

# Symmetry - watermarking?

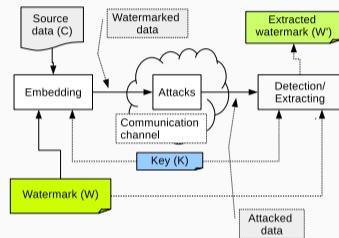
doc. dr. Bogdan Lipuš

LABORATORY FOR GEOSPATIAL MODELLING,  
MULTIMEDIA AND ARTIFICIAL INTELLIGENCE

Monday 17<sup>th</sup> May, 2021

# Point cloud watermarking

- Two processes:
  - **Embedding** the watermark (spatial or frequency domain)  $\Rightarrow$  small (invisible!) changes in the positions of the points;
  - **Detection/Extraction** of the embedded watermark from the (attacked) watermarked cloud;
- **attacks**: data modification that destroys the watermark;
- **trade-off**: between the amount changes in the position of the points (embedding + attacks) and ability to detect/extract the watermark from the point cloud;



# Main idea

- Use symmetry to embed the watermark (the sequence of symbols) into the point cloud;
- (local) "smart" change the positions of the points in the (randomly defined?) areas;
  - different types (bounding box, circle, etc.) and sizes; (perform some clustering???)
  - apply to all or some subset of the points in these areas (some criteria?);
  - spatial or frequency domain (DCT, FFT etc.);
- able to detect/extract these symmetries from the point clouds (A- knowing the area, B - not knowing ?)

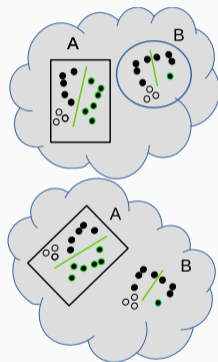


Figure 2

- Questions:
  - Can symmetry be detected/extracted efficiently in small areas of the point cloud? How many points need to be provided?
  - How efficient/robust is detecting of symmetries (even if attacks damage the symmetries)?
  - If the result of searching is the **straight line**. Can the length of this line determines (the value) of the watermark symbol? Can this line and its length be determined efficiently (even if the cloud is attacked)?
  - If the same watermark symbol is embedded multiple times, can this be helpful to determine the value of the watermark symbol?
  - **The points need to be changed very imperceptible and be robust against attacks.** Is this an issue for detecting the symmetry? Can we actually change the points in some area in such way that the symmetry is "created", and consequently detected?