**Title:**

Automated detection and classification of hollow terrain shapes

* An approach to

**1. Introduction:**

Introduction of MOF area:

* Area
* Approach
* Goal

**2. Methods:**

General Information:

Pinge:

A *Pinge* is the name given in German-speaking Europe to a wedge-, ditch- or funnel-shaped depression in the terrain caused by mining activity.[[1]](https://en.wikipedia.org/wiki/Pinge#cite_note-1) This depression or sink-hole is frequently caused by the collapse of old underground mine workings that are close to the Earth's surface.[[2]](https://en.wikipedia.org/wiki/Pinge#cite_note-2)

1. Joachim Huske: Die Steinkohlenzechen im Ruhrrevier. 3rd edition, German Mining Museum, Bochum, 2006, ISBN 3-937203-24-9
2. Walter Bischoff, Heinz Bramann, Westfälische Berggewerkschaftskasse Bochum, In: Das kleine Bergbaulexikon. 7th edn., Verlag Glückauf GmbH, Essen, 1988, ISBN 3-7739-0501-7

Sinkhole:

A sinkhole, also known as a cenote, sink, sink-hole,[[1]](https://en.wikipedia.org/wiki/Sinkhole#cite_note-1)[[2]](https://en.wikipedia.org/wiki/Sinkhole#cite_note-2) swallet, swallow hole, or doline (the different terms for sinkholes are often used interchangeably[[3]](https://en.wikipedia.org/wiki/Sinkhole#cite_note-3)), is a depression or hole in the ground caused by some form of collapse of the surface layer. Most are caused by karst processes – the chemical dissolution of carbonate rocks[[4]](https://en.wikipedia.org/wiki/Sinkhole" \l "cite_note-4) or suffusion processes.[[5]](https://en.wikipedia.org/wiki/Sinkhole#cite_note-bgs-5) Sinkholes vary in size from 1 to 600 m (3.3 to 2,000 ft) both in diameter and depth, and vary in form from soil-lined bowls to bedrock-edged chasms. Sinkholes may form gradually or suddenly, and are found worldwide.[[6]](https://en.wikipedia.org/wiki/Sinkhole#cite_note-6)

1. Whittow, John (1984). Dictionary of Physical Geography. London: Penguin. p. 488. ISBN 978-0-14-051094-2.
2. Thomas, David; Goudie, Andrew, eds. (2009). The Dictionary of Physical Geography (3rd ed.). Chichester: John Wiley & Sons. p. 440. ISBN 978-1444313161.
3. Kohl, Martin (2001). "Subsidence and sinkholes in East Tennessee. A field guide to holes in the ground" (PDF). State of Tennessee. Retrieved 18 February 2014.
4. Lard, L., Paull, C., & Hobson, B. (1995). "Genesis of a submarine sinkhole without subaerial exposure". Geology. 23 (10): 949–951. Bibcode:1995Geo....23..949L. doi:10.1130/0091-7613(1995)023<0949:GOASSW>2.3.CO;2.
5. "Caves and karst – dolines and sinkholes". British Geological Survey.
6. Kohl, Martin (2001). "Subsidence and sinkholes in East Tennessee. A field guide to holes in the ground" (PDF). State of Tennessee. Archived from the original (PDF) on 12 October 2013. Retrieved 18 February 2014.

Explosion crater:

1. P. W. Cooper. *Explosives Engineering*. Wiley-VCH. [ISBN](https://en.wikipedia.org/wiki/International_Standard_Book_Number) [0-471-18636-8](https://en.wikipedia.org/wiki/Special:BookSources/0-471-18636-8)

* Remote sensing

Flowchart graphic: (LIDAR->DEM->SOM->Segmentation->Artificial layers->Extraction->ordination->test validation and prediction)

* + Based on Lidar-data (hessisches bundesamt bla)
  + Generation of an digital elevation model (DEM)
  + Calculation of an sinks only model (SOM)
  + Segmentation of hollow terrain shapes (including validation and point layer)
  + Generation of artificial layers based on morphometrics (aspect, slope etc.) and sky-view factor
  + Extraction of artificial layers values (pixel-based) using the polygons generated by the segmentation (mathematical operation included)
  + Training area selection (pinge, sinkholes, explosion craters) (Sources)
  + Perform workflow on training area
  + Ordination and cluster analysis
  + Cluster statistics
  + Internal validation -> test on all classes
  + Prediction MOF

The first step is the creation of an digital elevation model (DEM) out of a LIDAR-pointcloud for each training area. The “Legion DEM” function creates multiple artificial layers (aspect, slope etc.) from the DEM. The “Cenith fillsinks” function is applied to calculate a sinks only model (SOM) which is used by the “Cenith hollow” function to perform a segmentation of hollow terrain shapes. The calculated polygon segments are used by the “Reaver extraction” function to extract the mean and standard deviation pixel-values from each of the previously generated artificial layers. After this step every segment has the mean, and standard deviation values for each artificial layer. In order to calculate a ordination the negative values were converted into positives.

Study areas:

Pinge: Neu-anspach

Explosion craters: Lahnberge

Sinkholes: Bad Drieburg

* Field methods

**3. Results:**

**4. Discussion/Conclusion/Outlook:**

**5. Literature**