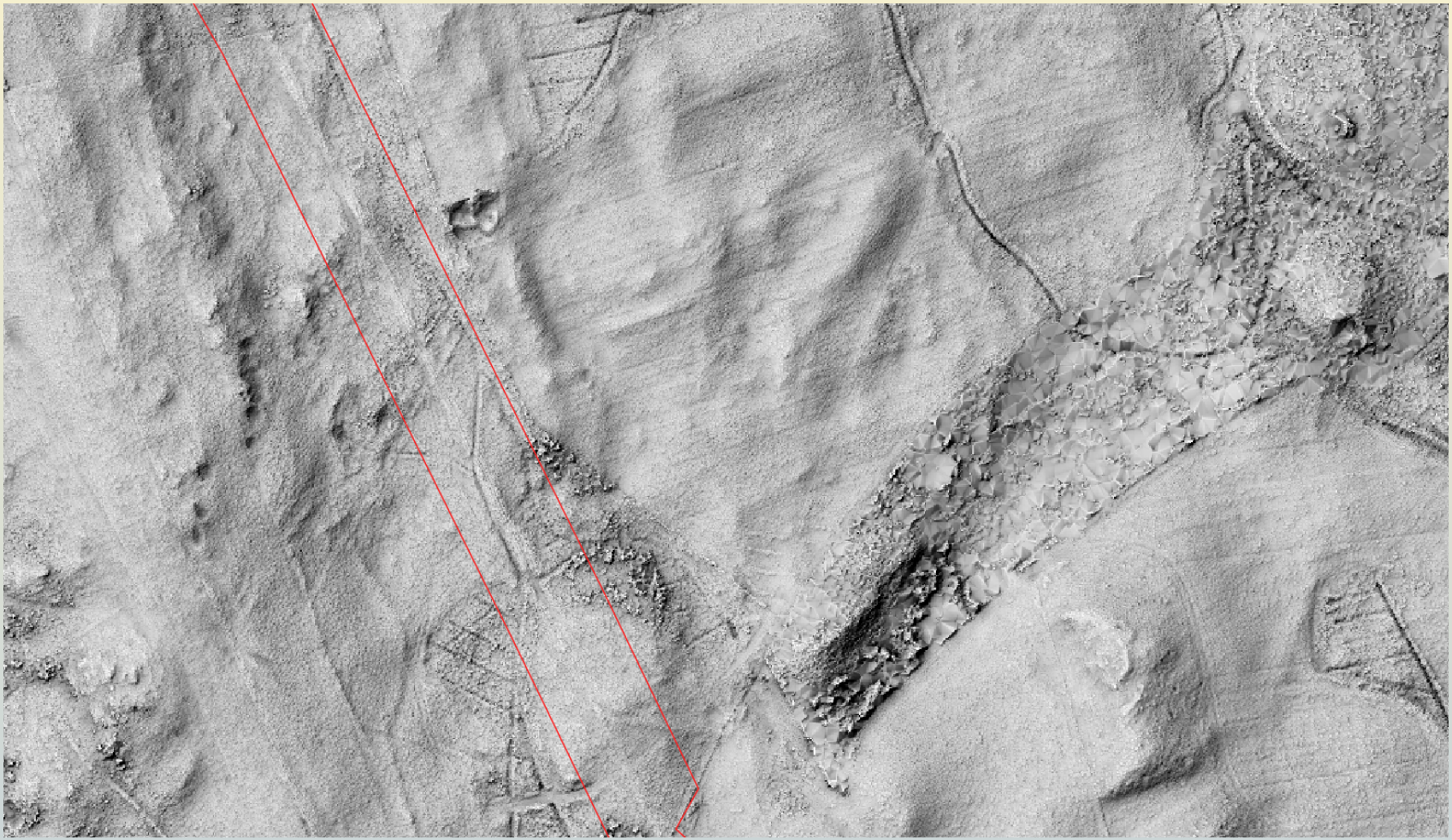


A Roman Road in LiDAR

Pre-processing the LiDAR

- Visualisation for Archaeological Topography (Kokalj and Somrak, 2019), we calculate 3 measures and combine them into a single image.
  1. sky-view factor which provides illumination related to how much of the sky is visible that is limited by relief (Zakek et al., 2011)
  2. the positive openness which highlights the high and low points of the terrain (Doneus, 2013)
  3. a normal hill shading algorithm

A Roman Road After Processing

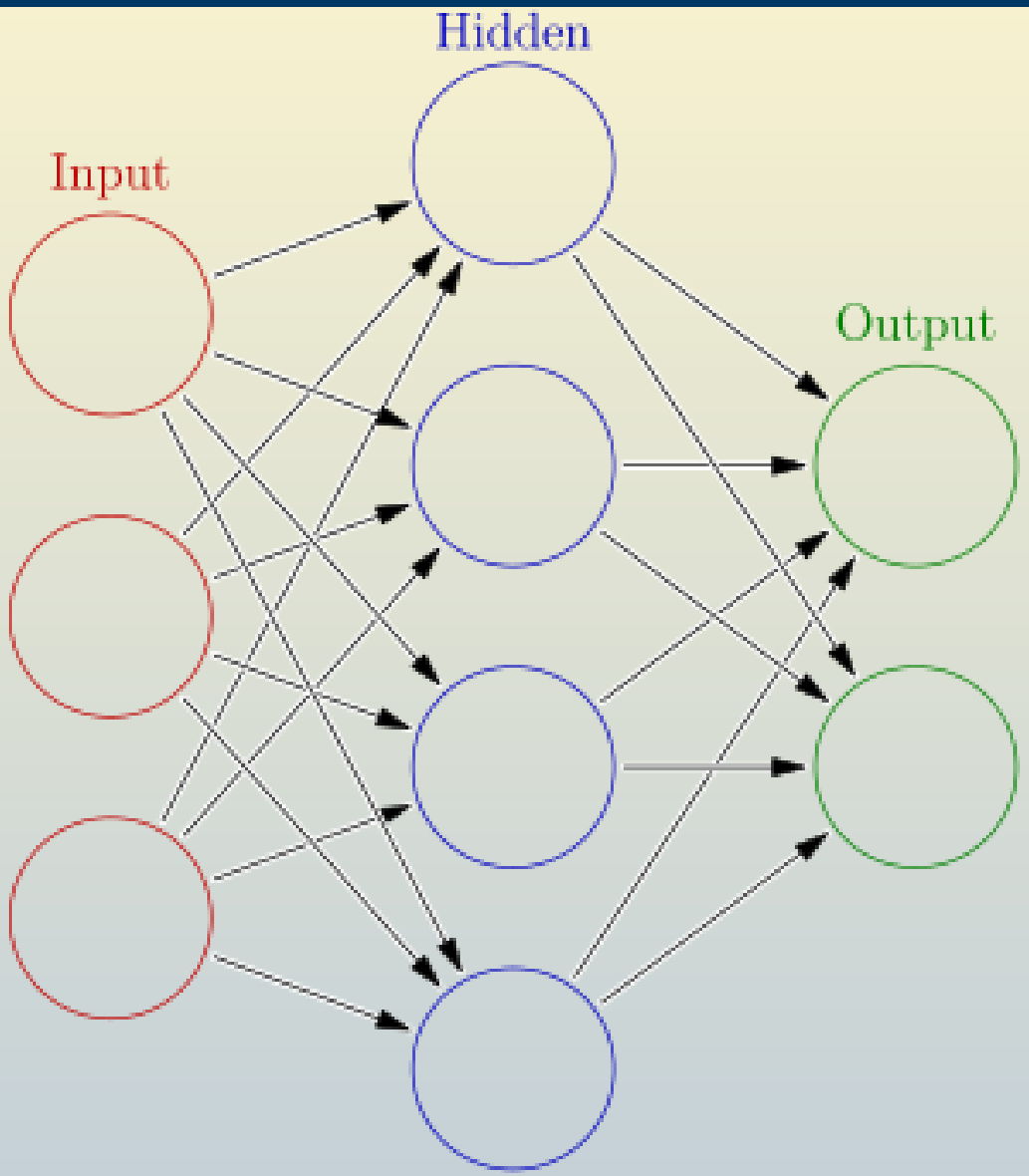


A Roman Road after application of VAT

What is GeoAI

- Artificial Intelligence applied to geographic problems
- Artificial Neural Networks (sort of like a brain)
- Allows us to do things a (bright) five year old can do
- But much faster on bigger data (with out the tantrums)

An Artificial Neural Network



An artificial neural network, Wikimedia Commons CC-BY-SA

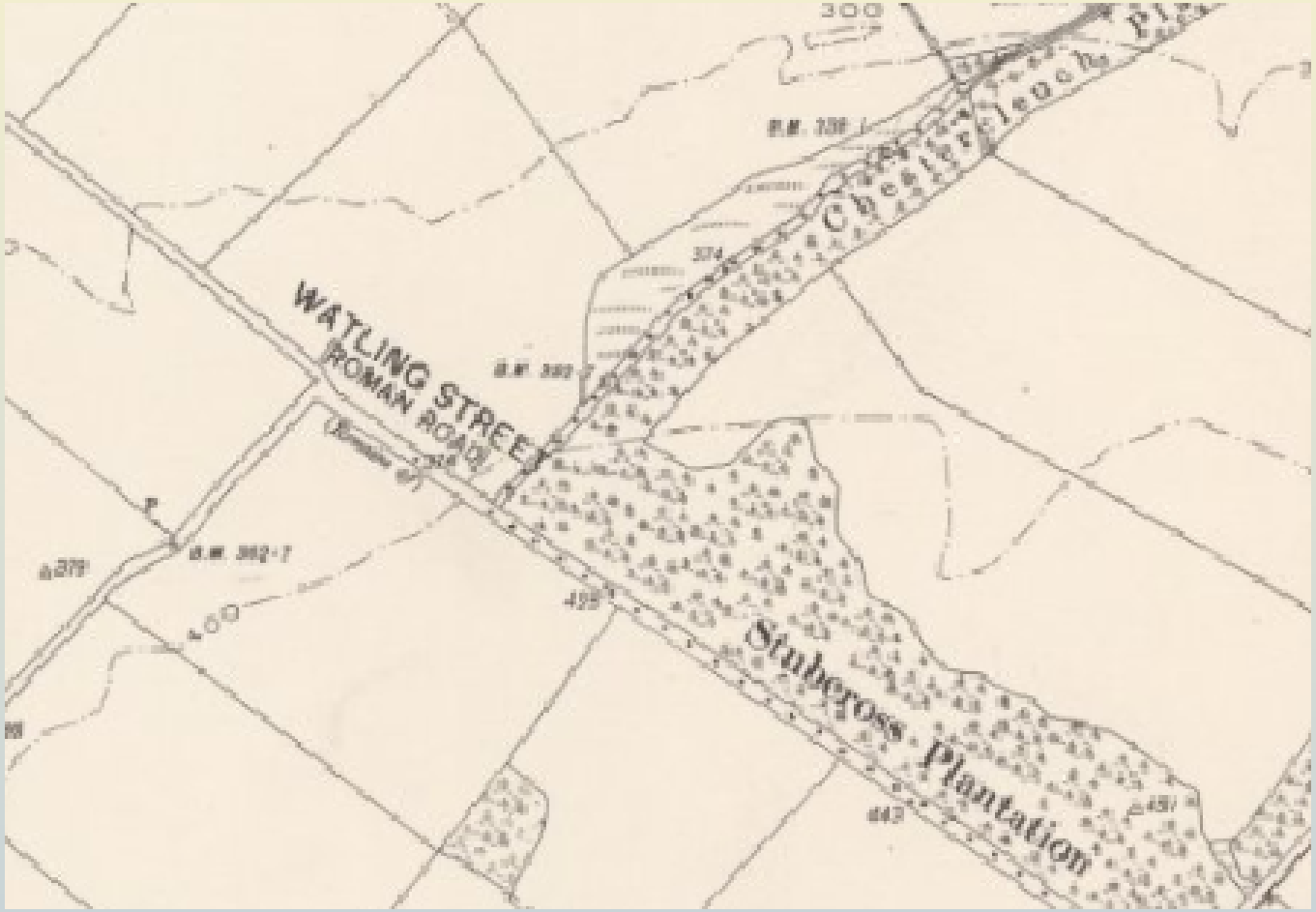
How it Works in Practice

- Create a (large) training data set, lots of small images that either show a road or not
- Pass that image through the neural network
- Look at the answer - if it is right then update the weights
- Repeat a lot of times until performance stops improving
- Check performance using a validation dataset (training data that has not been used yet)

Results

- Currently, there are no results.
- Generating enough training scenes is proving tricky
- Seems that we don't know where enough existing roads are (that aren't under tarmac)

- Track down more roads, that are not scheduled monuments



A section of OS Second Edition 6 to the Mile map, National Library Scotland.

Conclusions

- GeoAI is a reasonable way to discover unknown Roman roads
- Need to find more training examples
- Should allow us to find more of the Roman B-roads

Links to slides

www.ianturton.com/talks/pos24/romanroads.pdf

References

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