
Threedy Documentation Portal

Threedy

May 15, 2024

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Note: Release 3.8.0 includes possibly breaking changes.

For further details see *3.8.0 Migration Guide*

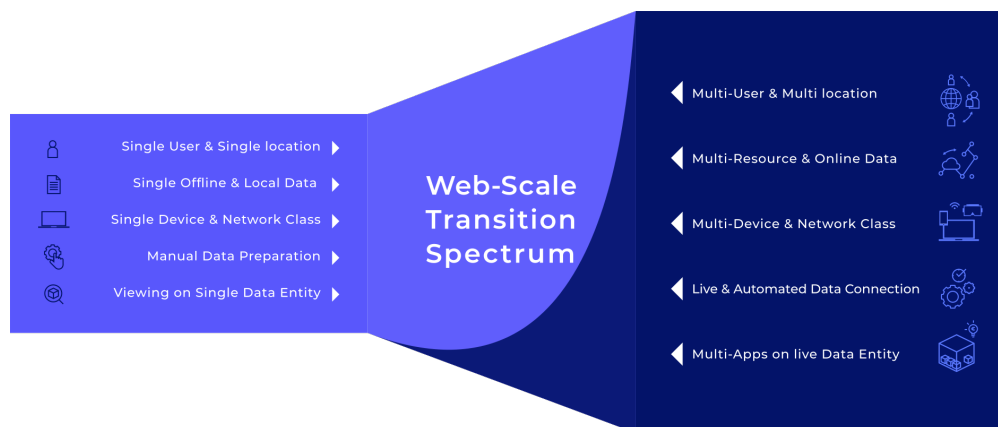
CONCEPTS

1.1 Introduction

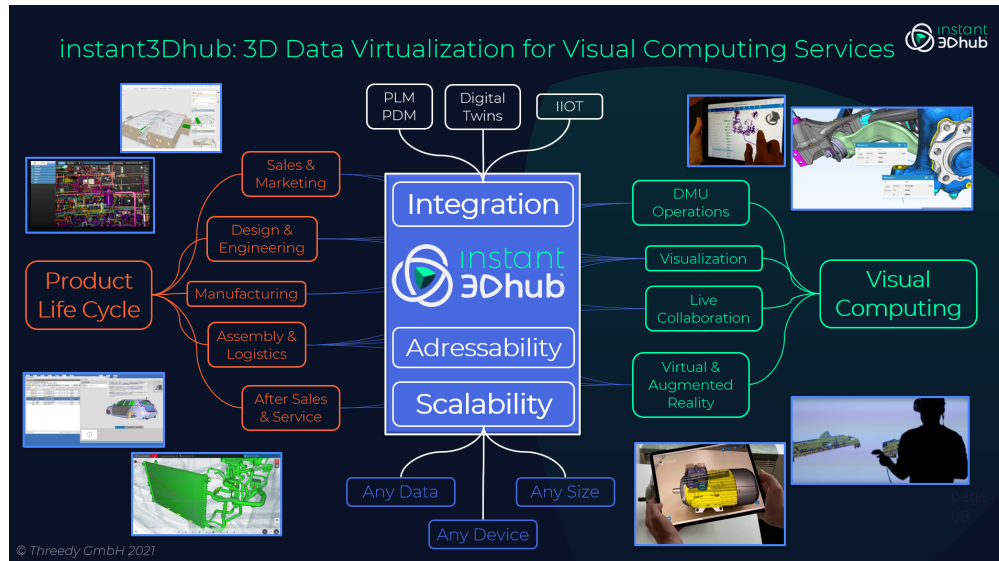
3D data and 3D visualization has been a key to industrial applications for more than 25 years. While modern technology enables an increasing number of incredible software solutions by the day, when it comes to 3D and Mixed Reality solutions, industry is facing challenges not even the ever-increasing computing power of cutting-edge hardware is able to overcome.

One of many reasons is the explosion of variation and complexity of modern manufacturing data and processes, accompanied by an increasing demand to access such data dynamically and within unknown hardware and network conditions. While moving from monolithic applications and expert tools to continuous services and APIs for cloud-first applications, traditional document-based management and distribution of 3D assets doesn't fit into modern software environments. The future is driven by loosely coupled service interfaces, where 3D data and Mixed Reality applications more than often are treated as foreign bodies. While, at the same time, for the creation of digital twins, the demand for high-quality 3D data to be made available for work processes all along the value chain becomes increasing relentlessly.

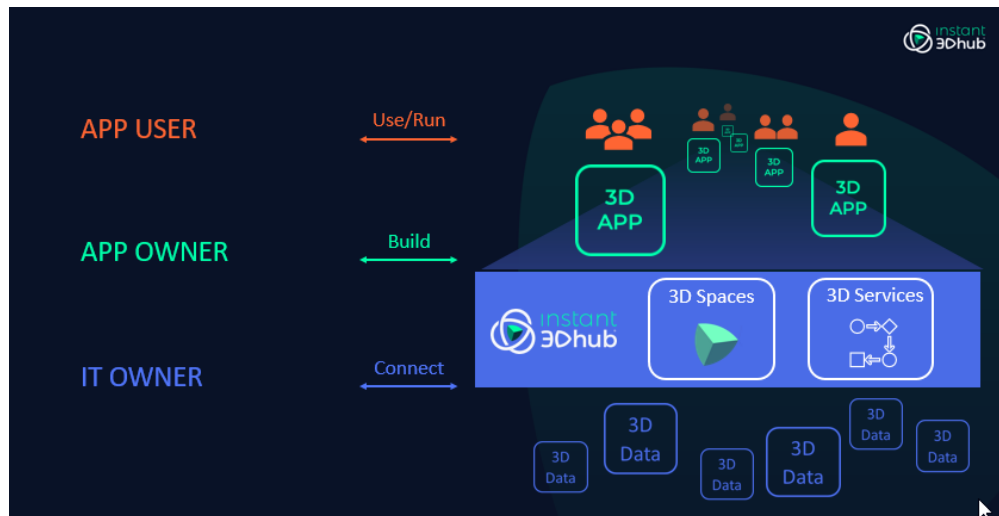
instant3Dhub is a unique solution for web-scale visual-computing-as-a-service to enable 3D data as a key for the digital transformation. Visual computing covers not only the generation of 3D images from data, but also any generation of knowledge from images and their synthesis. The strong interdependency of computing power, algorithms and 3D data size can only be dissolved by flexibly distributing computation between clients and services, even for highly complicated tasks, while seamlessly integration with modern web-scale software infrastructures.



This is the promise of *instant3Dhub*'s 3D data virtualization architecture: Any Data, Any Device, Any Size - instantly! It's achieved by combining standardized gateways to connect any kind of 3D data, made available by a broad range of front-end APIs and applications. In-between the two-sided API's, *instant3Dhub*'s *3D Spaces* serve as a unified concept for process and tool-chain integration along the full value chain, to dynamically connect 3D data and business data and to combine session management with live collaboration while supporting various application and data provisioning patterns.



This integration pattern provides all classes of stakeholders with the required flexibility to build 3D applications, which perfectly fit their specific requirements. This documentation provides information for three classes of stakeholders, covering topics from low-level infrastructure integration, through documentation of the various APIs, up to user tutorials for *instant3Dhub*'s default front-end applications.



1.2 3D Data, Spaces & Gateways

instant3Dhub's base data structure and control mechanism is the *InstanceGraph*. Using the *InstanceGraph*, users and applications control the content that is processed, visualized, stored or just synchronized inside *instant3Dhub*. For example, when an application wants to visualize geometry, it will add the geometry by a reference to the *InstanceGraph* and *instant3Dhub* will visualize it on all attached viewers. In contrast to a scene graph, the *InstanceGraph* is a linked structure of resources, which serves as the base data structure used internally to communicate with users, applications or other, synchronized clients.

The other important entity is the *3DSpace*. A *3DSpace* is an instantiation of the *InstanceGraph* that exists as an addressable, persistent web resource. *3DSpaces* can be used to easily collaborate, store and share information or

decouple the composition of 3D data assemblies and their consumption. For example, a user can setup a *3DSpace* with 3D data and annotations and share it with colleagues, who can then, at a later point in time, review and discuss the contents in a shared 3D experience. All of these can happen in separate applications and any results can automatically be forwarded to or triggered by other systems.

On the data side *instant3Dhub* classifies information into two types: Resource and *3DSpace* data.

1.2.1 Resource Data

Resource data comprises all information in external, linked data management environments. This contains f.e. geometry, material or metadata from a PDM system. This type of data is always linked, the data is never uploaded or added to *instant3Dhub* explicitly. *instant3Dhub* understands these resources as web resources and accesses them via HTTP(S). Resource data is considered immutable and can not be changed from within *instant3Dhub*, but it can be augmented with other information. *instant3Dhub* can also be configured to automatically react to external data updates. This HTTP interface is what called *Data Gateway*. *Data Gateways* do not necessarily need to be a infrastructural component as requirements are minimal and adhere to HTTP standards. In fact, in most cases any pre-existing HTTP interface can be used as an *instant3Dhub Data Gateway* out-of-the-box. The *Data Gateway* interface makes use of HTTP defaults to enable the use of authorization, encryption and caching. Please follow the *configuration guide* to set up the connection from *instant3Dhub*.

1.2.2 3DSpace Data

3DSpace data comprises all information that is applied or generated on the *3DSpace* layer, including among others:

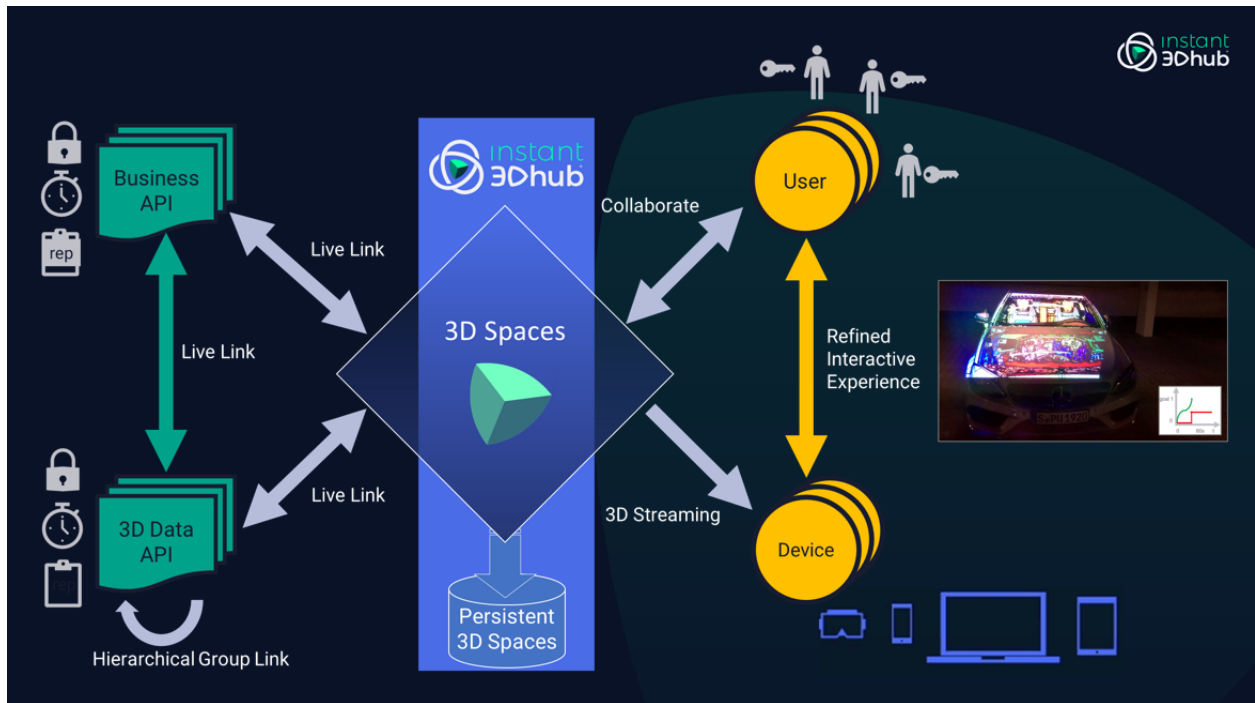
- The top-level structure of the *InstanceGraph*, e.g. links to resource data.
- Node state of the *InstanceGraph*
- Clipping planes, Measurements, Paintings, Annotations
- Session information, like current users of the space
- Custom/application data

3DSpace data is considered mutable and can be accessed with the *instant3Dhub* frontend APIs or the dedicated *3DSpace* API.

1.2.3 3DSpaces API

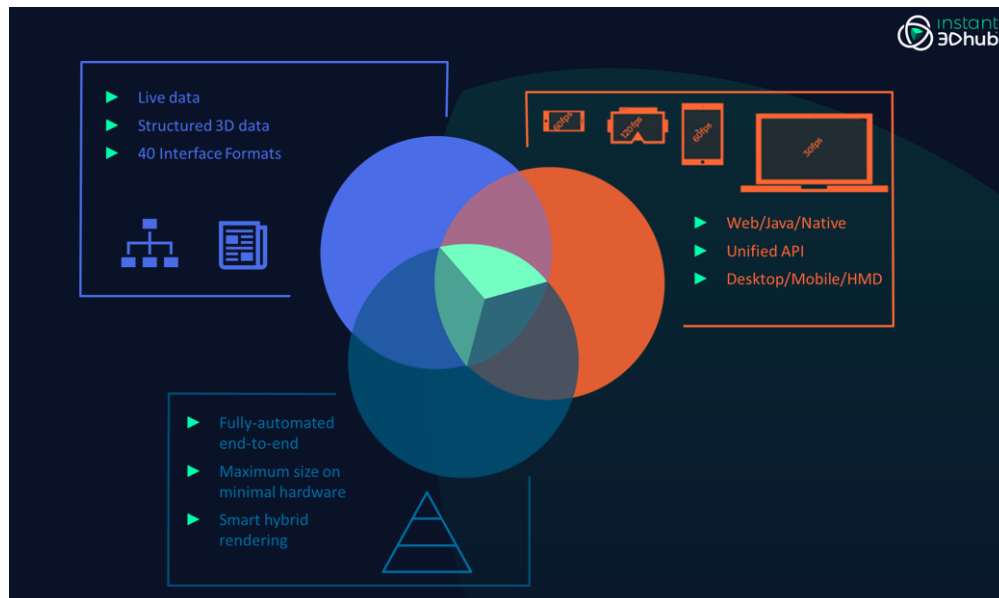
instant3Dhub provides an API to directly interact with *3DSpaces*. The API is based on OpenAPI and allows the access to *3DSpaces* without the need of a runtime or the use of a frontend library. This API can be used for service-to-service communication, like pre-filling a *3DSpace* from automated, prior process steps.

The *3DSpaces API* also allows the upload of local data into a space with a HTTP POST, to enable the use of non-web resources or just to share data without the need to create or access to a data pool. Any data uploaded this way is handled as resource data and thus is immutable.



1.3 Applications

instant3Dhub's pre-packaged applications allow for an easy start and deliver a whole range of features out-of-the-box. Under the hood, these applications are built on top of *instant3Dhub's* unified APIs and can serve as a reference when implementing individual applications.



1.3.1 Front-End Applications

Standard front-ends are:

- **webvis**: Rapidly create new web applications using the JavaScript API (TypeScript supported) or simply integrate our powerful webvis-Application into your processes.
- **navis**: Easily integrate 3D views directly or Qt-based into your native C++ application using navis.
- **jxvis**: Widget-based integration of webvis (using JxBrowser) or navis to extend your Java applications with *instant3Dhub*.

Complementary, an increasing number of standard runtime environments for different platforms are under active development:

- **instant3Dhub iOS App**: Connect web apps with local APIs to make e.g. the video streams usable for spectator users in collaborative sessions.
- **instant3Dhub VR Client**: Delivers high quality rendering on-screen and in VR (Windows).

Please refer to the next chapter for a more detailed description of *instant3Dhub*'s *feature packages*.

1.4 Feature Packages

1.4.1 3DSpaces

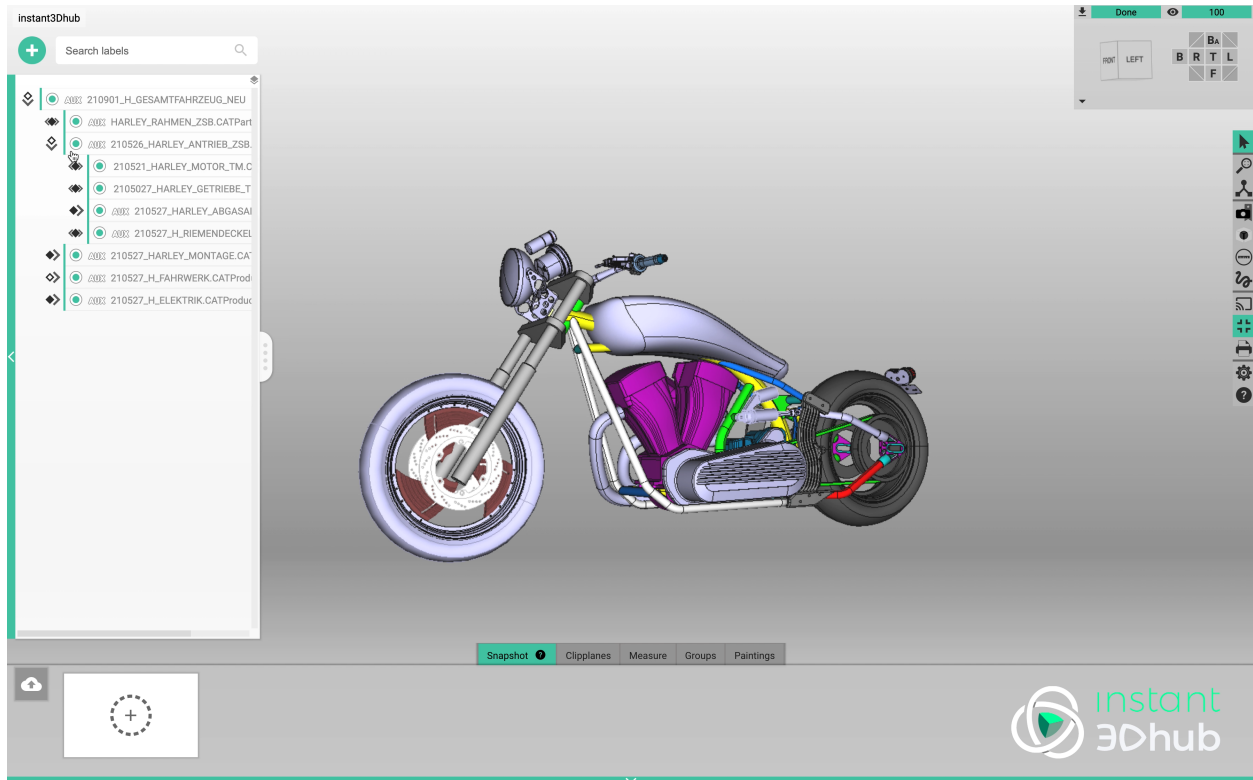
The 3D Spaces feature package includes all functions for the creation and content composition of the 3D Spaces, interactions to switch states e.g., on the level of InstanceGraph nodes, as well as using orthogonal structures like LayerFilter. Snapshots are common tools to define reusable views and states of the data further enriched using annotations or other attachments.

Composition

Add and remove nodes and *resources* to the *InstanceGraph* to utilize pre-defined data sets or build complex structures dynamically at runtime. The InstanceGraph API provides a range of pre-defined properties, but can also reflect custom properties for building your own logic. For example, it allows for dynamically switching the *enabled state* of a node or subtree at any time, as reflected by the tree view. Refer to the tutorials for step-by-step introductions and tutorials.

webvis API Reference

InstanceGraphAPI

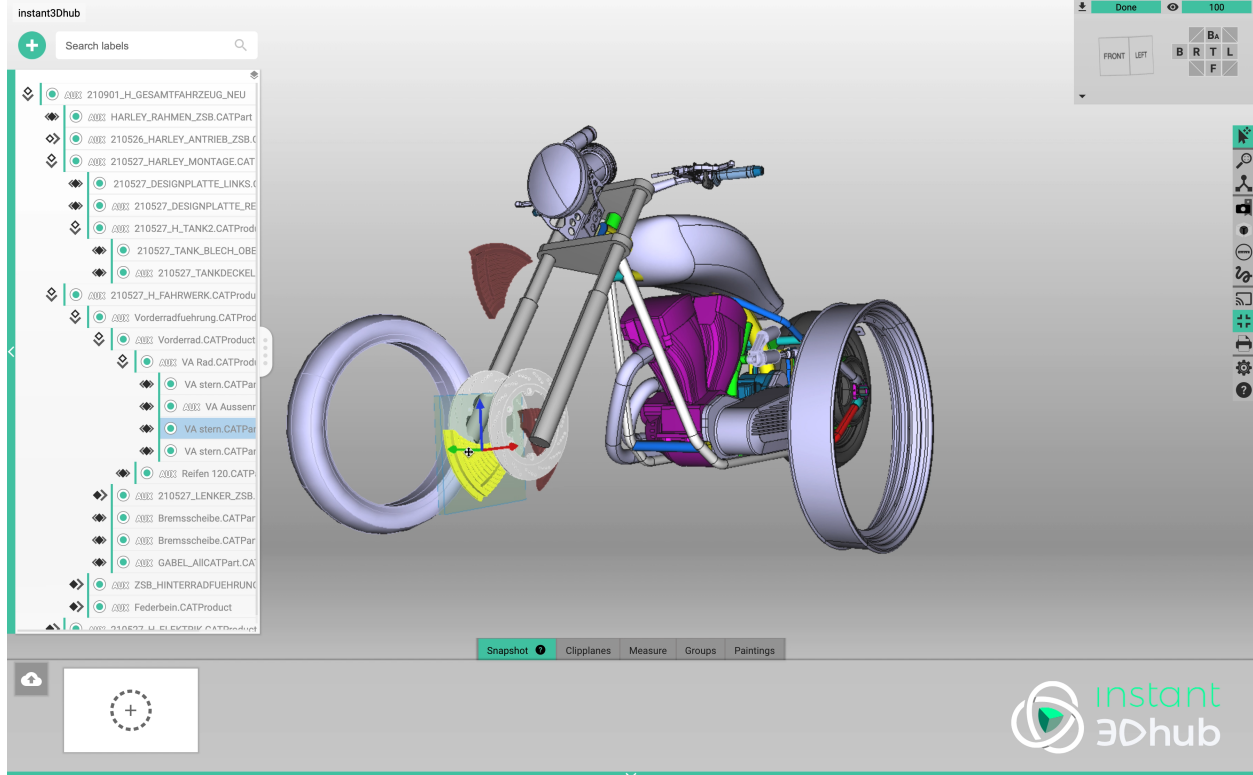


Meta Data

Metadata is usually the best way to link 3D data and business information. The *InstanceGraph* reflects all meta data as present in your 3D data using `getMetaData` as visualized in the *meta data inspector*.

Transformation

Dynamically transform your data in the 3D Space using the `localTransform` property of a node via API or using built-in gizmos. Use this feature for example to visualize step-wise working instructions. An overview is available [here](#).

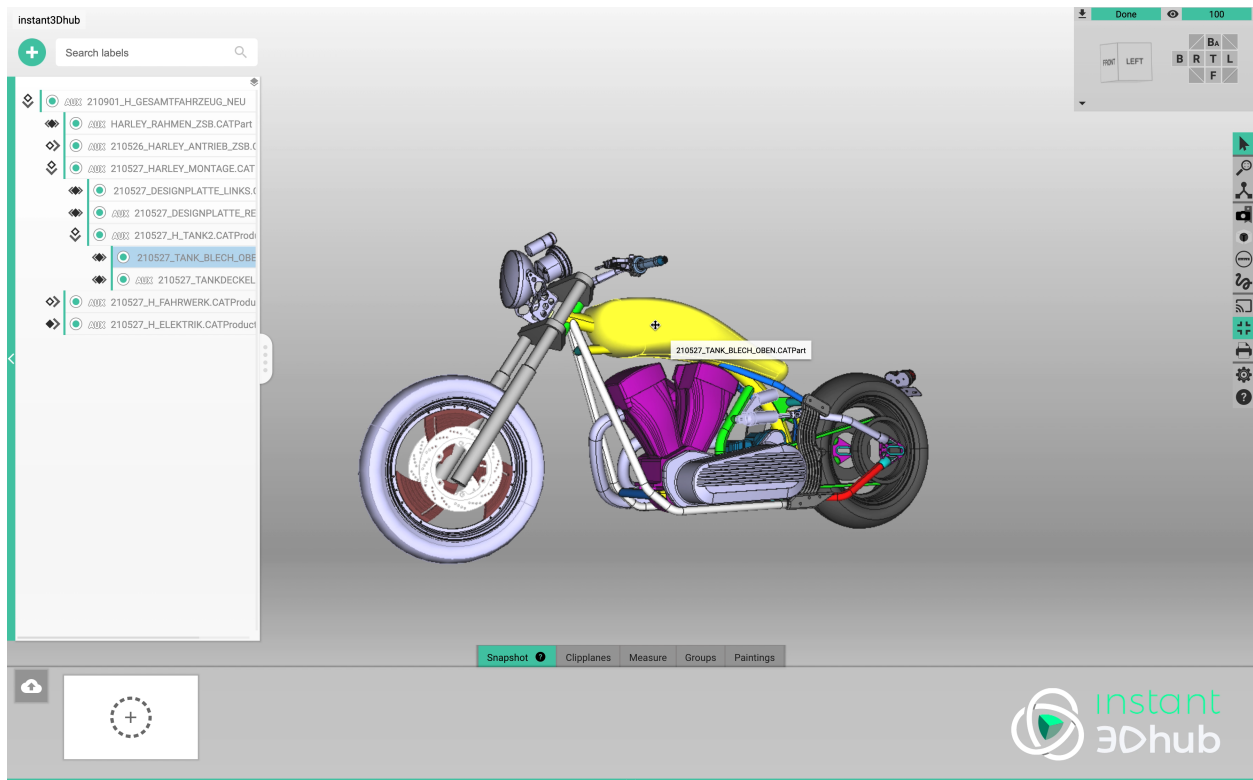


Selection

Use the pre-defined property to select a subset of the 3D data in your 3D Space. Selected entities are visually highlighted and serve as the target of subsequent user interface operations. Retrieve the set of selected nodes using the API (or respective events) for applying custom logic.

webvis API Reference

SelectionAPI

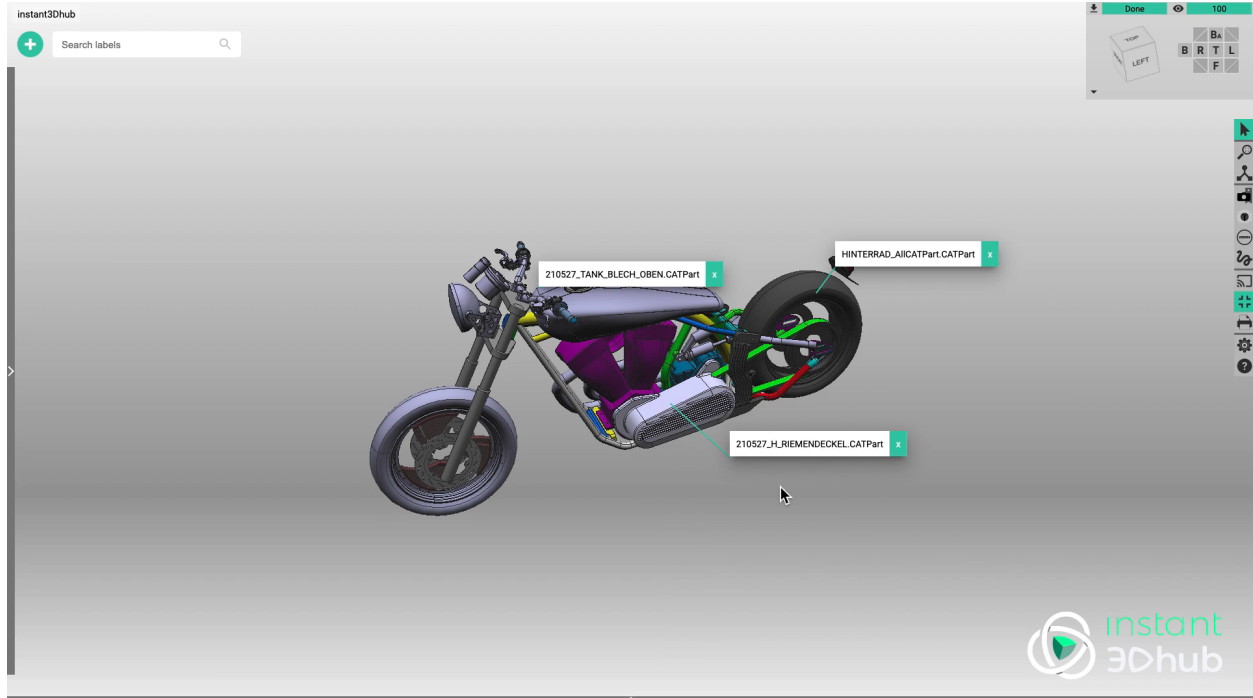


Annotations

Use annotations to enrich the data in your 3D Space with additional information e.g., for collaboration purposes or to integrate with external knowledge. Annotations support HTML content to easily embed images or videos or create direct linkage to external software solutions e.g., tickets systems.

webvis API Reference

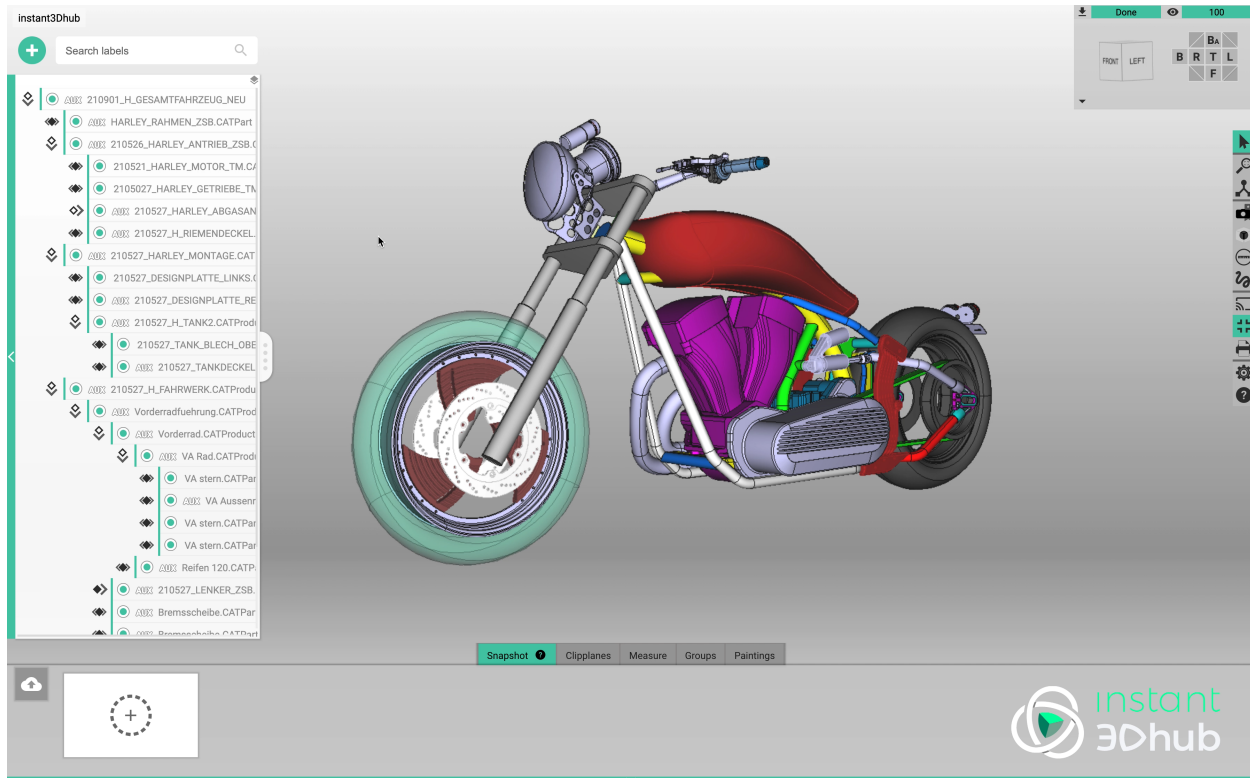
AnnotationAPI



Dynamic Appearance and Rendering

Next to switching the enabled state of nodes, changing their appearance is probably one of the most common interactions. The 3D Spaces support a variety of functions to dynamically adjust the visualization of your data, mostly reflected by the properties of nodes of the *InstanceGraph*.

- **Appearance & Transparency:** Change the *color and/or transparency* of assemblies or individual parts to adapt the expressiveness of the presentation to your very needs e.g., to easily locate hidden parts of your 3D data.
- **Render Modes:** Switch the *rendering modes* to visualize topological entities, wireframes or use occluders for advanced visual effects.
- **Shading:** Dynamically switch the lighting environment or apply image-based effects.

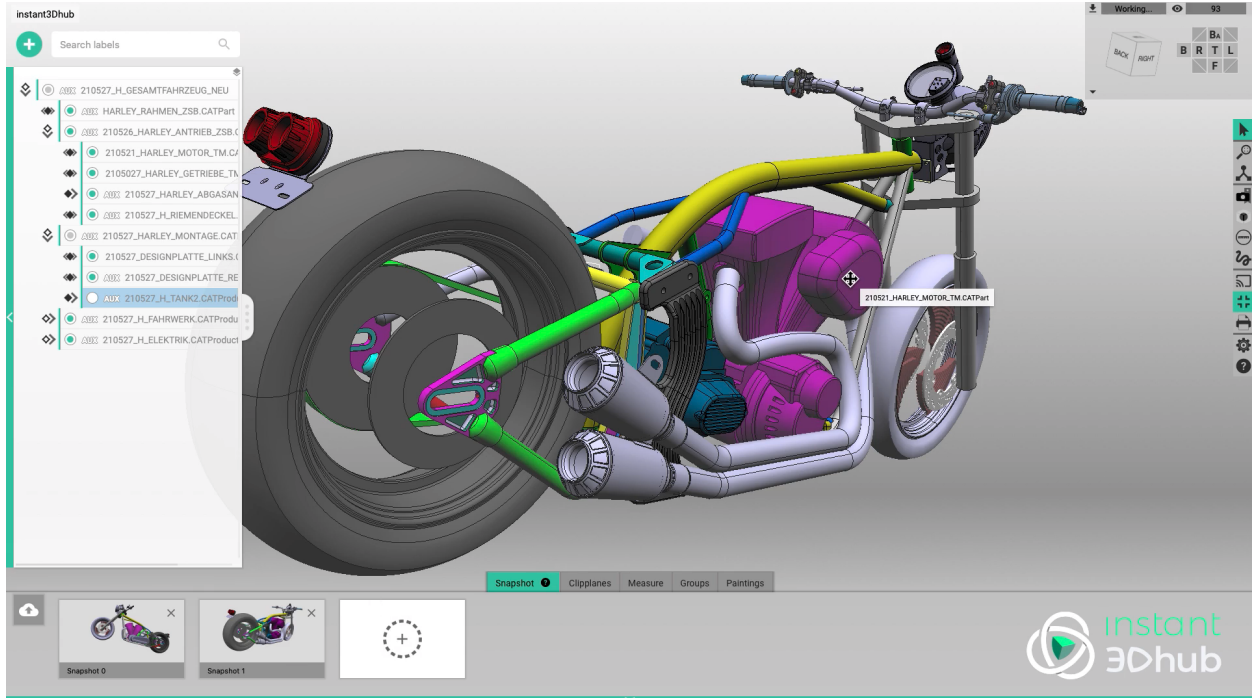


Snapshots

Snapshots are a way to persist configuration states of your 3D data inside the 3D Space to restore them at a later point in time or cycle between multiple snapshots.

webvis API Reference

SessionStorageAPI



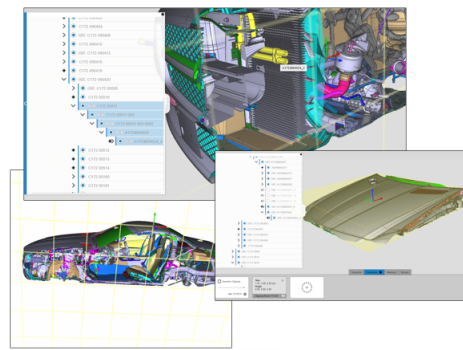
Depending on the usage of the API, snapshots can reflect only a subset or the complete state of your 3D Space. Find a detailed explanation of the included UI component [here](#).

1.4.2 CAD/DMU

To support complex CAD and DMU operations this feature package provides access to the underlying topological structures of your 3D data. Beyond their visualization, this enabled the highlighting of topological faces, edges and points as well as the exploration of relations from the PMI data. These entities are most commonly used as target for algorithmically complex calculations, such as distance measurements or arc measurements. Further features include the generation of cappings or colorization of geometric differences.

Clipping Planes & Clipping Rooms

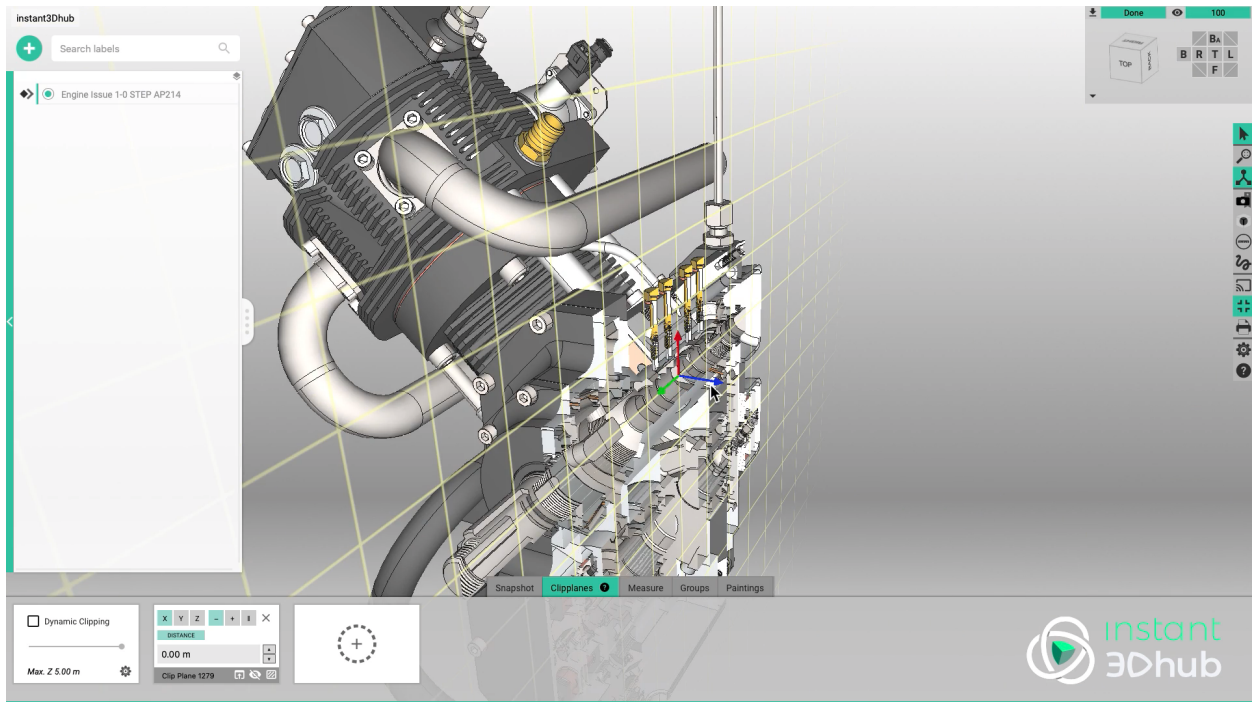
Clipping planes are a common tool in CAD used to inspect inner details of your 3D data. Clipping planes can be set dynamically, either by a given position and orientation in the 3D Space, or using derived information from your 3D data e.g., surface properties like normals or edges.



Clipping rooms or clipping volumes are defined by a combination of six planes. As for clipping planes, they can be derived from nodes of the InstanceGraph interactively, for example using the volume of a node.

webvis API Reference

ClipPlaneAPI



A detailed example on the usage of the included UI component can be found [here](#).

Capping

The capping feature allows the creation and control of cappings for geometry as resulting from a clipping plane. Capping geometries are directly correlated with the individual nodes of the assembly structure which they were derived from.

webvis API Reference

ClipPlaneAPI

A detailed tutorial on capping can be found [here](#).

Measurement

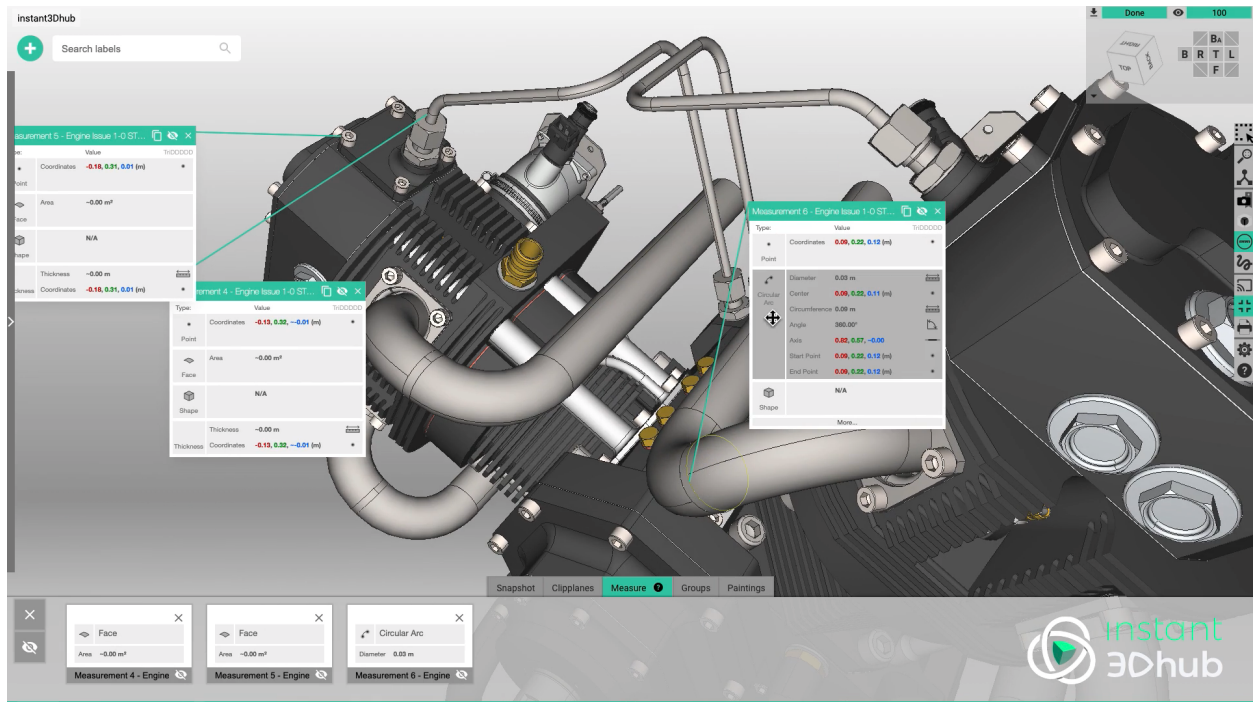
A measurement is defined by a [MeasurementType](#) and one or more targets. Depending on the complexity of the measurement, the operation might require a few seconds of computation and utilize a specific service.

webvis API Reference

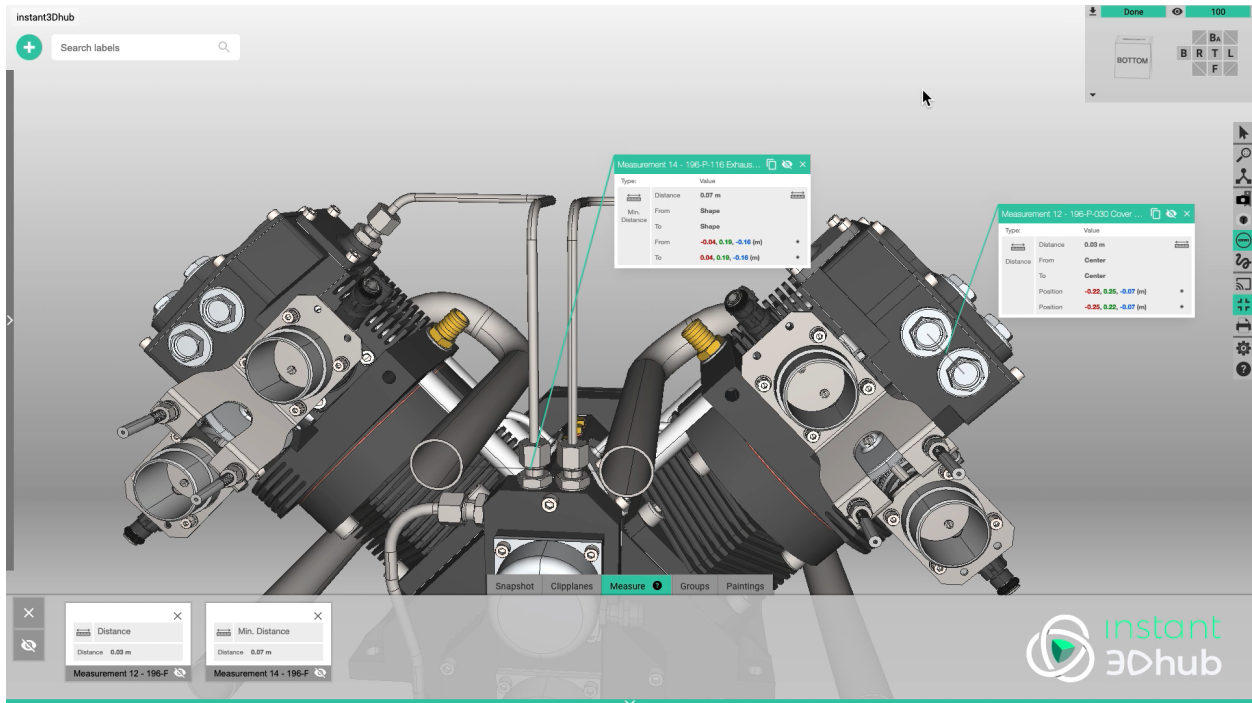
MeasurementAPI

Three common types of measurements are:

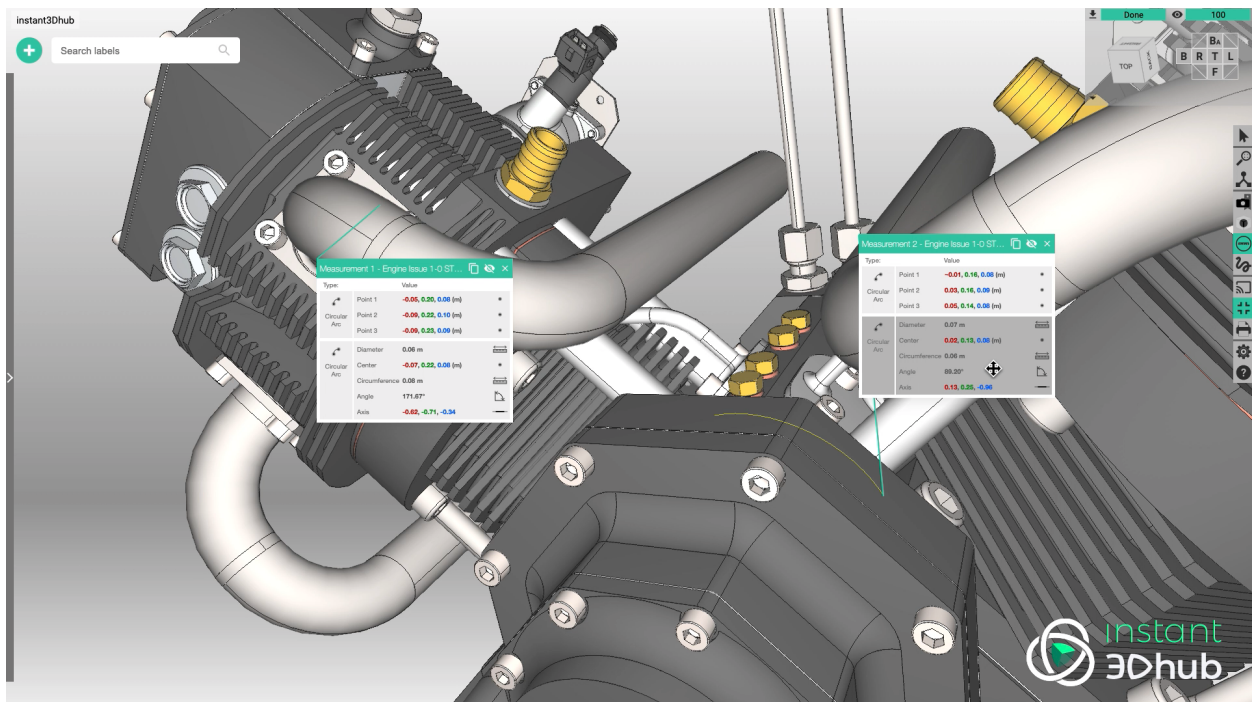
- **Single Measurement:** Single measurement provide detailed information on the properties of a topological entity e.g., it's surface area, length or volume.



- **Double Measurements:** Double Measurement provide information on relations between topological entities e.g., distances or angles. For convenience, the result set automatically matched for the input data types.



- **Arc Measurements:** Arc measurements are defined by three points in the 3D Space, typically derived from surfaces of the geometry. They provide information on center, diameter, circumference, angle and axis of the respectively defined arc.



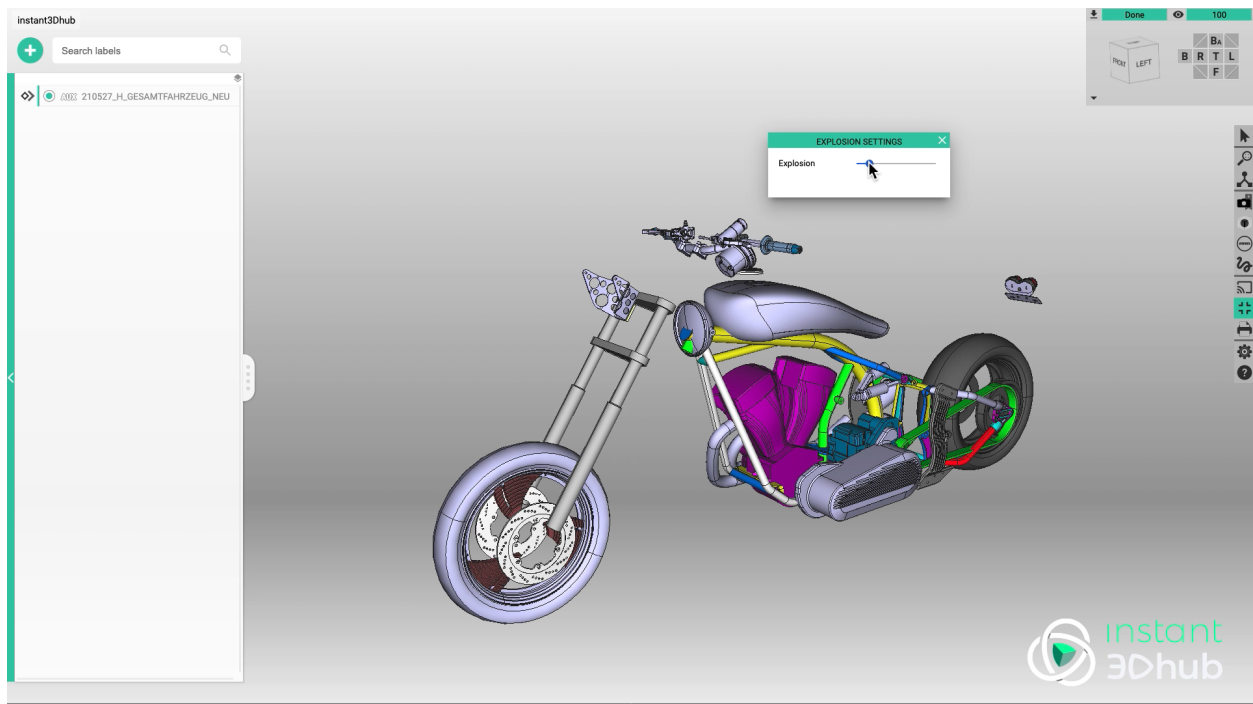
A detailed example can be found [here](#).

Explosions

This feature allows to explode the geometry in your 3D Space based on an explosion center and using the transformations of your data.

webvis API Reference

ExplosionAPI



Find a detailed description of the respective elements of the toolbar UI [here](#).

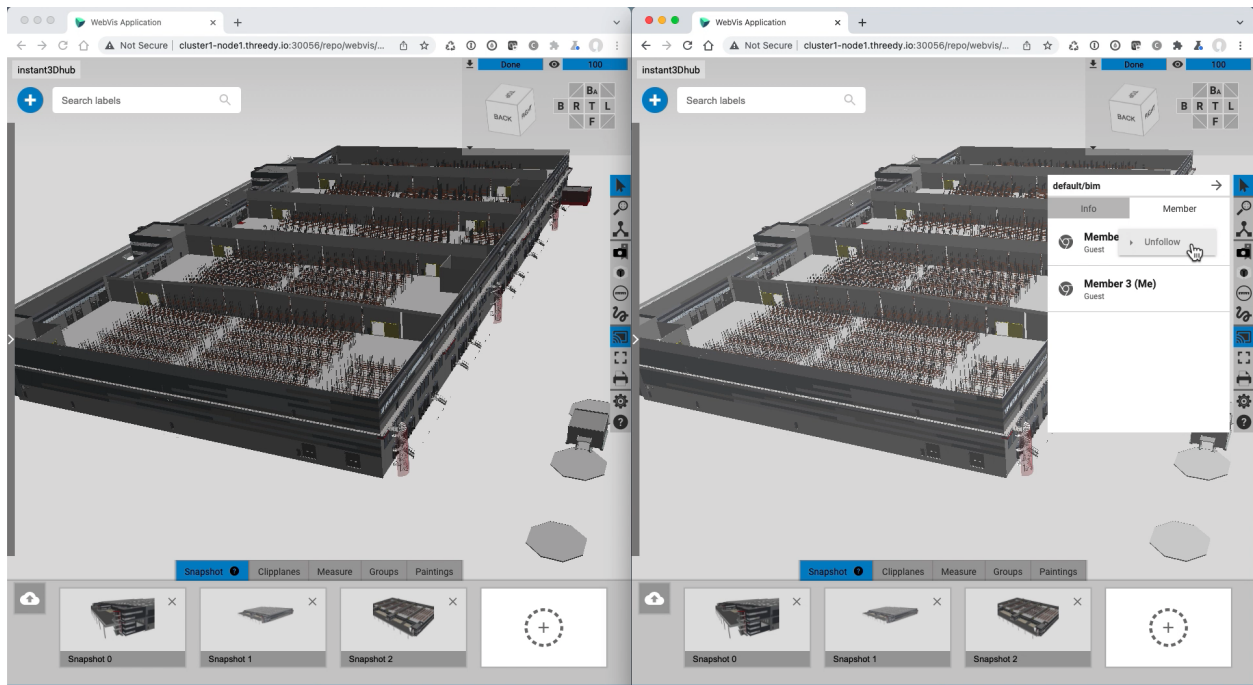
1.4.3 Collaboration

Shared Sessions

This feature allows you to simultaneously collaborate on a shared 3D Space. Use a 3D Space's identifier or the provided QR Code to instantaneously invite others to join and collaborate.

webvis API Reference

SessionAPI

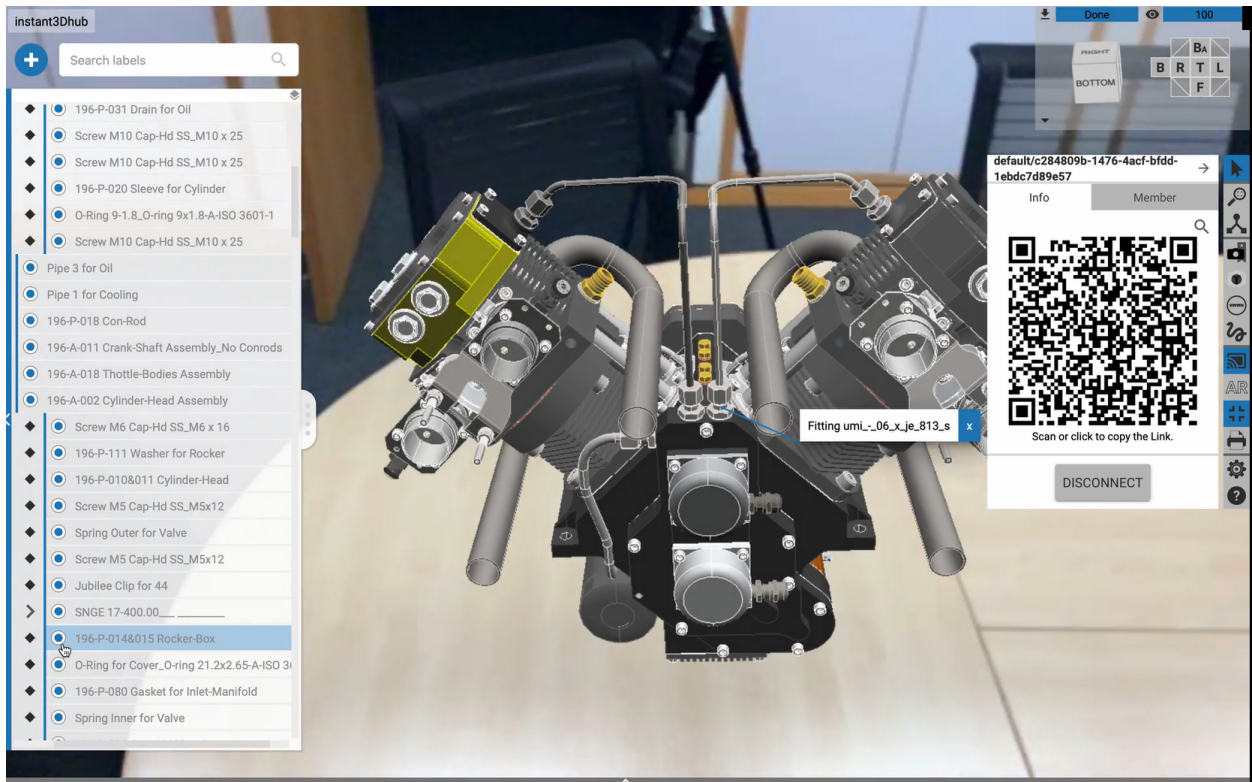


Find a detailed tutorial on creating a shared session using the included UI components [here](#).

1.4.4 XR

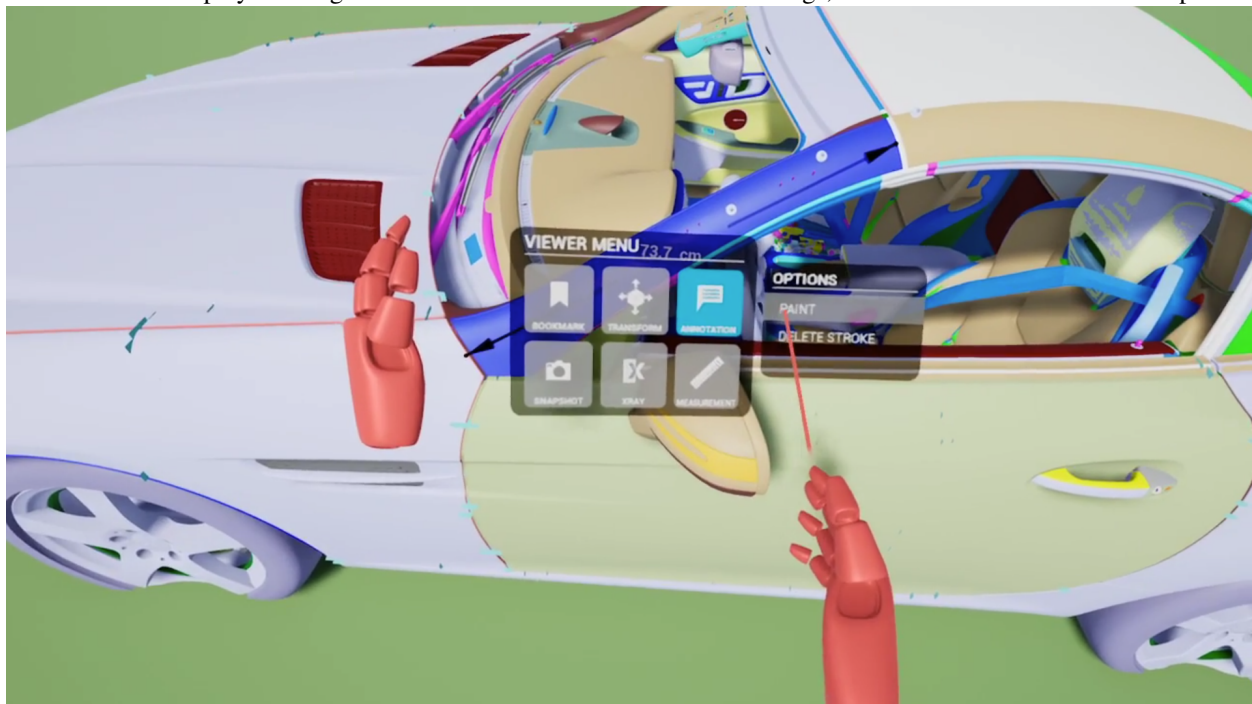
SLAM Tracking

Employ device-integrated SLAM tracking, where available, to position 3D content into the real world and share video and pose information, e.g. for remote assistance or inspection.



VR Client

Join any 3D Space using the VR Client and experience high quality immersive virtual environments while still relying on instant3Dhub's scalable streaming of 3D data. Employ integrated functions such as Paintings, Measurements or Snapshots.



1.4.5 Model-Tracking

instant3Dhub is the only technology providing fully automated Augmented-Reality-as-a-Service for arbitrary data sets. To deliver this best in class solution, instant3Dhub relies on the user devices' sensor data combined with a robust server-side model-tracking.

visionLib by Visometry

instant3Dhub's service-level integration of VisionLib - Visometry's industry leading computer vision tracking engine (<https://visionlib.com/>) - delivers high-fidelity tracking of moving objects with moving cameras.

- Employ fully automated object tracking at industrial scale, without manual preprocessing and for arbitrary 3D data sets.
- Connect your 3D data and business information with real, manufactured objects, for digital twins or the internet of things.
- Create process-integrated high class augmented reality applications to put object-related information into the visual context of reality for essential AR cases, like Maintenance/Repair Overhaul, Variance Analysis / Marketing & Communication.

