

Automated 3D Data Interpretation

AI-based object recognition in 3D point clouds

Infrastructure monitoring generates large amounts of data. Interpretation of such data can be enhanced by automatic object recognition.

Today, high-performance cameras or laser scanners are used for monitoring traffic infrastructure such as roads, tunnels or bridges. They deliver high-resolution images and precise, georeferenced measurement data, which are usually evaluated in a manual process. 3D-AI, a software framework by Fraunhofer IPM, automates the evaluation process, providing a tool for the efficient analysis of 2D and 3D data.

AI-hybrid approach

The software framework 3D-AI combines two approaches for automated data interpretation of 2D and 3D data: artificial intelligence (AI) and 3D geometry based object detection. While AI based approaches provide good results in object detection, especially in 2D images, reliability of detection is insufficient in critical processes such as infrastructure monitoring. Purely geometry based object detection, which is rule and feature based, proves to be not robust enough against object variations.

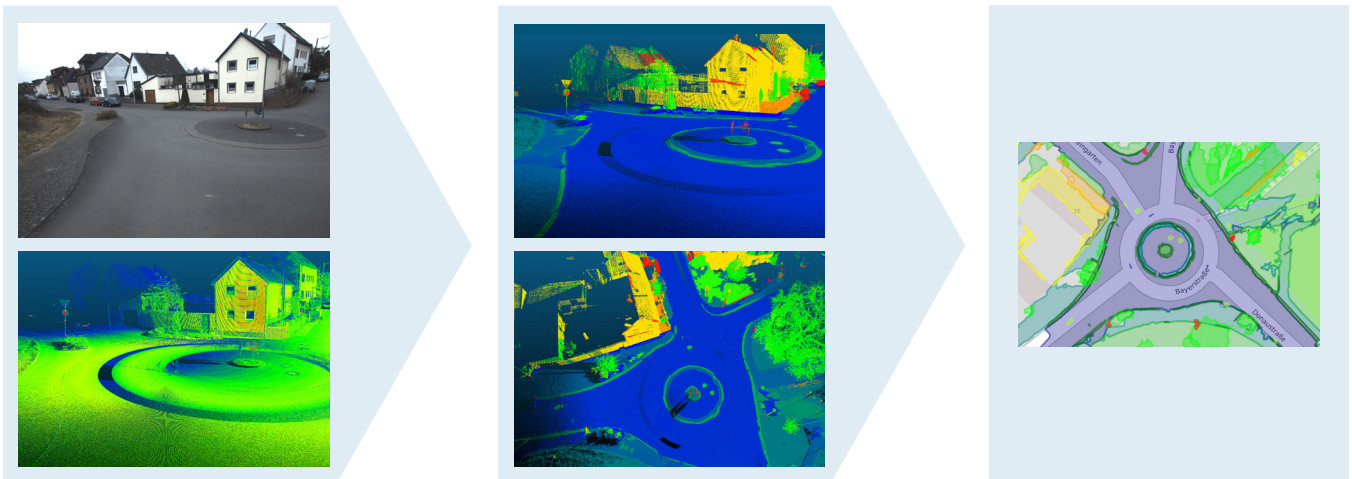
Hybrid algorithms as applied in 3D-AI combine the strengths of both approaches, thus enabling highly reliable recognition in real world data.

End-to-end process chain

The 3D-AI software framework is part of a comprehensive end-to-end process chain that allows georeferenced 2D image data and 3D point clouds to be fed into a cloud-based system. A fully analyzed data set is provided in the form of a point cloud in which each point is assigned a specific object class. The objects are separated from each other and enclosed by bounding boxes. As a result, georeferenced objects are available. Depending on the application, a 2D or 2.5D map can be generated, which includes information on the altitude of objects. In addition, the data can be combined with different maps or GIS solutions according to the specific application.

Advantages at a glance

- Efficiency evaluation of mobile mapping data
- Segmented point clouds including georeferenced objects
- 2D or 2.5D maps according to application
- Processing sequences according to application



2D camera data (upper left) and 3D laser scanner data (lower left) depict the infrastructure quickly and efficiently. 3D-AI analyzes the data automatically using smart algorithms (Mid). Each color in the point cloud represents a singular class of objects. This data is then transferred to a digital planning map (right) for automated route planning. In addition to the categorized surfaces, this plan contains information on the position of the objects.

Analyzing mobile mapping data

Fraunhofer IPM developed 3D-AI especially for mobile mapping data. In its current version, the software framework covers 30 object classes from urban environment such as different types of pavement, sidewalks, vegetation, posts, etc. The analysis of measurement data acquired in a full geodetic survey of a small town with a road network of around 200 kilometers is carried out within a few hours. The combined georeferenced 2D RGB image data and 3D laser scanning data are analyzed directly using the AI-based software framework. No RGB-D data is generated, which ensures fast processing. All object classes are projected into the 3D point cloud. Finally, special heuristics and filters are applied. Several companies employ 3D-AI for classifying and evaluating measurement data.

Adaptable for specific user scenarios

Fraunhofer IPM customizes 3D-AI for specific applications by adding object classes or adapting the software framework to further data sources and data outputs. Proprietary tools are provided for including further object classes. These tools allow for a fast and straightforward annotation of 2D and 3D data, resulting in additional training input for the AI component. Object detection can be carried out based on the image data alone or directly based on the 3D data. Interfaces of the award winning 3D-AI software framework are adapted according to customers' requirements.

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