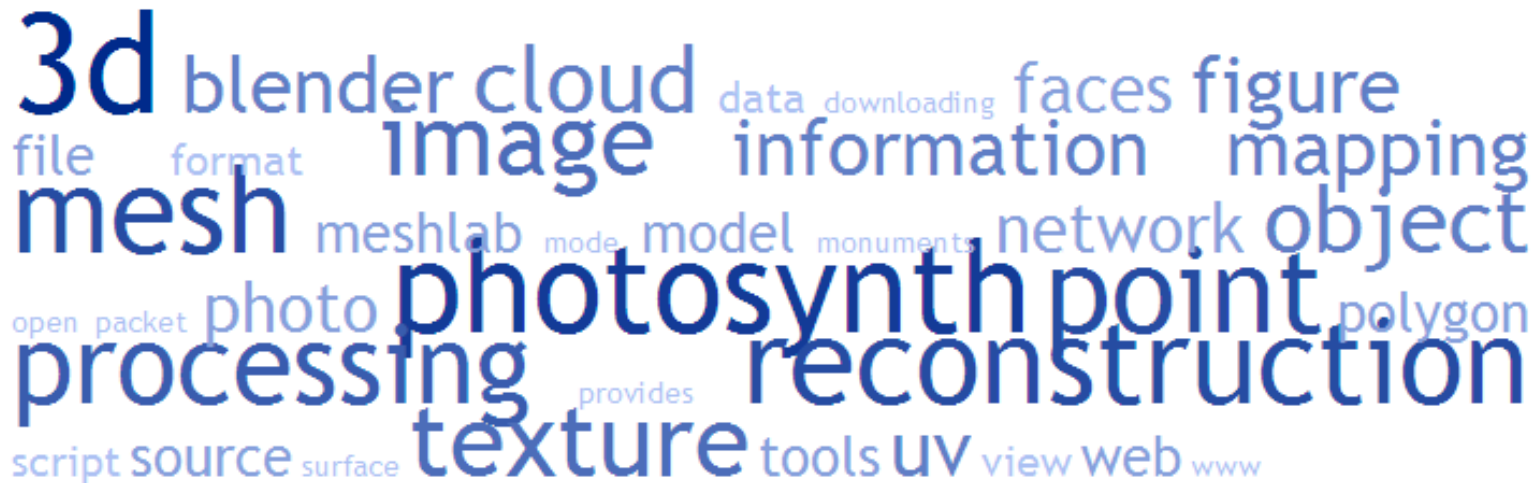


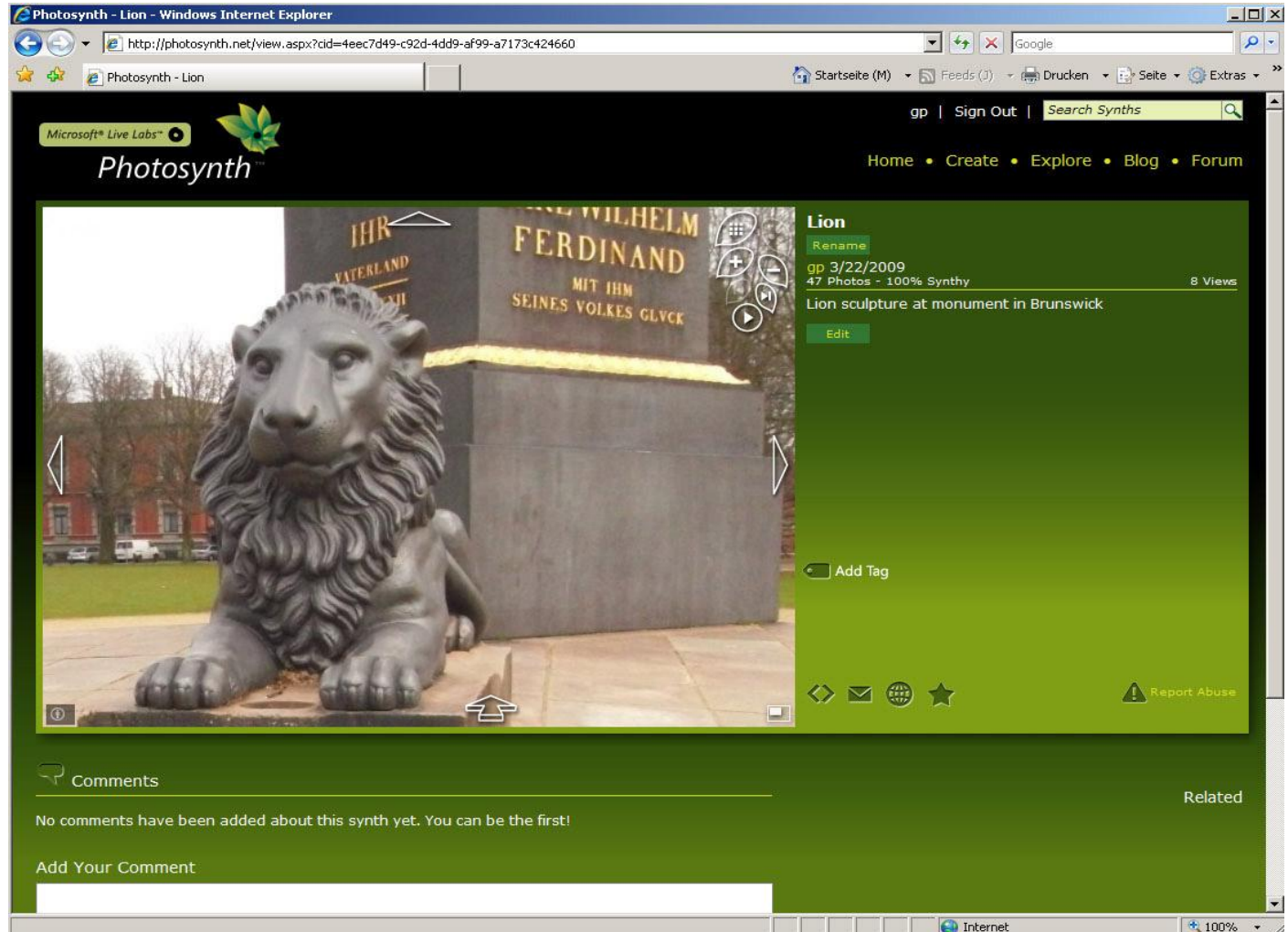
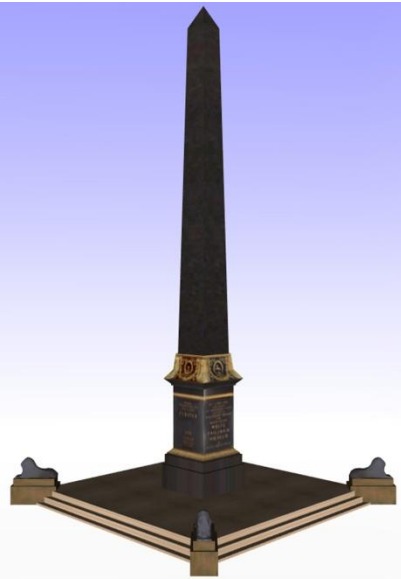
Utilization of PhotoSynth Point Clouds for 3D Object Reconstruction



Guenter Pomaska
University of Applied Sciences Bielefeld, Germany
<http://www.imagefact.de>



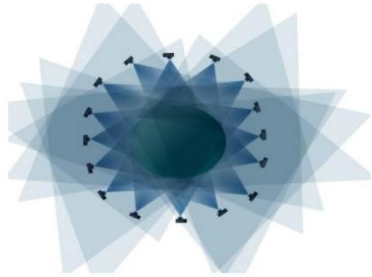
Microsoft PhotoSynth image browser enables smooth transition between photos.



- Download
- Install
- Register
- Take photographs
- Upload
- View



Take care of baselines between photos and enough overlapping while taking photographs.



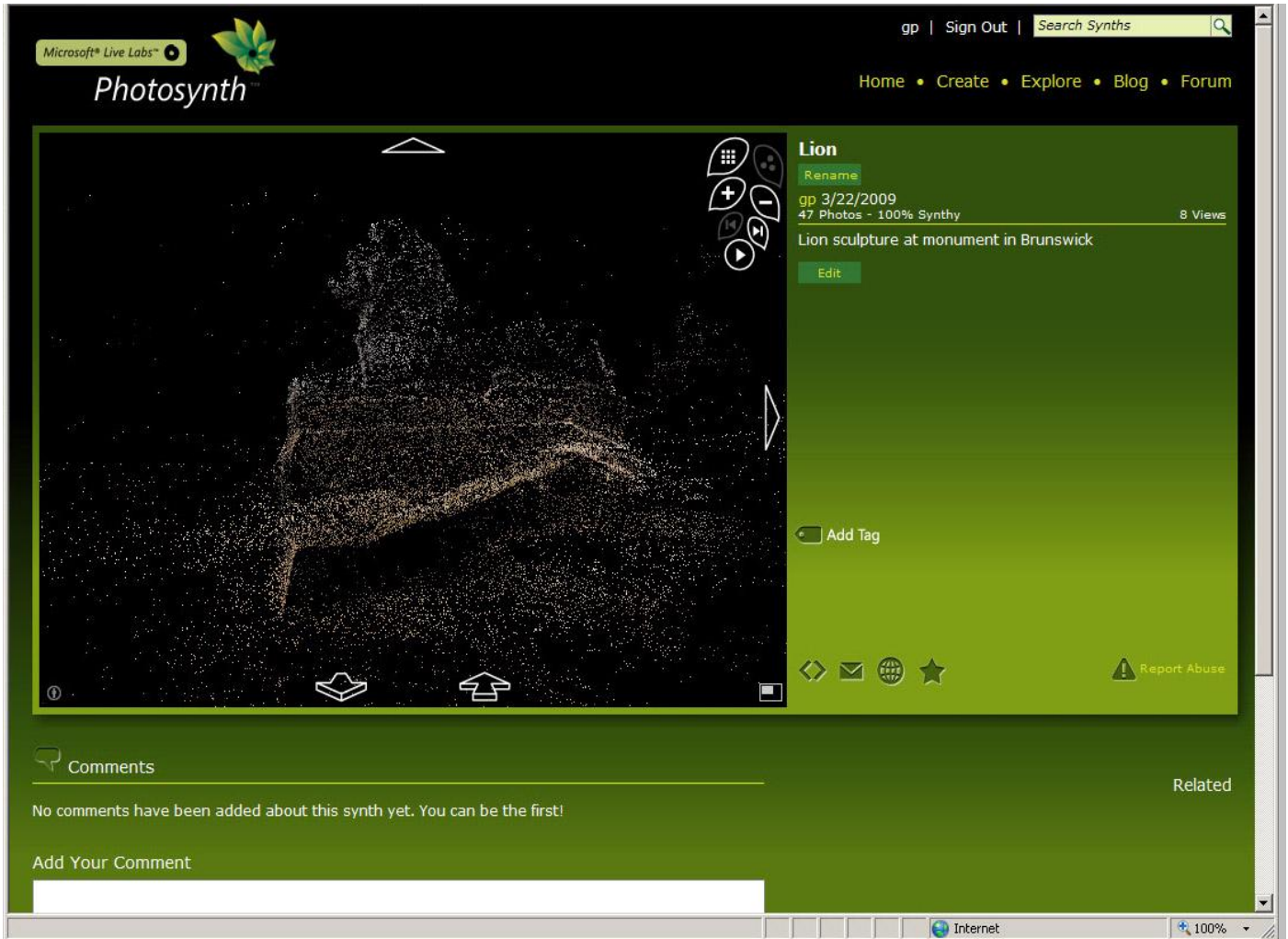
Shooting a 3-D object

A screenshot of the Microsoft Live Labs Photosynth web application. The interface features a grid of 47 small thumbnail images of a lion sculpture, arranged in a roughly circular pattern around the object. On the right side, there is a metadata panel for the 'Lion' synth, including a 'Rename' button, the date 'gp 3/22/2009', '47 Photos - 100% Synth', and '8 Views'. Below this, there is an 'Edit' button and an 'Add Tag' button. At the bottom right of the synth view, there are icons for navigation and a 'Report Abuse' button. The interface is set against a dark green background. The browser's address bar at the bottom shows 'Internet' and a zoom level of '100%'.



Uploading photos to the Microsoft server includes registration of the images.

- Generating image tiles
- Extracting image features
- Matching images
- Reconstructing scene
- Generating synth files
- Uploading files



Detecting network traffic by running WIRESHARK packet analyzer.



Network Protocol Analyzer

Handing off plugins ...

99%

The screenshot shows the Wireshark interface with a filter set to 'http.request.uri contains "points"'. The packet list pane shows a series of HTTP GET requests. The selected packet (No. 2493) is expanded to show the following details:

- Frame 2493 (439 bytes on wire, 439 bytes captured)
- Ethernet II, Src: HewlettP_1f:b8:a8 (00:21:5a:1f:b8:a8), Dst: SurecomT_02:75:c4 (00:15:8a:02:75:c4)
- Internet Protocol, Src: 192.168.0.110 (192.168.0.110), Dst: 87.248.217.233 (87.248.217.233)
- Transmission Control Protocol, Src Port: proshare-mc-2 (1674), Dst Port: http (80), Seq: 1058, Ack: 42319, Len: 385
- Hypertext Transfer Protocol
 - Request Method: GET
 - Request URI: /d5/photosynth/m6/collections/b2/9d/83/b29d8374-803d-4b17-b177-9e716cbd9150.synth_files/points_0_0.bin HTTP/1.1\r\n
 - Request Version: HTTP/1.1
 - Accept: */*\r\n
 - UA-CPU: x86\r\n
 - Accept-Encoding: gzip, deflate\r\n
 - User-Agent: Mozilla/4.0 (compatible; MSIE 7.0; Windows NT 5.1; GTB6; .NET CLR 1.1.4322; .NET CLR 2.0.50727; .NET CLR 3.0.4506.2152; .NET CLR 3.5.30729)\r\n
 - Host: ms-labs-946.vo.llnwd.net\r\n
 - Connection: Keep-Alive\r\n
 - \r\n

The packet bytes pane shows the raw data of the request, including the 'HTTP/1.1' status line and the 'Accept: */*' header.



Downloading the binary point clouds from the MS labs host.

points_0_0.bin

The screenshot displays a Wireshark network capture of an HTTP GET request. The packet list pane shows a request for `/d4/photosynth/m6/collections/4e/ec/7d/4eec7d49-c92d-4dd9-af99-a7173c424660.synth_files/points_0_1.t`. The packet details pane shows the request headers, including `Accept-Encoding: gzip\r\n` and `User-Agent: seadragon\r\n`. A 'Dateidownload' dialog box is open, showing the file name `points_0_1.bin` and the URL `mslabs-229.vo.llnwd.net`. The background shows the Photosynth web interface with a lion sculpture image.

No.	Time	Source	Destination	Protocol	Info
352	11.497158	192.168.0.113	87.248.216.40	HTTP	GET /d4/photosynth/m6/collections/4e/ec/7d/4eec7d49-c92d-4dd9-af99-a7173c424660.synth_files/0.json HTTP/1.1
381	12.704573	192.168.0.113	87.248.216.40	HTTP	GET /d4/photosynth/m6/collections/4e/ec/7d/4eec7d49-c92d-4dd9-af99-a7173c424660.synth_files/points_0_0.t HTTP/1.1
383	12.715317	192.168.0.113	87.248.216.40	POST	/PhotosynthHandler.aspx HTTP/1.1 (application/x-www-form-urlencoded)
394	13.252584	192.168.0.113	87.248.216.40	HTTP	GET /d4/photosynth/m6/images/71/4C/18/714C18B31E14264CBFD198C19EA61AA9.dz1 HTTP/1.1
442	14.082499	192.168.0.113	87.248.216.40	HTTP	GET /d4/photosynth/m6/images/B6/CD/4A/B6CD4A5624CE9E741BECC3949A002514.dz1 HTTP/1.1
481	14.796524	192.168.0.113	87.248.216.40	HTTP	GET /d4/photosynth/m6/images/5B/1E/0E/5B1E0E8C4C37E8C2EE514FBB121C30A0.dz1 HTTP/1.1
484	15.363192	192.168.0.113	87.248.216.40	HTTP	GET /d4/photosynth/m6/collections/4e/ec/7d/4eec7d49-c92d-4dd9-af99-a7173c424660.synth_files/points_0_1.t HTTP/1.1
568	18.921865	192.168.0.113	87.248.216.40	HTTP	GET /d4/photosynth/m6/collections/4e/ec/7d/4eec7d49-c92d-4dd9-af99-a7173c424660.synth_files/points_0_2.t HTTP/1.1
655	24.856102	192.168.0.113	87.248.216.40	HTTP	GET /d4/photosynth/m6/collections/4e/ec/7d/4eec7d49-c92d-4dd9-af99-a7173c424660.synth_files/points_0_3.t HTTP/1.1
751	38.359522	192.168.0.113	87.248.216.40	HTTP	GET /d4/photosynth/m6/collections/4e/ec/7d/4eec7d49-c92d-4dd9-af99-a7173c424660.synth_files/points_0_4.t HTTP/1.1
851	40.451281	192.168.0.113	87.248.216.40	HTTP	GET /d4/photosynth/m6/collections/4e/ec/7d/4eec7d49-c92d-4dd9-af99-a7173c424660.synth_files/points_0_5.t HTTP/1.1
887	92.332885	192.168.0.113	87.248.216.40	HTTP	GET /d4/photosynth/m6/collections/4e/ec/7d/4eec7d49-c92d-4dd9-af99-a7173c424660.synth_files/points_0_1.t HTTP/1.1

Frame 484 (275 bytes on wire, 275 bytes captured)
Ethernet II, Src: dell_c7:4f:79 (00:21:70:c7:4f:79), Dst: Surecc
Internet Protocol, Src: 192.168.0.113 (192.168.0.113), Dst: 87.2
Transmission Control Protocol, Src Port: funk-logger (1786), Dst
Hypertext Transfer Protocol
GET /d4/photosynth/m6/collections/4e/ec/7d/4eec7d49-c92d-4dd9-af99-a7173c424660.synth_files/points_0_1.t HTTP/1.1
Accept-Encoding: gzip\r\n
User-Agent: seadragon\r\n
Host: mslabs-229.vo.llnwd.net\r\n
Cache-Control: no-cache\r\n
\r\n

Name: points_0_1.bin
Typ: Unbekannter Dateityp, 71,4 KB
Von: mslabs-229.vo.llnwd.net

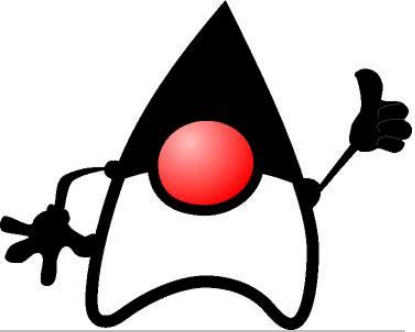
Suchen Speichern Abbrechen

Dateien aus dem Internet können nützlich sein, aber manche können auf dem Computer Schaden anrichten. Suchen Sie nach keinem Programm zum Öffnen der Datei bzw. speichern Sie sie nicht, falls Sie der Quelle nicht vertrauen. [Welches Risiko besteht?](#)

Microsoft® Live Labs
Photosynth
Lion
Rename
gp 3/22/2009
47 Photos - 100% Synth
Lion sculpture at monument in Brunswick
4 Views
Edit



PROCESSING scene viewer from *binarymillenium.com*



Metrowerks CodeWarrior

File Edit View Search Project Debug Tutorial Window Help

vase.Csv

```

0.0451172441244, 0.165708690882, -0.656962811947, 22.35, 8
-0.124477230012, 0.18902155757, -0.760991454124, 12.2, 2
-0.107682310045, 0.198488980532, -0.748542964458, 18.11, 6
-0.195894673467, 0.164559692144, -0.623100936413, 11.21, 10
-0.208198159933, 0.157160192728, -0.698306202888, 3.3, 0
-0.264053910971, 0.00713660987094, -0.6395637393, 26.46, 18
-0.27624225165, 0.052973909976, -0.675126850605, 2.4, 1
-0.28262090683, -0.00926596391946, -0.668055713177, 23.34, 8
-0.269422471523, 0.0716328769922, -0.684500873089, 10.15, 6
-0.278673946857, -0.103884391487, -0.710687339306, 4.
-0.202510342002, -0.0680802613497, -0.581171691418, 9.
-0.261931240559, -0.136007189751, -0.726109564304, 2.
-0.268267035484, -0.118594117463, -0.730604231358, 4.
-0.268627434969, -0.121967591345, -0.728480875492, 9.

```

psynth | Processing 1.0.3

File Edit Sketch Tools Help

psynth\$ Control\$ PointCloud

```

/*
 * Simple Radiohead Scene Viewer
 * by Aaron Koblin
 * To use-
 *
 * -download, extract, and open Processing Development Envir
 * -make sure SceneViewer.pde, Control.pde, and PointCloud.p
 * -open SceneViewer.pde in Processing
 * -make sure the "data" folder with your scene files exists
 * -go to file>preferences
 * -check the box next to "set maximum available memory to"
 * -press ok
 * -press play and enjoy.
 * -change file names in the setup function to look at differ
 *
 * UP and DOWN Arrows control zoom.
 *
 * Copyright 2008 Aaron Koblin
 * Licensed under the Apache License, Version 2.0 (the "License"
 * you may not use this file except in compliance with the Licen
 * You may obtain a copy of the License at
 * http://www.apache.org/licenses/LICENSE-2.0

```

Anzahl der Punkte: 10150

Start | Eudora - [In] | psynth | Processing 1.0.3 | Metrowerks CodeWarrior | psynth



A Python script provides converting binary files into text files.



- The script is provided by *binarymillenium.com*
- Modifications for generating an AutoCAD script file are as follows:

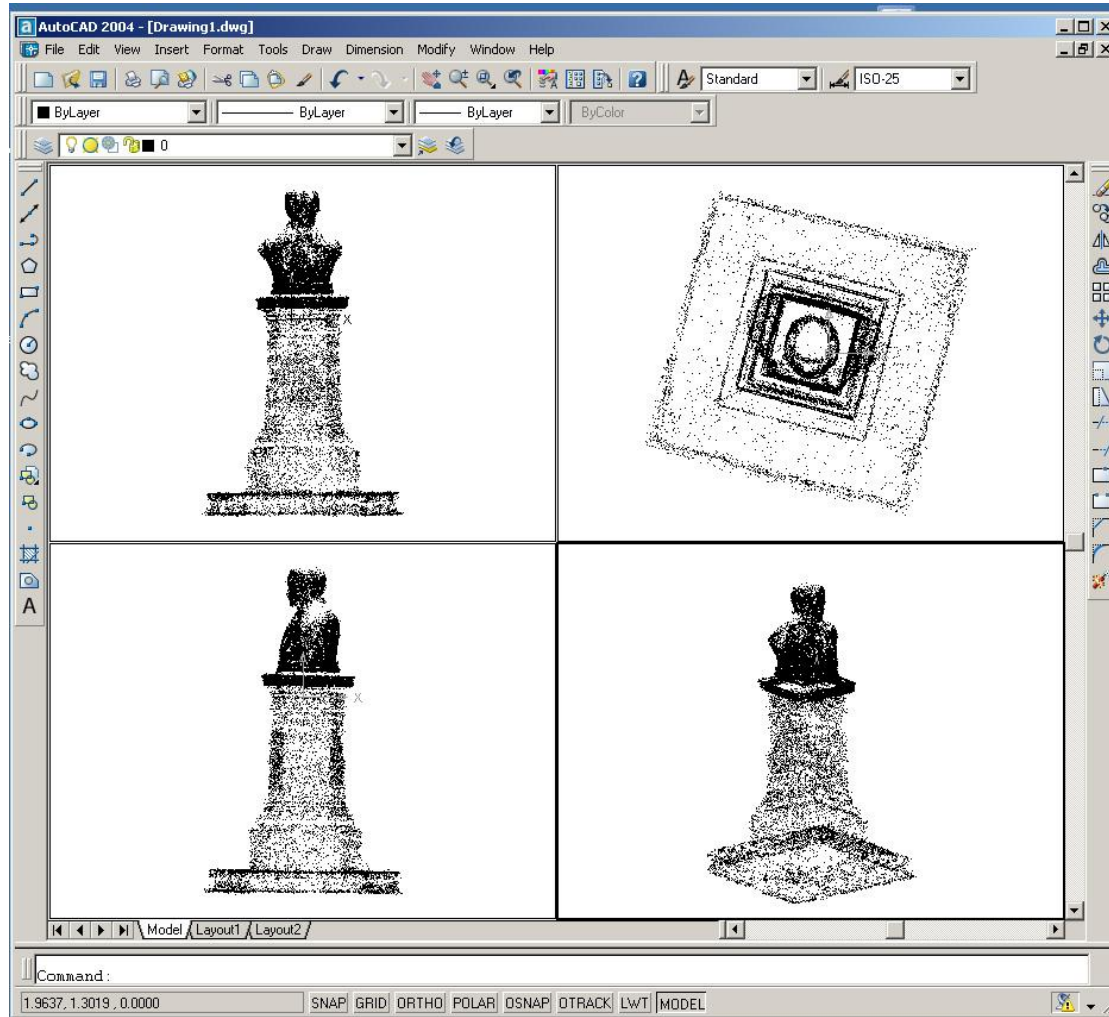
```
sys.stdout.write( `_point\n` )  
sys.stdout.write( str( fbin[0] ) + `,`  
                  + str( fbin[1] ) + `,` + str( fbin[2] )  
                  + ` \n ` )
```

- Use the script command for AutoCAD import.
Switch off OSNAP

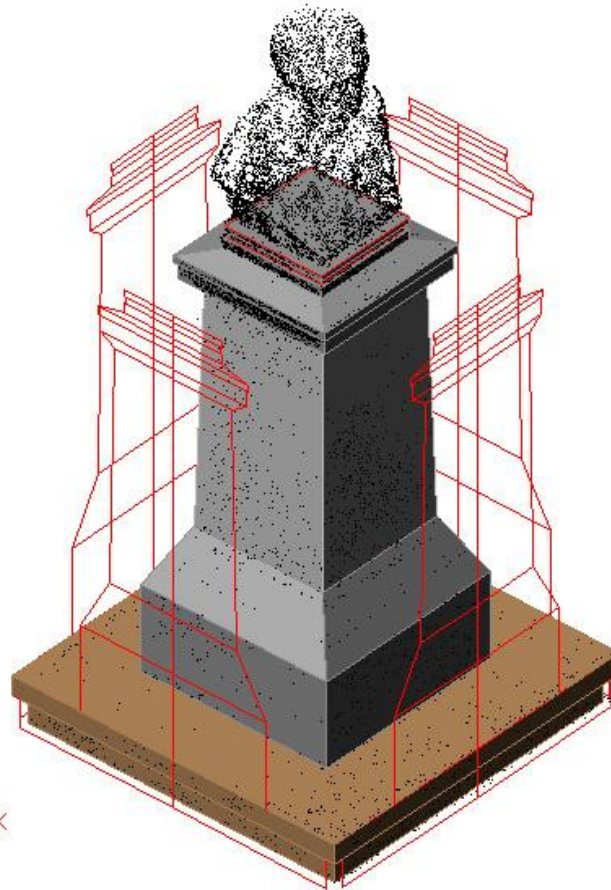


Preprocessing the point cloud needs extracting points of interest and alignment.

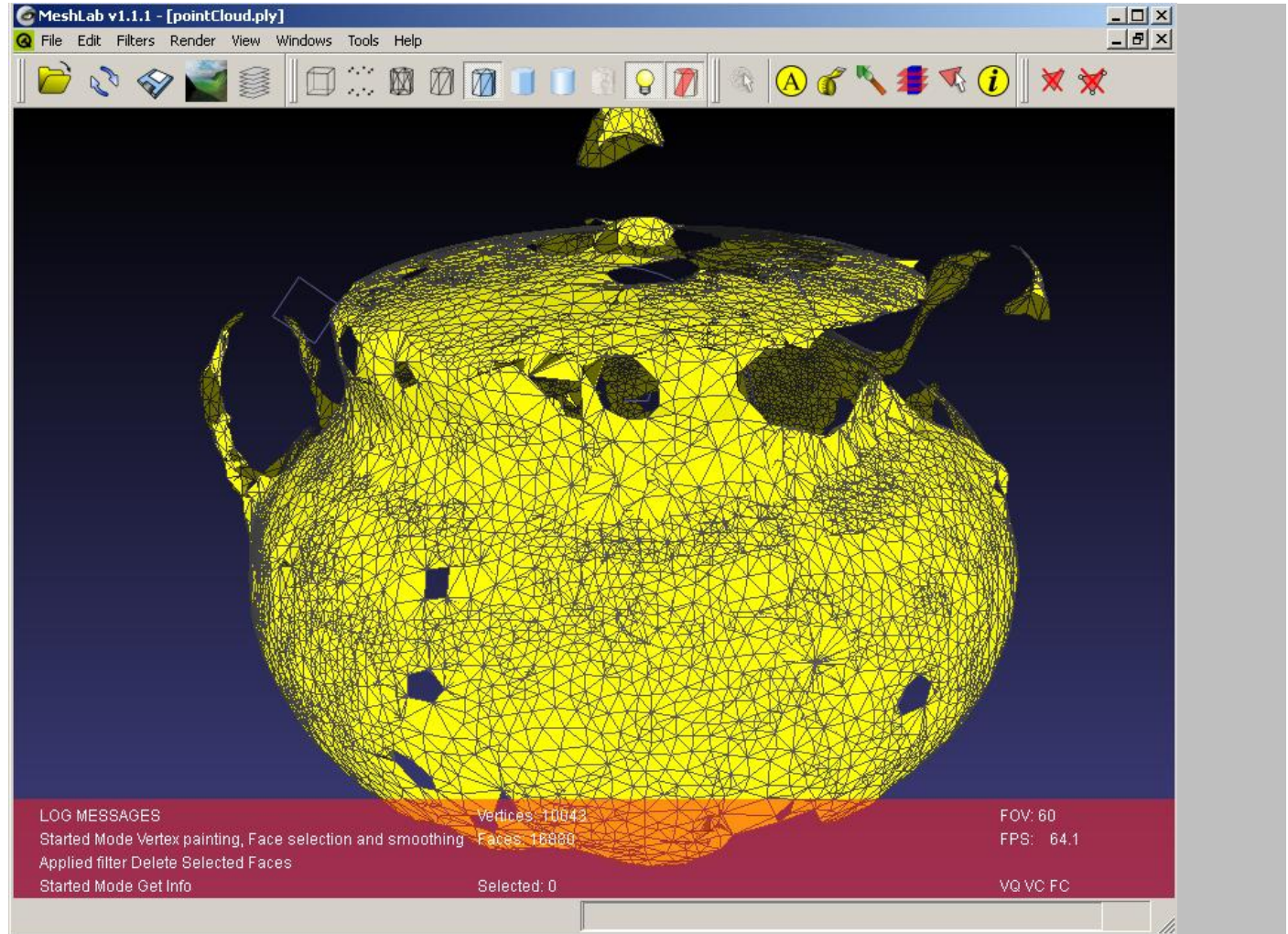
Gate to MeshLab:
Converting DXF into
Stanford Polygon
File Format PLY



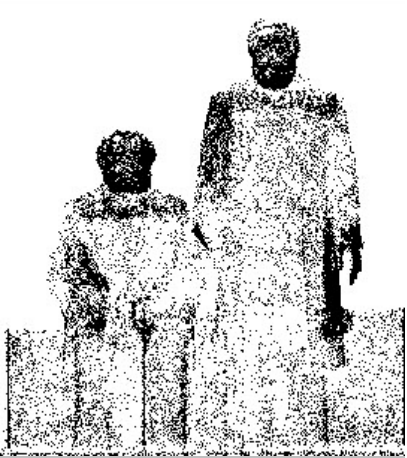
Modeling discrete structures is carried out straight in the CAD tool.



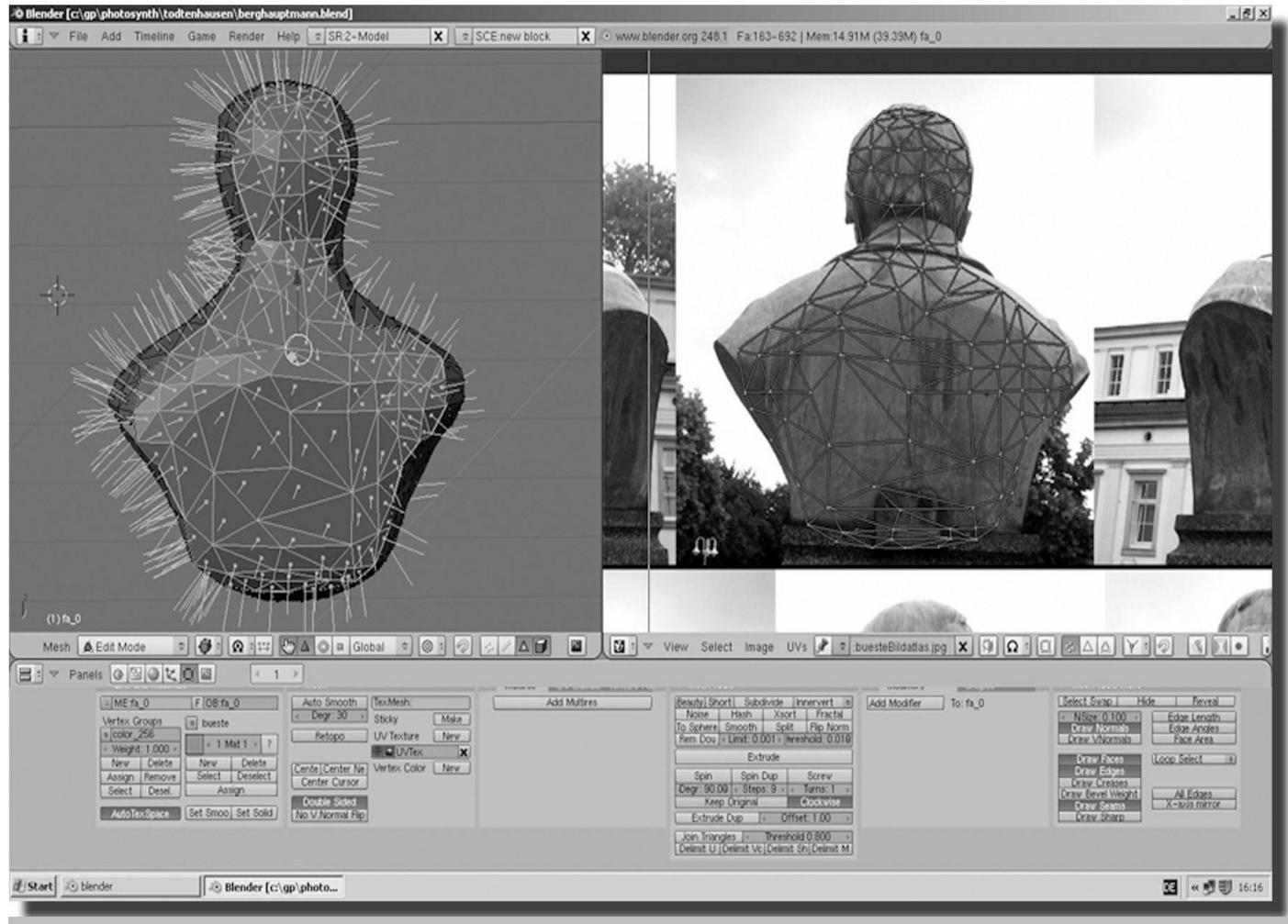
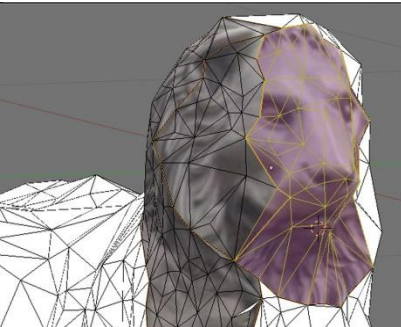
MESHLAB open source 3d mesh processing



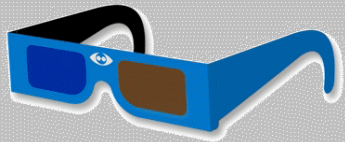
Poisson Reconstruction or Ball Pivoting Algorithm?



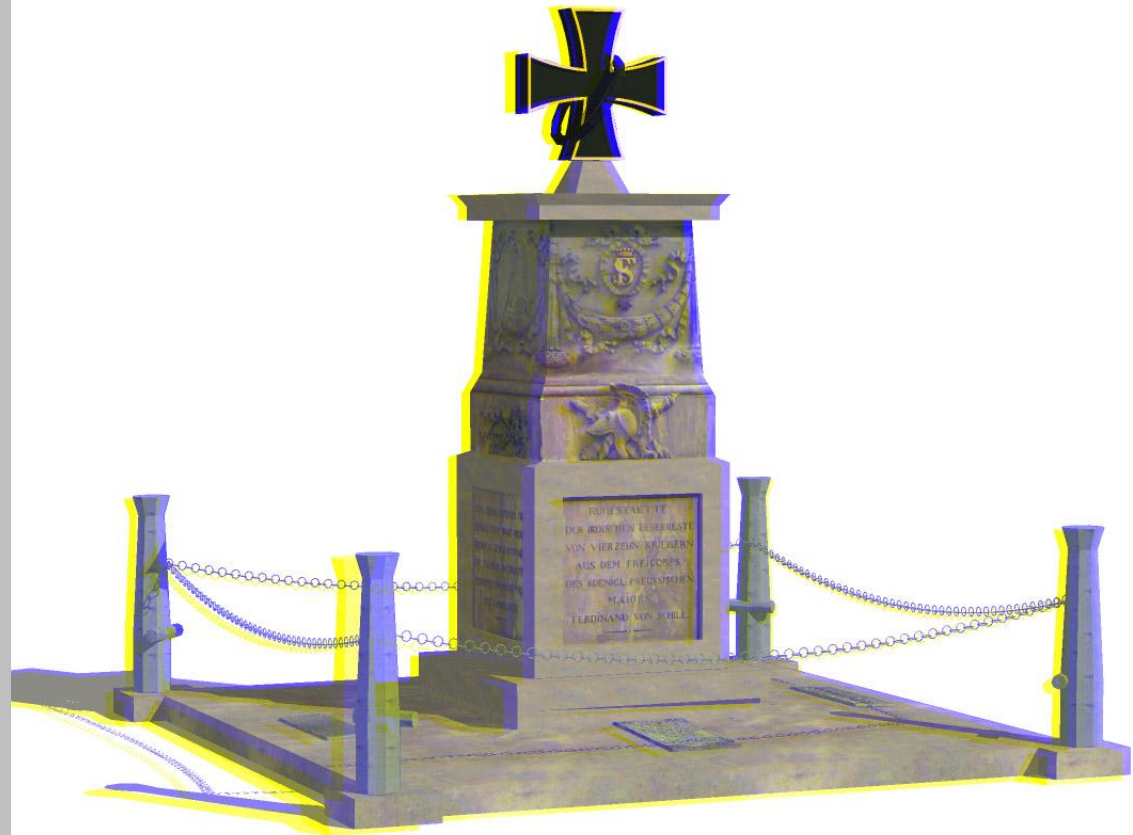
Finding the seams and unwrapping the mesh with BLENDER's UV image editor.



Application: Monument dedicated to Major Ferdinand von Schill, killed 1809 at Stralsund. Head buried 1837 in Brunswick. A ColorCode 3D image.



lat 52.25645
long 10.54157



Getting the ribbon. From Google 3D warehouse to the Google Earth 3D building layer.



Denkmale von gp - Google 3D-Galerie - Windows Internet Explorer

http://sketchup.google.com/3dwarehouse/cldetails?mid=acfa3734f3c573a1cc1f87781951e6f8&ct=mdcc&prevstart=0

Deutsch | Anmelden

Google 3D-galerie Modelle [Erweiterte Suche](#)

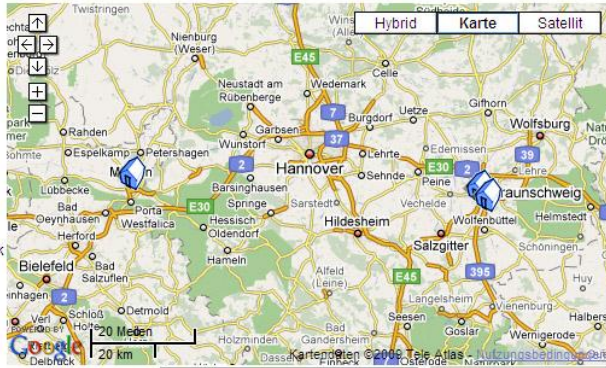
Denkmale
von gp
3D-Modelle von Denkmälern aufgenommen mit Photosynth.
Modelliert mit MeshLab, SketchUp, Blender
<http://www.imagefact.de>
Aktualisiert 19.09.2009

☆☆☆☆☆ [Diese Sammlung bewerten](#)

[Keine Bewertungen](#)




[In Google Earth betrachten](#)

Sie können [den Eigentümer kontaktieren](#), um Ergänzungen vorzuschlagen oder Feedback zu geben.



Ergebnisse filtern

Modelle in Denkmale Sortiert nach Datum [Erweiterte Suche](#)

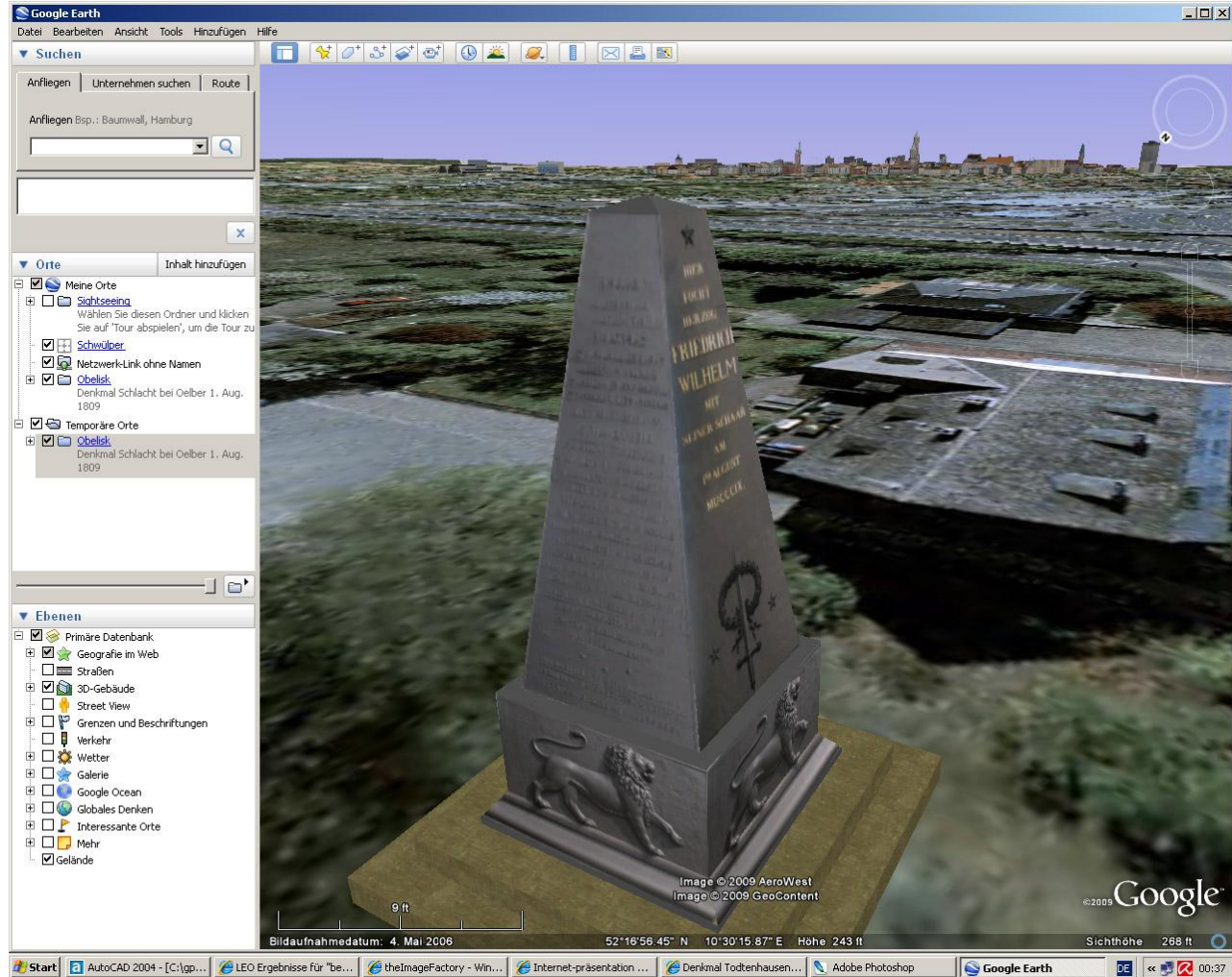
 Ferdinand von Schill von gp Monument in Brunswick... In Google Earth betrachten ☆☆☆☆☆	 Obelisk Oelper von gp Monument in remembrance of... In Google Earth betrachten ☆☆☆☆☆	 Denkmal Todtenhausen von gp Denkmal zur Erinnerung an die... In Google Earth betrachten ☆☆☆☆☆
---	--	---

[Verletzung der Richtlinien melden](#)

Modelle [Erweiterte Suche](#)



The Google Earth 3D building layer – far in the background the city of Brunswick.

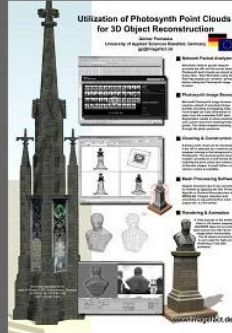


Visiting the ImageFactory

www.imagefact.de/monuments

- Workflow
- Models X3D
- Script
- References

3D Object Reconstruction from Photosynth Point Clouds



Open source Software like MESHLAB and BLENDER are powerfull tools for mesh processing, rendering and animation. Access to Photosynth point clouds closes a gap in the working chain from recording to 3D object reconstruction. A digital camera delivers the range maps, MESHLAB does the mesh processing and with BLENDER's UV image editor the scene becomes a realistic look.

Click into the left icon to enlarge the workflow chart.

Click here for downloading the [contribution to XXII CIPA Symposium](#), Kyoto, Japan [PDF 1.1 MByte]



Monument in remembrance of Dukes Karl Wilhelm Ferdinand and Friedrich Wilhelm of Brunswick who died during the war of liberation against Napoleon (lat 52.259693, long 10.530974).

[X3D - download the model](#) [zip 1.1 MByte].



Ferdinand von Schill was a Prussian officer who revolted against French domination. Schill was killed 1809 at Stralsund on May 31. German patriots obtained his head for the dedication of the monument 1837.

Visit Google Earth at lat 52.25645 and long 10.54157 to view this monument in it's environment.

[View the VRML model.](#) | [Go to Photosynth!](#)

[View the Berghauptmann as a Photosynth!](#)



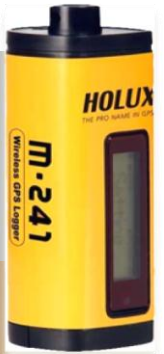
[Berghauptmann](#)s are uploaded to the GOOGLE 3D WAREHOUSE and belong to the collection *Denkmale*.

[Click here to visit the collection of monuments constructed from Photosynth point clouds.](#)



We come to the conclusion:

- Microsoft Photosynth takes *internet imagery* to reconstruct a 3D photomodel
- Data source is the photo and it's EXIF information only
- The bundle of photos is presented to the Web community for *browsing* through
- Access to the cloud of feature points enables 3D construction and mesh processing for visualization
- Required equipment refers to touristic needs



ご清聴ありがとうございました

