24 September 2025

Answers to question during NOSP meeting September 23rd.

I got some very good questions after my talk. Due to the short time, the answers could have been a little better. Here I will try to give some better answers:

Question: How to correct data with wrong coordinates, distortion?

It depends on why the data are wrong and if the distortion is even over the dataset, or if you have different distortion in different areas of the image/map. If the image/map is only placed in the wrong place with wrong rotation, it is simpler. If not you nee to do more work. Back in 1990 we digitised paper maps manually using a digitiser tablet. Then we had the same problem. To fix this we used affine transformation. ChatGPT gives us this explanation:

An affine transformation in cartography is a mathematical method for moving, rotating, scaling, or shifting a map or set of coordinates to fit another coordinate system or map projection. There are also other transformations available.
More specifically:

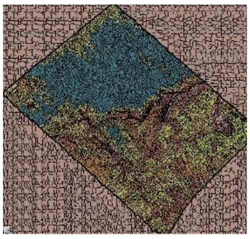
- What affine transformation is:
  - An affine transformation is a linear transformation combined with a translation. It preserves parallel lines and straight lines, but not necessarily distances or angles.
- What it does in maps:
  - Moves map data so that it matches a known reference (georeferencing).
  - Used when adapting scanned map images (raster) to a coordinate system.
  - Can correct simple distortions, e.g. when a map sheet is scanned slightly askew.
  - Makes it possible to use points with known coordinates (control points) to recalculate the map.
- Properties preserved:
  - Parallel lines remain parallel.
  - Midpoints and relationships between collinearity are preserved.
  - Distances and angles may not be correct (it is not a "conformal" transformation).
- Example:
  - If you have an old scanned paper map and want to place it in modern UTM coordinates, you can use an affine transformation based on at least three known points (e.g. intersections or trigonometric points) to make it fit reasonably well.

Mapping software normally have this function built in. In QGIS (free on net) you can adjust one image to another image so they line up. You need to pick points in both images that are the same point and QGIS does the transformation. One is the correct image and the other is the image to be corrected.

If you have a million images you may need better and more automatic solution to do this. Modern image solutions have the function to find points in two images that are the same point. You use this function in normal photos to create panoramic images based on two or more images. You still need a good overlap between the images.
First, I would try to find standard software that do the work for you, since this is a general problem in mapping.

If there is no SW in the market and it is very important, you may use a program called SIFT that find points in two images that are the same. This requires more work for you. Maybe there is an AI solution to do this for you.

Question: What data and sediments were used for NGU?



This is a description we wrote when we made the ruleset in eCognition. The document is longer. This is the main answer to the questions:

Data input:
BS: back scatter value, corrected for angle, distance and terrain
BPI: bathymetric positioning index, whether a point is lower or higher than the area around
The BPI algorithm compares each cell's elevation to the mean elevation of the surrounding cells within a user defined rectangle, annulus (donut shape) or circle (Figure 1). Using negative bathymetry data results in a negative BPI value for depressions (a cell is lower than its neighbouring cells), a positive BPI for crests (a cell is higher than its neighbouring cells) and a zero BPI for constant slopes or flat areas (Figure 2) (Lundblad *et al.*, 2006).
Bpi3,
bpi5,
bpi10,
bpi25,
bpi50
radius of curvature,
curvature is this same as radius of curvature
Curvature is the rate of change of the slope, or the slope of the slope. There are three types of curvature: profile, plan, and total curvature. Profile and plan curvatures are the curvatures on a line formed by the intersection of a plane and the terrain surface. The curvature of a line is the reciprocal of the radius of curvature, so a gradually changing curve has a small curvature, while a tight curve has a large curvature (Galant and Wilson, 2000). Profile curvature represents the rate of change of slope in the direction of the maximum slope, which affects the acceleration and deceleration of flow and therefore influences erosion and deposition. Profile curvature also differentiates between upper and lower slopes (Galant and Wilson, 2000). The plan curvature represents the rate of change of the slope perpendicular to the direction of the maximum slope and influence convergence and divergence of flow and differentiates between ridges, valleys, and hillslopes (Galant and Wilson, 2000). The total curvature represents the curvature of the surface itself, not the curvature of a line across the surface in a given direction. (Galant and Wilson, 2000). A positive total curvature value represents an upwardly convex surface, while a negative total curvature value represents an upwardly concave surface. A zero curvature value represents an area of constant slope (Figure 7). In addition to the slope, the total curvature was used to characterize the relationship between interpolation deviations and terrain characteristics.

curvPL	Plan curve
curlPR	Profile curve
eastness	Aspect
northness	Aspect
rgh	roughness
slope	

rugosity triangles to side pixels compared to total area. This is more like slope area compared to ortho area. The rugosity is the ratio of the surface area to the planar area. It gives an indication of the "bumpiness" of the terrain.

Segmentation:
Use these layers for segmentation:
Bpi25
BS
Rgh

Scale: 10
Shape: 0.1
Compactness:0.5

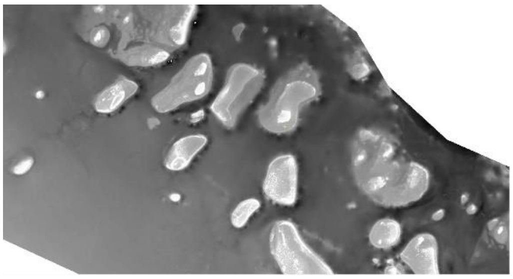
Classes

G	Gravel
G/R	Gravel / Rock
gS	Sand / Silt with gravel
R	Rock
S	Sand / Silt
sG	Gravel with Sand / Silt
sM	Mud with Sand / Silt

We adjusted the model to what is practical in eCognition. Thanks to Dr. Markus Diesing at NGU who developed the theory behind. TerraNor automated the solution in eCognition.

Question: How can we check if the classification is correct?

If you have grapple samples from the seabed, the normal statistical approach is to use 80% of the samples to create the model and do the classification. Then you check to see if the last 20% samples ‘land’ in the right classification. Since classification is actually based on statistics from the samples and normally not the position, it is possible to use all samples for this. Look up user/producer calculations in statistics.



If you use sonar and have no samples: you will find what you look for. You will find small ‘hilltops’ on top of larger ‘hilltops’ and assume that this is coral on top of larger rocks. Then you pay someone a large amount of money to send down an AUV or ROV to check the real world. You do not need to check the whole area, only take samples placed in a random grid. You should ask a forest surveyor or a statistician how to do this.

What is the difference between Artificial Intelligence, AI, and Deep Learning, DL?

DL means picking a huge number of samples of each class, normally at least 1 500 pr class. That is why it is called DL. DL uses something called Convolution Neural Network to create the model. People good in math will know what this is. The method was first abandoned because it did not work very well. Then one stubborn scientist tried with a huge number of samples for each class. Then the method turned out to be the best for classification of images as long as you have many samples.
AI uses DL to analyse and process the classification. The difference from use of DL in a software like eCognition, is that the AI can go out and pick the samples automatically. If the samples are picked well, you will receive the same result as in eCognition.

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Normally you will need to adjust the result when you classify large datasets like satellite images.
eCognition has a lot of functions to improve the result.
In AI you need to know what questions to ask and ask it to collect the right samples.

Scientists have looked into the result of classification/analysis:
AI: 85% correct.
Expert: 85% correct.
AI + Expert: 95% correct.
The numbers may vary, but the result shows why we still need the experts.

Remember Jack Reacher: in a survey, details matter.

Hope this is clarifying things a little bit. If you have more questions or you have some thousands images you need to improve:
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Med hilsen
TerraNor

Nils Erik Jørgensen