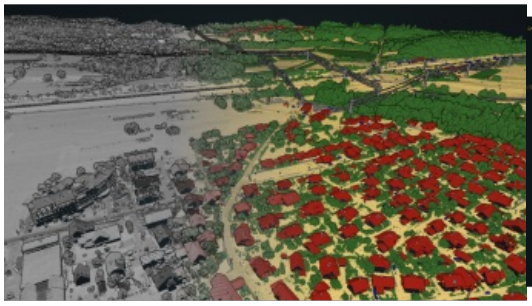
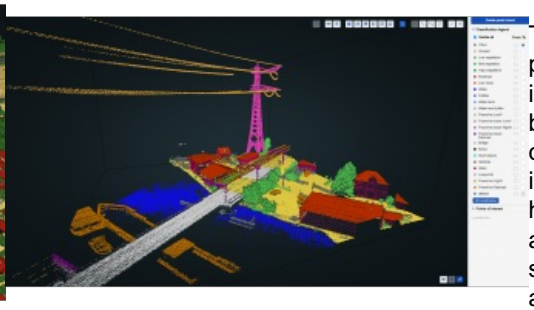
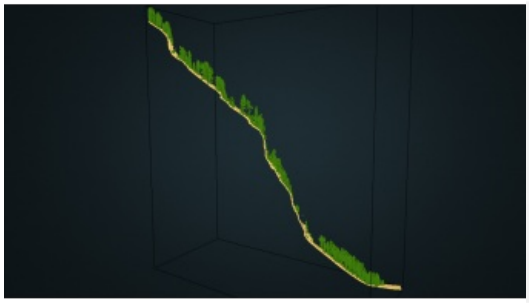
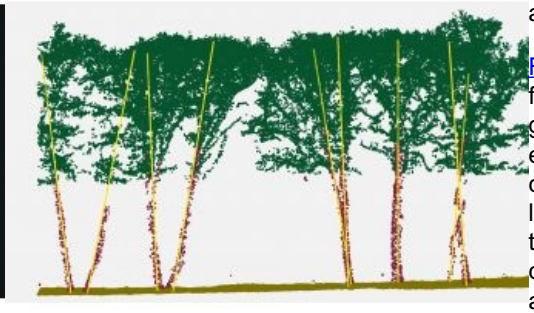
# *SOFTWARE AS A SERVICE FOR STREAMLINING POINT CLOUD PROCESSING WORKFLOWS*

# Leveraging AI for automated point cloud processing

The creation of an accurately classified point cloud usually requires tremendous input from manual annotation. At Flai, we believe that all those repetitive procedures can be greatly reduced by using the latest innovations in artificial intelligence. We have developed a cloud-based web application that provides easy-to-use solutions for the classification, exploration and management of geospatial data, with a special focus on point cloud datasets.

Flai was created by a team of experts from various backgrounds, ranging from geodesy and physics to computer engineering and machine learning. By combining our expertise in processing large quantities of data utilizing the latest technologies with our understanding of customer needs, we have developed Flai as a solution to the increasing demand for the automation of common geospatial tasks and customized requests. Our solution enables companies working with point cloud data to shift from labour-intensive human processing to faster and more efficient autonomous flows powered by the latest machine learning (ML) and artificial intelligence (AI) techniques. Those approaches are crucial to consistently delivering accurate products faster than ever before.

### Web application and data ingestion

To make it easier to use our tools and be independent of the underlying hardware and operating system on which they would be run, all operations are available through the Flai web application. The application enables uploading, browsing and combining various geospatial datasets, such as point clouds, rasters, vectors and images. After uploading, the datasets are safely and securely stored in the cloud and are accessible only to the organization that initiated the data ingestion procedure. When even greater security is requested and data cannot leave its country of origin or the data-producing company, the Flai environment can be deployed at the user's own computing facility. In the case of processing large data volumes, we also offer on-site batch-processing services for specific tasks, without the need of using the web application.

The web application interface provides easy access to uploaded data and offers an intuitive interface for creating and running user-defined processing flows. Each flow can combine multiple input datasets of different types and simultaneously output countless new datasets generated from input data. Focusing mostly on point cloud datasets, users can choose from a broad selection of predefined processing tools, ranging from simple operations such as class remapping and filtering to complex operations aimed at interpreting the data and creating higher-level results understandable by the wider public. The most sought-after tool is point cloud semantic segmentation that takes raw measurements and assigns a meaningful semantic label to every Lidar point. The generated set of labels depends on the selected field of interest and the required level of detail.

The Flai automatic artificial intelligence algorithm transforms raw point clouds into fully annotated and ready-to-use datasets.

## How does Flai point cloud classification work?

At Flai, we strive to use the latest approaches and best practices in all our data processing tasks. This is most pronounced in our point cloud classification task that uses state-of-the-art AI and ML algorithms for working with point clouds. The most challenging part of working with such data comes from the unordered structure and data specifics, as even datasets acquired in a uniform way can have vastly different densities and height spans. To overcome these potential hazards, we first split a dataset into small overlapping sections, where each one gets treated individually. For the classification algorithm to understand relations between points, their exact cartesian coordinates, height above ground and additional Lidar attributes (intensity, return number, number of returns and RGB values) are passed to a pre-trained AI model. The model's internal computations output per-point classification labels whose meaning was predefined by our team based on average customer requirements and use cases.

The application includes ready-to-use AI models suitable for large-scale mapping, drone applications, forestry inventory creation and mobile mapping. They have been trained on an extensive collection of diverse point cloud scenes that were hand-picked and skilfully annotated by our team of data engineers. This ever-growing set gets expanded whenever we encounter new types of structures, vegetation or terrain. For more advanced and specific use cases, we also offer an option to create user-tailored classification models that are trained on their data and classification labels. This feature is also available for all our users to try on their data and create their own custom models. The training process also includes an interactive component that will suggest which data should be additionally labelled and added to a training set to improve prediction quality.

The Flai point cloud viewer offers multiple classification tools to easily set objects in a point cloud to any user-defined label.

## Manual point cloud annotation

After the automatic classification procedure has been completed, results can be reviewed, edited and measured in the application. For this purpose, we embedded an intuitive three-dimensional viewer that allows users to seamlessly fly through even the largest datasets. At the same time, any identified misclassifications can be corrected by a range of point selection tools. Those include strip, box and polygonal selections that can be interchangeably combined to achieve desired results by remapping points of one or multiple labels into a new label. Additionally, the manual classification task can be distributed among multiple people in the user organization through virtual tiles that seamlessly split the dataset into smaller, more manageable chunks. Whenever any annotator has a problem deciding on an object type, they can initiate a conversation by placing a note directly in a point cloud.

## How can I benefit from using Flai?

The possible applications for point clouds are diverse and go far beyond the described classification task. Flai is constantly developing and adding new tools that extract more informative and easier-to-manage vector products from point clouds. Our team can also develop custom solutions to simplify and speed up your current workflows to make it easier to digitalize construction sites, urban planning, mining operations and surveying, among other activities.

## Large-scale aerial mapping

The majority of large Lidar acquisition companies still use semi-automatic scripts that can extract only the most basic and simple objects from the acquired point clouds. For extraction of additional classification labels and post-processing, they still rely on labour-intensive human-produced annotations. With the help of Flai, some of them are already leaving behind their old methodologies and replacing them with automated solutions. Since the production of digital elevation models is the main aim of large-area mapping datasets, our main task for such extensive mapping projects is to extract reliable ground representation without any outliers. Additionally, depending on customers' needs, we can also deliver annotations for buildings, vegetation, bridges, water, powerline infrastructure and all other remaining human-built structures. Over the course of the last year, our AI models enabled significant time savings for end clients. Regarding the time allocated to the manual annotation, reported time savings range between 30% and 80%, depending on the complexity of the use case.

Flai provides reliable ground extraction for even the most complex scenarios, such as overhangs, terraces and boulder-filled regions.

## Mapping with drones

The same approaches can also be applied to typically much denser datasets acquired by unmanned aerial vehicles (UAVs or 'drones'). Here, we focus on processing small areas captured to understand a specific region. Those regions require high-frequency monitoring which is usually not feasible from the ground, or the ground measurements are too time-consuming to produce. Therefore, drone scanning combined with our automatic procedures is the optimal solution for the timely and constant delivery of reliable products for monitoring critical infrastructure and risk assessment. Our clients come from various different sectors such as mining, urban planning, landslides and rockface monitoring, transmission wire inspection and many others. Our application has helped multiple UAV mapping companies to complete their projects in a matter of days, rather than weeks as was previously the case.

## Forest inventory

With the growing demand for sustainable processes and the need to account for and measure greenhouse gas sinks and sources, a growing number of initiatives are trying to produce as accurate forest inventories as possible. Extracting inventory information, such as tree size, diameter and species, is typically very labour-intensive and limited to only a few sample locations in vast forests. To make this work easier and produce more accurate results, a growing demand for extracting this information directly from point clouds has emerged. When the point density is high enough and an adequate number of Lidar points penetrate the canopy down to the ground level and hit tree trunks, they are ideal sources for the estimation of biomass at the individual tree level.

The Flai solution for single tree delineation can report all relevant tree information such as tree height, canopy distribution, trunk length and radius.

To ease the transition, we have developed a custom classifier that can discern forest volume into three important segments: tree canopy, trunks and understory. They are used to create accurate maps of individual tree top locations and heights, trace canopy outlines and compute vertical crown density profiles. Additionally, single trunk classification enables us to monitor tree trunks in the three-dimensional space, create radial profiles along their length and estimate individual volumes. The described approach has already helped multiple customers around the world to unlock the untapped potential for the use of AI and ML in forest inventory and carbon trading applications.

## Conclusion

Flai's web application has been proven useful for numerous use cases related to analysing point cloud data from diverse sources. Our application can handle any kind of data, from low-density aerial data to very high-density terrestrial scanning data. To enable you to test our application without any risk and understand how Flai can help your business, we offer a freemium plan with limited processing resources for all our existing tools. Simply create an account on our web page and give it a try.

## More information

info@flai.ai

https://www.gim-international.com/case-study/leveraging-ai-for-automated-point-cloud-processing