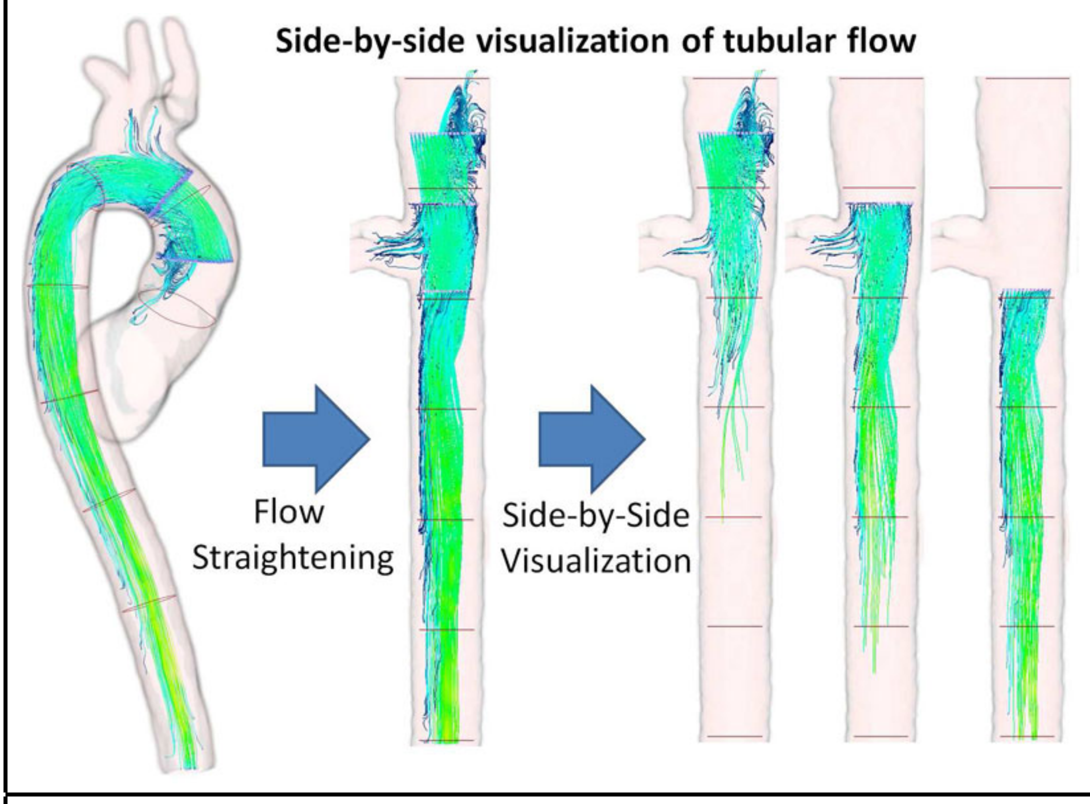
NORSIGD INFO
Nummer 2 2011



NORSK SAMARBEID INNEN GRAFISK DATABEHANDLING

ISSN 0803-8317

Notiser

Visual Computing Forum

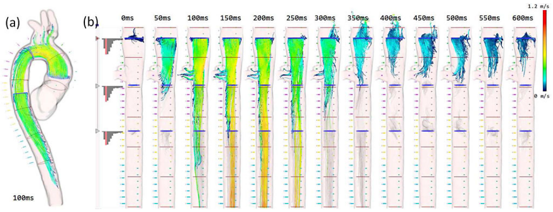
The Visual Computing Forum, or VCF, is a series of seminars organized by the visualization group at the University of Bergen with selected talks from the fields of visualization, image processing, computer graphics, and so on. The individual seminars are arranged approximately once a month, on Fridays from 11am to 12am, and they will be interleaved with the MedViz seminars. They will be held either at the Høyteknologisenteret or at the VilVite Science Center in Bergen. Please visit http://www.ii.uib.no/vis/vcf/index.html for the current programme.

INREMO Nettverket

INREMO nettverket startet offisielt 12. september 2011 med et Kick-off seminar på InterMedia (Universitet i Oslo). Deltakere fra partnerinstitusjonene presenterte sine visjoner for det videre arbeidet i nettverket. Se inremo.no for mer informasjon. Deltakerne på seminaret i alfabetisk rekkefølge: Otto Anshus (IFI Tromsø), Dag Andreassen (NTM), John Markus Bjørndalen (IFI Tromsø), Kari Gjestrang (Expology AS), Jo Herstad (IFI Oslo), Per Hetland (InterMedia), Alfredo Jornet Gil (InterMedia), Anders Kluge (InterMedia), Ingeborg Krange (InterMedia), Wolfgang Leister (Norsk Regnesentral, NORSIGD), Sten Ludvigsen (InterMedia), André Mlonyeni (Forskningsrådet), Andrew Morrison (AHO), Kathrine Myhre (Meditech), Palmyre Pierroux (InterMedia), Ole Smørdal (InterMedia), Dag Svanæs (NTNU), Christian Tarrou (Kalkulo), Ingvar Tjøstheim (Norsk Regnesentral), and Torgunn Wøien (Aschehoug Undervisning).

VRVis Conference Calendar: http://confcal.vrvis.at/

Eurographics Events: http://www.eg.org/events



Om forsiden

Bildet er en illustrasjon fra følgende artikkel: *Paolo Angelelli and Helwig Hauser: "Straightening Tubular Flow for Side-by-Side Visualization", IEEE Transactions on Visualization and Computer Graphics, 17(12):2063–2070, 2011.*

Abstract: *Flows through tubular structures are common in many fields, including blood flow in medicine and tubular fluid flows in engineering. The analysis of such flows is often done with a strong reference to the main flow direction along the tubular boundary. In this paper we present an approach for straightening the visualization of tubular flow. By aligning the main reference direction of the flow, i.e., the center line of the bounding tubular structure, with one axis of the screen, we are able to natively juxtapose (1.) different visualizations of the same flow, either utilizing different flow visualization techniques, or by varying parameters of a chosen approach such as the choice of seeding locations for integration-based flow visualization, (2.) the different time steps of a time-dependent flow, (3.) different projections around the center line, and (4.) quantitative flow visualizations in immediate spatial relation to the more qualitative classical flow visualization.*

Hilsen fra styret

Kjære medlemmer,

vi må alle møte fremtiden med en passende dose fornyelse, samtidig som vi tar vare på det gamle. I de siste årene har NORSIGD vært finansiert av inntektene fra GPGS. Men disse inntektene blir det mindre av, selv om programvaren fremdeles er i bruk i mange grafiske anvendelser. Nye teknologier som GPU og 3D-skjermer vil etterhvert overta flere nisjer, på bekostning av eldre teknologier. Derfor må vi etterlyse en fornyelse og gjøre oss tanker hva NORSIGD skal satse på i fremtiden.

NORSIGD har alltid vært en forening som satser faglig. Styret mener at vi burde styrke den faglige satsingen ytterligere, samt samarbeidet med universiteter og instituttssektoren. Deltakelse i nasjonale faglige nettverk og et tettere samarbeid med Eurographics er en del av denne strategien.

I denne utgaven ønsker vi å gi dere en variert meny bestående av en faglig artikkel fra Høgskolen i Bergen, konferanserapporter fra årets SIGGRAPH og VisWeek, samt en presentasjon fra IllustraSound prosjektet ved Universitetet i Bergen. Vi presenterer også tre illustrerte sammendrag fra masteroppgaver.

Styret i NORSIGD ønsker alle lesere en riktig God Jul og et godt datagrafikkår 2012!

Hilsen,

Wolfgang Leister

NORSIGD Info
– medlemsblad for NORSIGD

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Ettertrykk tillatt med kildeangivelse.

Innhold

Automatic Surface Reconstruction for Industrial Point Clouds Using Cellular Automata

Anders Vik, Bergen University College

This paper presents a cellular automaton approach that can be used for surface reconstruction from point clouds. Surface reconstruction from point clouds is a major task in several application fields. The reconstruction is generally a time consuming task that requires interactions between humans and computers.

When planning an upgrade of equipment on oil rigs, the suppliers need to know where the new equipment will fit. Sending a person offshore to do this job is expensive and time consuming. Another method for finding where the new equipment will fit is to use a 3D computer model. Yet, 3D models of the rigs might be unavailable or outdated. But, a point cloud of the environment can be created with 3D scanners. In this context, a point cloud is a set of points representing the visual parts of an environment. There exists computer software for visualizing and manually or semi-automatically creating 3D shapes in these point clouds. The surface reconstruction is illustrated in Figure 1; where a point cloud is presented to the left and a desirable output is presented to the right.

The point clouds may be several hundred gigabytes when stored on a disc. On today's offshore networks this amount of data takes too long to be sent. Instead of sending the data over a network connection, the data is in many cases stored on hard drives and then sent by normal mail. When the hard drive is received, computer software is used to create some 3D shapes, and trained personnel can manually create the missing 3D shapes in their model. The manual process can significantly delay the equipment upgrade.

Another approach than using point clouds for storing the visual data is to store the data as geometric shapes such as triangles, squares and circles. This paper will present a partial transform from point clouds into such geometric shapes based on cellular automata algorithms. The surface reconstruction is illustrated in Figure 1. Such a conversion may eventually result in:

- Significant file size reduction, which may make it possible to send data over satellite links instead of in mail.
- Easier and faster computer rendering of the visual data.
- It may be possible to extract additional information from the geometric data that may be used in rendering in order to make the human perceived image look better.
- Automatic processing instead of manual processing may speed up the surface reconstruction time, and expensive trained personnel may become superfluous.

Related work

Past research in this area includes: delaunay triangulation [3], marching cube [6], marching triangles

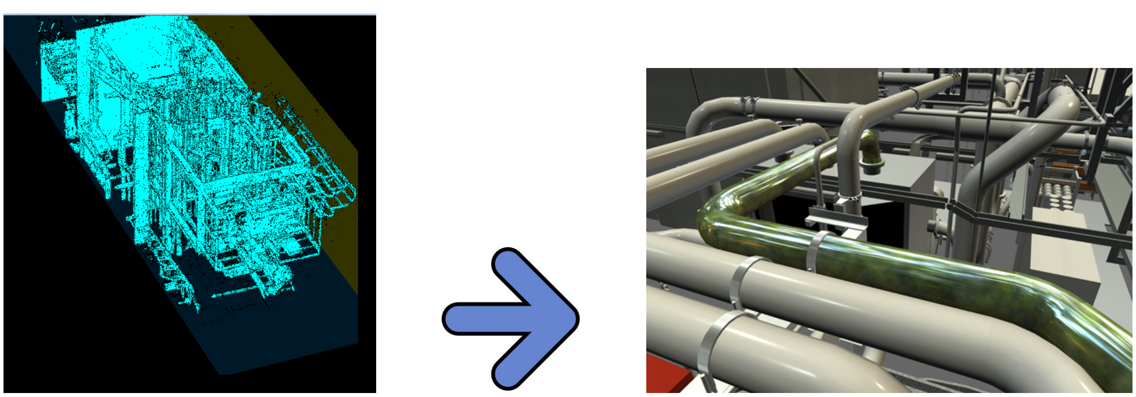


Figure 1: Surface reconstruction (Right figure is taken from Stormfjord's SFConstructor program)

[4], ball pivoting [2], cocone [1] and poisson surface reconstruction [5]. This paper presents research in how to detect parts of surface planes partly by the use of cellular automata. A great advantage of cellular automata compared to other methods is its parallelization. Modern Graphic Processing Units can be used to parallelize the cellular automata algorithms.

Cellular automaton

Cellular automaton is a way of handling a dataset of x dimensions by changing the data over time. The data is changed based on its neighbor data. In this paper a datum is a voxel, and the voxel is changed dependent on the $3 \times 3 \times 3$ neighboring voxels including itself. In cellular automata algorithms the neighbors of a cell (voxel) are of importance. A $3 \times 3 \times 3$ neighborhood means the $3 \times 3 \times 3$ voxels surrounding and including a specified voxel.

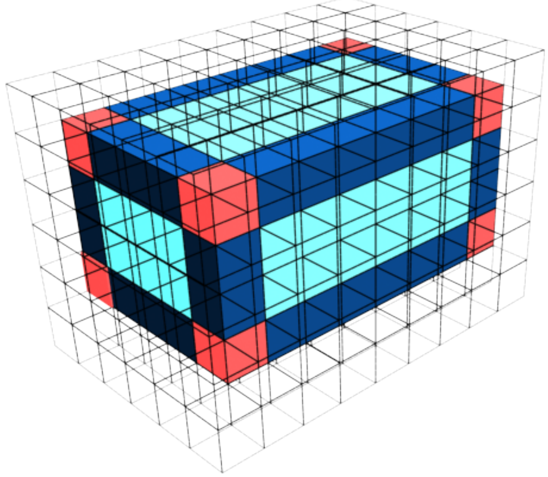


Figure 2: Voxel Terminology

Preprocessing

When using cellular automata algorithms it is of great benefit to have data stored so that the neighboring data can be accessed quickly. A voxel map with the voxels stored in memory ordered by its voxel position fits well for this purpose. The point cloud is converted to a voxel map of size (x, y, z). An algorithm iterates through the points in the point cloud, if a point is located within the range of a voxel, that voxel is set to solid as illustrated in 2D in Figure 3.

Surface Reconstruction

The surface reconstruction starts by detecting which voxels in the voxel map are representing an edge of a geometric shape. In this paper, the edges of a geometric shape (dark blue and red voxels in Figure 2) are named edge voxels, while the interior of a geometric shape (light blue voxels in Figure 2) are named interior voxels. A 3D scanner can't scan the voxels inside of an object, therefore those voxels are considered to be empty in this paper. A collective term for the edge and interior voxels are solid voxels. The voxels which are not solid are named empty voxels.

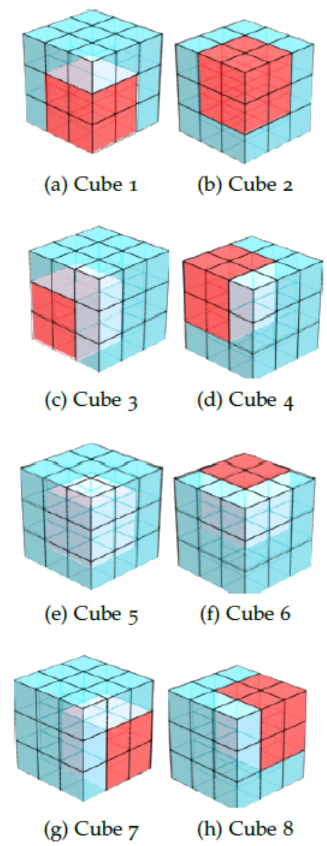


Figure 4: Cubes

The algorithm that declares a voxel as edge, interior or empty uses cellular automata with a $3 \times 3 \times 3$ neighborhood. The neighborhood is also split into $2 \times 2 \times 2$ cubes as displayed in Figure 4 and $3 \times 3 \times 1$ planes as displayed in Figure 5.

In the scope of this paper, density is the number of solid voxels in a neighborhood. If a $3 \times 3 \times 3$ neighborhood contains 8 solid voxels out of 27 voxels, it has a density of 8. If a $2 \times 2 \times 2$ cube contains 8 solid voxels out of 8 voxels, it has a density of 8. If a $3 \times 3 \times 1$ plane contains 8 solid voxels out of 9 voxels, it has a density of 8.

The criteria for setting a voxel as edge, interior or empty are found by tentative inspection on an example dataset.

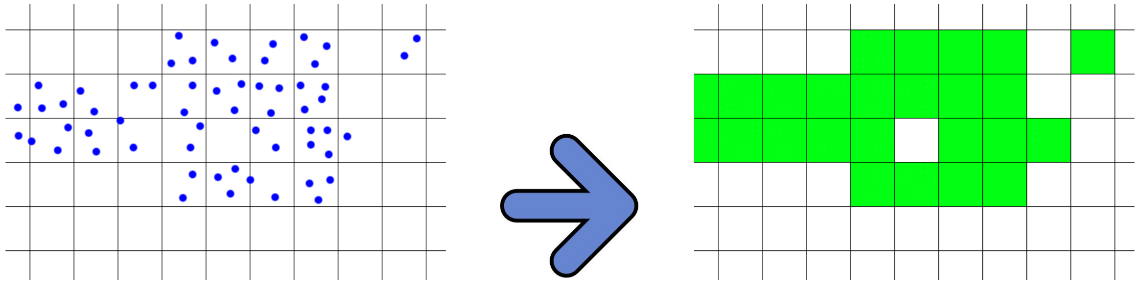
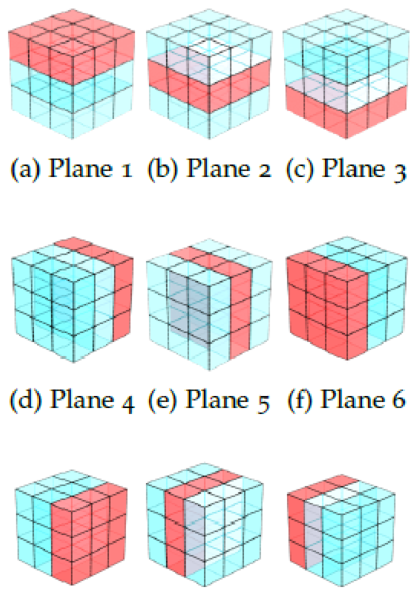


Figure 3: Preprocessing (Left: point cloud. Right: voxel map)



(a) Plane 1 (b) Plane 2 (c) Plane 3

(d) Plane 4 (e) Plane 5 (f) Plane 6

(g) Plane 7 (h) Plane 8 (i) Plane 9

Figure 5: Planes

A voxel is declared as an edge voxel if it complies with the following criteria: *a*) all cubes have a density greater than 2, and *b*) at least 7 planes have a density greater than 0. A voxel is declared as an interior voxel if it complies with the following criteria: *a*) It is not an edge voxel, and *b*) All cubes have a density greater than 1 In order to remove noise, empty voxels are also declared. A voxel is declared as empty if it complies with the following criteria: *a*) It is not an edge or interior voxel, and *b*) the $3 \times 3 \times 3$ neighborhood density is less than 5. The algorithm for declaring the voxels is iterated with parallel ¡¡¡¡¡¡¡ cellularautomaton.tex cellular automata algorithms until a stable ~~solid~~ state is reached, and no more ======= cellular automata algorithms until a stable state is reached and no more ¿¿¿¿¿¿¿ 1.6 voxels get updated.

When the voxels are declared, the edge voxels are used to find edge lines for geometric shapes. The line recognition algorithm uses parallel processing to find the lines. The parallelization does create some overhead processing, but as long as the parallel processing thread count is high, it will be of benefit. Here is an overview of the line detection algorithm:

1. Try to find a line of edge voxels leaving the current voxel.
2. If a line is found, check if its angle is $-90° \leq \Theta \leq 90°$, ($0°$ is in the direction of the positive x-axis).
3. Continue finding edge voxels in the same direction as far as possible.
4. Save the start and end coordinates of the line in a vertex buffer object (VBO).

What follows is a more complete description of the algorithm: A parallel thread is started from each voxel in the voxel map. If the voxel is an edge voxel, the algorithm will search for more edge voxels nearby. If the algorithm finds any voxels in the area of $-90° \leq \Theta \leq 90°$, then it will assume it is a part of a line and it will continue searching for more edge voxels in the same direction $\pm 90°$. This will go on until five voxels are found and the direction angle from the first to the fifth voxel will be used for the rest of the algorithm.

When five voxels are found, the direction Θ from the first to the last voxel is checked to see if it satisfies $-90° \leq \Theta \leq 90°$. There is also a check to see if there are any voxels in the opposite direction of Θ, giving direction $-\Theta \pm 45°$. If any of those criteria are met, then another of the parallel processing threads will handle the specific line, and the current thread is terminated.

The direction Θ found from the five first voxels decides the expected direction for the rest of the line. The algorithm will continue searching for voxels in the same direction $-\Theta \pm 45°$. As long as there exists edge voxels in $-\Theta \pm 45°$, the algorithm continues searching. When no more edge voxels are found, the algorithm checks to see if the line is of a length of 5 units or more (1 unit is the distance between the centers of 2 neighbor voxels). If the line's length

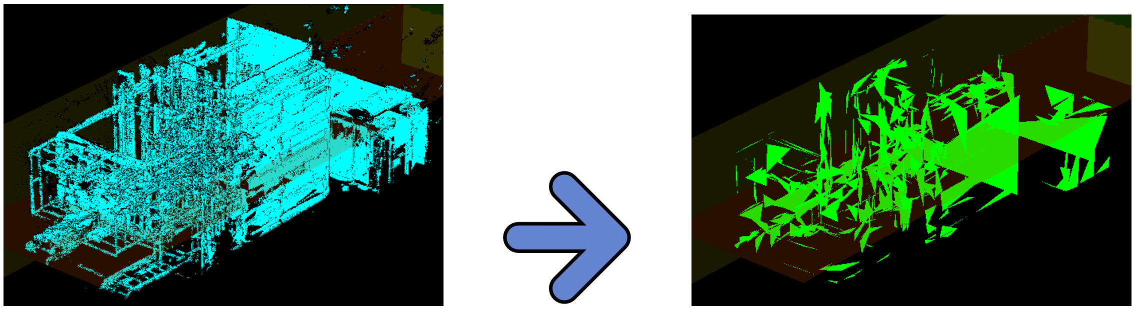


Figure 6: The input dataset compared to the triangles found

is accepted, the line's start and end coordinates are stored in a VBO.

A serial algorithm iterates over the lines in the VBO. If two lines in the VBO are found to have a start or end voxel in common, it is combined into a triangle. The triangle is converted to a voxel map with the POLYGON algorithm from [7]. The created voxel map is compared to the original input voxel map. If 90% of the voxels in the triangles voxels map are found in the original voxel map, then the triangle is accepted, and the original data is removed.

When all lines have been handled, the whole process described in this article is repeated until no more triangles are found.

Results

Figure 6 shows an example of the voxel map after the voxel declaration stage, and the final output data from one iteration of the algorithms described in this article.

The parts of the data which was converted to a triangle map had a compression rate of 71 when converted from a voxel VBO to a triangle VBO. A benefit of the algorithms described in this thesis is that they can be run on a relatively affordable modern PC.

The cellular automata approach for surface reconstruction from point clouds is an interesting approach. Further research could investigate the following:

- If the 3D scanner positions are known, make special cases for areas that are partly hidden from the scanner by the solid surfaces that have been found so far.

- Reconstruct other geometric shapes like circles and shapes with special curves.

- Recognize real world objects from the geometry, and store the objects with the help of lookup tables to a larger object database.

Acknowledgement

Thanks to Hans Birger Drange, Talal Rahman, Harald Soleim and Jon Eivind Vatne for their contribution regarding this paper. This paper is based on the master thesis "Automatic Surface Reconstruction for Industrial Point Clouds" written by the author. The master thesis problem was given by Stormfjord Oil & Gas and submitted to Bergen University College and the University of Bergen.

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[2] Bernardini, Fausto, Joshua Mittleman, Holly Rushmeier, Clàudio Silva, and Gabriel Taubin. "The ball-pivoting algorithm for surface reconstruction." Visualization and Computer Graphics. 1999.

[3] Delaunay, Boris. "Sur la sphère vide." Izvestia Akademii Nauk SSSR. 1934.

[4] Hilton, A, A.J. Stoddart, J. Illingworth, and T. Windeatt. "Marching Triangles: range image fusion for complex object modelling." International Conference on Image Processing. 1996.

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Conference Report SIGGRAPH 2011

Veronika Solteszova, University of Bergen

SIGGRAPH (Special Interest Group on GRAPHics and interactive techniques) is an annual conference and exhibition on computer graphics arranged by the ACM SIGGRAPH organization. The first SIGGRAPH conference was held in 1974. Since then, it was organized at different places across the USA until 2011, when SIGGRAPH took place in Vancouver Convention Center, in Canada.

SIGGRAPH is the biggest event in the computer graphics world and gathers 15.000-20.000 participants every year. The recent paper acceptance rate of SIGGRAPH has been less than 20% which makes SIGGRAPH the most prestigious forum for paper presentation. Since 2002, the accepted papers have been printed in a special issue of the ACM Transactions on Graphics journal. For a researcher in computer graphics, a presentation of a technical paper at SIGGRAPH is considered to be reaching Olympus.

The Conference Center

Another highlight of the event is the Animation and Electronic Theater presentations where videos made by the most accomplished video creators are screened. Awards this year have been granted to *The Fantastic Flying Books of Mr. Morris Lessmore* (best in show award), *Paths of Hate* (Jury Award) and *Flamingo Pride* (best student project prize). In addition to the paper presentations and the theater, a great number of exhibitors and panelists from the industry is there ready to discuss the newest advancements in technology.

The keynote speaker this year was Cory Doctorow, a journalist contributing for example to The Guardian, The New York Times and a co-editor of the Boing-Boing blog. It was very interesting to listen to his views on copyright laws and as he explicitly allowed people to film his speech, it is now available to everybody's pleasure through various channels.

The author of this article visiting the exhibition

SIGGRAPH 2011 was my first SIGGRAPH and the advice to plan "what to see because there is too much happening" turned out to be totally well-placed. The technical papers were presented in parallel sessions and covered the most interesting topics such as modeling, motion capturing, animation, image processing and understanding, geometry processing and acquisition, simulation, tone editing and color, rendering and hardware. A huge amount of people gathers at SIGGRAPH which makes it difficult to meet people by accident. One must schedule meetings with colleagues. Nevertheless, it is great that your old friends from studies and colleagues, now dispersed around the world, gather at once and you have the opportunity to discuss with them during lunch or a session break with a cup of coffee.

The Vancouver Skyline with the Convention Center and Stanley Park

Paradigm Shift in 4D Ultrasound Visualization

Ivan Viola and Odd Helge Gilja, University of Bergen

Medical ultrasound is the most-widely used medical imaging modality. For a long period 3D ultrasound acquisition was performed by ordinary 2D probes that were interfaced to a position location system, either mechanically steering devices or various tracking systems (magnetic, optical, auditive). In the last years, all the major ultrasound vendors introduced to the markets new 4D (volumetric) transducers, targeting primarily at cardiac examinations. The next natural step is to deliver 4D technology for abdominal examinations and vendors are intensively competing to present the best possible 4D imaging quality with new abdominal transducers.

The IllustraSound research project carried-out at the University of Bergen, Haukeland University Hospital and Christian Michelsen Research envisions entirely new utilization of 4D ultrasound in the abdominal context. In particular, the project aims at technology that would ultimately compete with computed tomography (CT) used nowadays for liver examinations for treatment planning, and intraoperative guidance. With CT it is possible to extract the liver from imaging scans, compute its volume and segment the organ into separate blood-filtering compartments and demonstrate hepatic pathologies. However, CT is associated with ionizing radiation which may seriously harm the patient.

In the course of our project, so far we proposed parts of complementary technology utilizing traditional 2D ultrasound with magnetic position sensors. Although this technology looks promising, it is clear that it will never outperform CT in terms of precision. The reason is simple, from series of 2D scans, a precise 3D reconstruction is difficult to achieve when considering all the voluntary and involuntary patient's movements such as respiratory movement.

Fortunately, this major drawback in precision can be alleviated by utilizing the new 4D ultrasound imaging modality. Compared to CT, it additionally offers live liver parenchyma extraction and semi-automatic and fast segmentation into liver segments. So in case the scans becomes noisy, the ultrasound examination can be immediately repeated. This is rarely an option with CT. Moreover, Doppler and contrast-enhanced ultrasound modes can provide additional physiological information about blood flow and blood supply of pathologies. Thus instead of an anatomical model as in CT, with ultrasound it is possible to extract a physiological model. All this information can be integrated into a four-dimensional space-time and patient-specific liver model, where the clinically-relevant information is provided in a clear way, as compared to direct 3D visualization of acquired scans. A 3D model like this can be integrated in a next-generation medical report which will offer 3D and interaction with the model. This report can be further provided to surgeons for treatment planning and assistance during intervention. Visualization of a virtual liver model will effectively convey disease information to the patient, who can more easily take part in the treatment decision process.

In the last year IllustraSound project researchers have started systematic investigation to propose new visualization technology based on 4D ultrasound examination of the liver. The first exciting preliminary result is that we can construct a high-precision liver scan from several overlapping small-area liver sectors. These sectors are stitched together to constitute the entire organ. This stitching is known as 3D image registration. The requirement is that it has to be performed instantaneously on the fly. We boosted the performance of this computationally-intensive task by utilizing the latest 3D gaming graphics hardware and we currently achieve registration of two sectors per second. This is sufficient for our purposes and in future gaming hardware will become faster and allow for higher frame rates. It even seems that the additional positional sensors, necessary for previous 2D stitching techniques, can be removed and the sector stitching can be done entirely based on overlapping information between 3D ultrasound sectors. Preliminary results show that the instantaneous sector stitching delivers high precision. This needs to be clinically validated first. If it proves successful, we can proceed to extraction of the liver parenchyma, vascular structures, and the pathologies from the ultrasound volume. Here we plan to use sophisticated methods that from few sketches, done by the examiner, algorithms will complete the extraction of 3D anatomical information. Afterwards, on the top of anatomy, we can incorporate relevant physiological information and trace respiratory movement and deformation of the organ. To reach our goal, we are still on a long way, but the initial proof of concept seems that we are on the right path.

Report from VisWeek 2011

Åsmund Birkeland and Endre M. Lidal, University of Bergen

The VisWeek is the largest annual conference in visualization and is organized by the IEEE computer society's Visualization and Graphics Technical Committee (VGTC). This was the 22nd anniversary of the conference; it was held in the city of Providence, Rhode Island and chaired by David Laidlaw from Brown University and Ross Whitaker from the University of Utah.

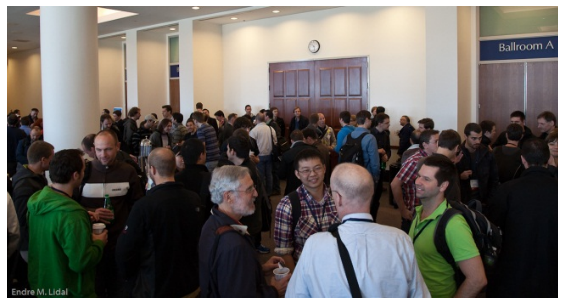
The scientific papers accepted by the conference are printed in a special issue of the IEEE journal TVCG (Transaction on Visualization and Computer Graphics), making the venue very prestigious for publications. This was the largest VisWeek yet with close to 1000 visitors. From Norway there were participants from University of Bergen (incl. four presenters), Statoil and CMR.

VisWeek is actually several co-located events and consist of the following IEEE conferences: Visualization (Vis), Information Visualization (InfoVis) and Visual Analytics Science and Technology (VAST). This year two additional symposiums were also arranged: Biological Data Visualization (BioVis) and Large-Scale Data Analysis Visualization (LDAV).

Welcome speech by VisWeek General Chair David Laidlaw, Brown University. Keynote speaker Paul Thagard is sitting behind him.

The VisWeek started, as usual, with a set of tutorials and workshops. Here, experts present their topics in order for others to gain knowledge of certain fields or theories around visualization. Simultaneously, the BioVis symposium was held with new developments in biological visualization. On the second day, the LDAV symposium was held, providing four sessions of new developments in techniques for handling very large datasets. The end of Monday closed with tutorials, workshops, BioVis and LDAV.

The third day, the main conference began with the keynote speaker. This year Paul Thagard discussed Visual Thinking and how imaging in the mind has influenced science and innovation. The presentation led to much discussion, both on content as well as on relevance.



There where many lively discussions during the breaks between the different sessions.

One of the major events at this conference is the presentation of research papers and the rest of the conference days were filled with presentations. The competition is hard for getting a scientific paper presentation accepted; only 25 % of submitted papers are accepted. The presentations were divided into several parallel tracks. This year, in additional to the usual Vis, InfoVis and VAST tracks, a track on invited papers, previously been published in the TVCG journal this year, was offered. For best-paper-award and honorable mentions for each track we refer to the final conference program found here: `http://www.visweek.org/program/program-web.pdf`. We also recommend the following papers:

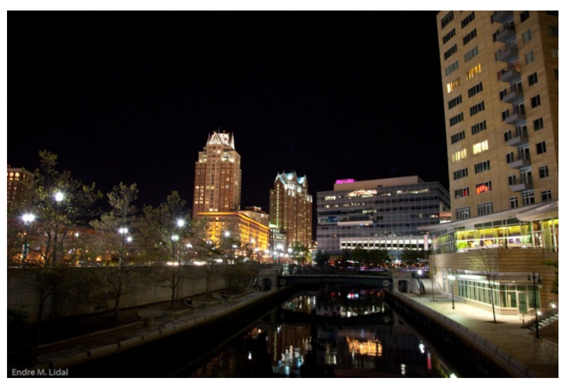
- Talbot, Justin; Gerth, John; Hanrahan, Pat: "Arc Length-Based Aspect Ratio Selection," Visualization and Computer Graphics, IEEE Transactions on, vol.17, no.12, pp.2276-2282, Dec. 2011
- Correa, Carlos; Lindstrom, Peter; Bremer, Peer-Timo: "Topological Spines: A Structure-preserving Visual Representation of Scalar Fields," Visualization and Computer Graphics, IEEE Transactions on, vol.17, no.12, pp.1842-1851, Dec. 2011

Close to 1000 participants attended the conference.

- Borkin, Michelle; Gajos, Krzysztof; Peters, Amanda; Mitsouras, Dimitrios; Melchionna, Simone; Rybicki, Frank; Feldman, Charles; Pfister, Hanspeter: "Evaluation of Artery Visualizations for Heart Disease Diagnosis," Visualization and Computer Graphics, IEEE Transactions on, vol.17, no.12, pp.2479-2488, Dec. 2011
- Schulz, H.-J.; Hadlak, S.; Schumann, H.: "The Design Space of Implicit Hierarchy Visualization: A Survey," Visualization and Computer Graphics, IEEE Transactions on, vol.17, no.4, pp.393-411, April 2011
- van Pelt, Roy; Olivan Bescos, Javier; Breeuwer, Marcel; Clough, Rachel E.; Groller, M. Eduard; ter Haar Romenij, Bart; Vilanova, Anna: "Interactive Virtual Probing of 4D MRI Blood-Flow," Visualization and Computer Graphics, IEEE Transactions on, vol.17, no.12, pp.2153-2162, Dec. 2011
- Endert, A., Han, C., Maiti, D., House, L., Leman, S., North, C.: Observation-level Interaction with Statistical Models for Visual Analytics

The Capstone talk this year was given by New York Times Graphics Editor Amanda Cox. She gave many good examples of how New York Times uses visualization to do storytelling.

There were many other activities at VisWeek, like poster sessions, panels, Birds-of-a-feather sessions and Meet the Experts, so the VisWeek is truly a conference that has many valuable gems for all involved in visualization. Next year's VisWeek conference will be held in Seattle, October 14^{th} to 19^{th}, 2012.



The city of Providence, RI at night.

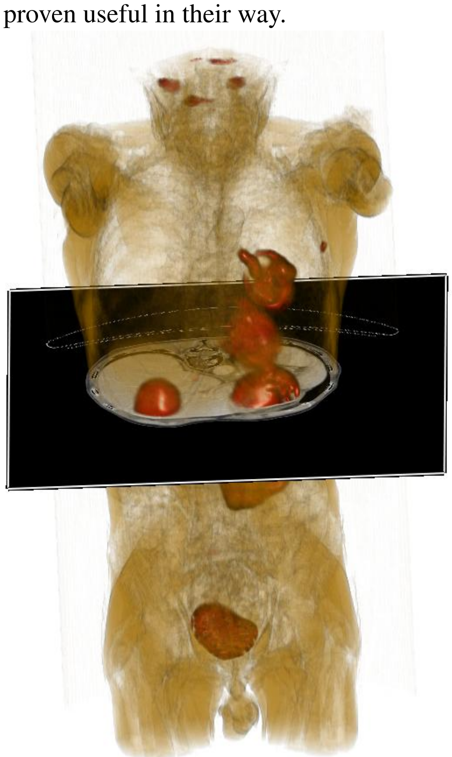
Written by: Åsmund Birkeland (`Asmund.Birkeland@ii.uib.no`) and Endre M. Lidal (`endre.lidal@ii.uib.no`), University of Bergen, Norway.

Master Thesis Abstracts

Advanced Storytelling for Volume Visualization

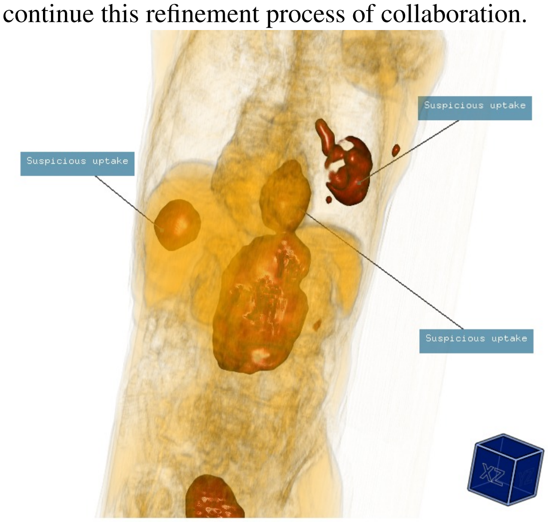
Master Degree Thesis by Andreas Lie, supervised by Helwig Hauser

Over the years, Storytelling has proven to be a very effective way of both retaining and transferring knowledge between humans. We find stories compelling, intriguing and stimulating, and these traits make storytelling as versatile as it is. Storytelling has manifested itself in oral and visual form, both proven useful in their way.



Today researchers struggle with presenting their results from the vast amounts of data collected, often because of the complex visualizations created, and the implicit difficulty of presenting these visualizations to both non-professionals and indeed professionals as well. In this thesis we show that the art of storytelling can aid in presenting complex visualizations, and that stories can be presented in a way that is both comprehensible and credible to the audience.

Storytelling as a form of communicating can help bridging the communication gap in a variety of situations. We aim at improving daily medical communication, exemplified by doctor to doctor communication, doctor to patient communication and medical documentation. Our visualization stories can also be used in an asynchronous form, as a collaboration tool between multiple participants. This can be achieved by exporting the stories and its structure, accompanied with the original data. Any partners can then recreate the stories, edit them and continue this refinement process of collaboration.



Our solution allows the creation of advanced visualization stories, that support recording, editing and playback at different levels of interactivity. The stories also include textual labels, annotations and recorded oral comments to aid the audience in interpreting the visualization results.

Articles on this subject:

- Michael Wohlfart and Helwig Hauser: Story Telling for Presentation in Volume Visualization. In the Proc. of the 9^{th} Joint EG – IEEE vgtc Symp. on Visualization (EuroVis 2007), May 23-25, 2007, Norrköping, Sweden, pp. 91-98
- Helwig Hauser: Story Telling for Visualization; Talk at the Story Telling Workshop 2010 at the UC Davis, CA
- Kwan-Liu Ma, Isaac Liao, Jennifer Frazier, Helwig Hauser, and Helen-Nicole Kostis: Scientific Storytelling using Visualization. In IEEE Computer Graphics and Applications (Jan/Feb 2012).

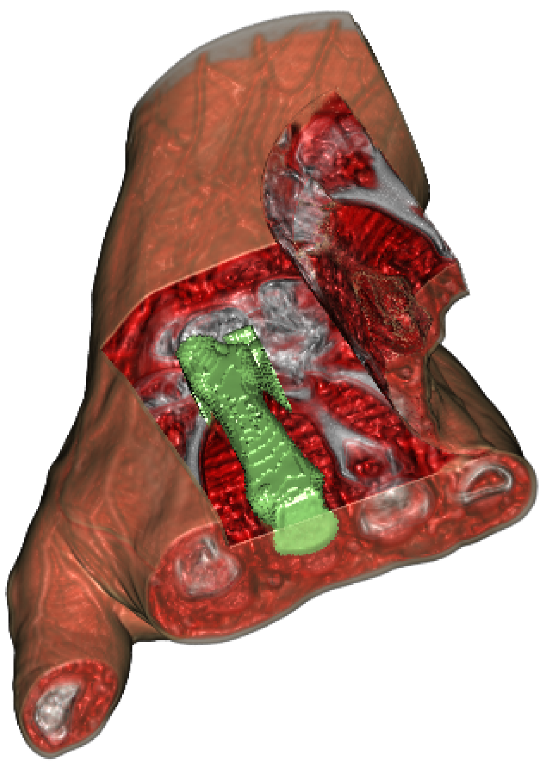
http://www.ii.uib.no/vis/teaching/thesis/2009-lie/index.html

Master Thesis Abstracts

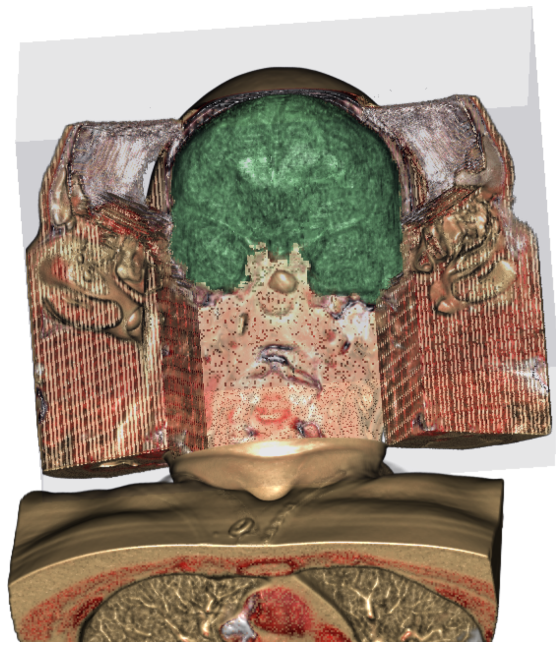
View-Dependent Peel-Away Visualization for Volumetric Data

Master Degree Thesis by Åsmund Birkeland, supervised by Ivan Viola

Traditional illustration of three-dimensional structures, has developed techniques to provide clear view on internal features that are otherwise hidden underneath other outer structures. Many techniques attempt to create a better view on features of interest, while still conveying information about surrounding contextual structures. In illustrative volumetric visualization, techniques developed in early illustrations have been adopted to increase visibility and improve the comprehension of volumetric datasets during interactive visualizations.



In this thesis a novel approach for peel-away visualization is presented. Newly developed algorithm extends existing illustrative deformation approaches which are based on deformation templates and adds a new factor of view-dependency to the peeling process. View-dependent property guarantees the viewer unobstructed view to structure of interest. This is realized by rotating the peel-template so that the structures peeled-away always face away from the viewer. Furthermore the new algorithm computes the underlying peel-template on-the-fly, which allows animating the level of peeling.



This is very helpful for understanding the original spatial arrangement. When structures of interest are tagged with segmentation masks, an automatic scaling and positioning of peel deformation templates allows guided navigation and clear view at structures in focus as well as feature-aligned peeling. The overall performance allows smooth interaction with reasonably sized datasets and peel templates as the implementation maximizes utilization of computation power of modern GPUs.

Articles on this subject:

- Åsmund Birkeland, Ivan Viola: View-Dependent Peel-Away Visualization for Volumetric Data. In Proc. of the Spring Conference on Computer Graphics (SCCG 2009)

`http://www.ii.uib.no/vis/teaching/thesis/2008-birkeland/index.html`

Master Thesis Abstracts

Visualization and Interaction with Medical Data in Immersive Environments

Master Degree Thesis by Yngve Devik Hammersland, supervised by Ivan Viola

Immersive visualization techniques are just starting to see limited adoption in medical applications. The Visualization Group at the University of Bergen wish to expand its research efforts into such immersive visualization techniques. A new immersive environment installed at the University is meant to be utilized for this purpose.

This thesis presents a solution which enables the use of VolumeShop in the immersive environments for presentation of volumetric data and for combination of 2D and 3D medical imaging modalities. VolumeShop is a rapid prototyping environment for visualization techniques, which is often used by our visualization group.

For general use of the immersive environment, motion tracking support needs to be added to VolumeShop. This motion tracking support can then be utilized to realize the immersive visualization pipeline. This pipeline computes correct perspective projection based on the user's position. Additionally it implements intuitive gesture based interaction with the data using a handheld interaction device.

A multimodal visualization pipeline is described and implemented, which enables the visualization of 2D+time ultrasound images combined with MRI volumes. To realize this pipeline, components for motion tracking of the ultrasound probe, for synchronization of the time offset between the motion tracking and the ultrasound series, picking landmarks in the ultrasound slice and MRI cross-section, and computation of the registration transformation which spatially unifies the two of the modalities.

The result of this thesis is a general purpose motion tracking component as well as the two described pipelines.

`http://www.ii.uib.no/vis/teaching/thesis/2009-hammersland/index.html`

Hva er NORSIGD?

NORSIGD – Norsk samarbeid innen grafisk databehandling – ble stiftet 10. januar 1974. NORSIGD er en ikke-kommersiell forening med formål *å fremme bruken av, øke interessen for, og øke kunnskapen om grafisk databehandling i Norge.*

Foreningen er åpen for alle enkeltpersoner, bedrifter og institusjoner som har interesse for grafisk datbehandling. NORSIGD har per januar 2007 16 institusjonsmedlemmer. Medlemskontingenten er 1.000 kr per år for institusjoner. Institusjonsmedlemmene er stemmeberettiget på foreningens årsmøte, og kan derigjennom påvirke bruken av foreningens midler.

Personlig medlemskap koster 250 kr per år. Kontingenten er redusert til 150 kr ved samtidig medlemskap i vår europeiske samarbeidsorganisasjon *Eurographics*. Ansatte hos institusjonsmedlemmer innvilges gratis personlig medlemskap. Personlige medlemmer får tilsendt medlemsbladet NORSIGD Info.

Alle medlemmer får tilsendt medlemsbladet *NORSIGD Info* 1–3 ganger per år. NORSIGD har tilrettelagt informasjon om foreningen på Internett på adressen `http://www.norsigd.no`. Der finnes det også informasjon om GPGS, samt tidligere utgaver av *NORSIGD Info*.

Interesseområder

NORSIGD er et forum for alle som er opptatt av grafiske brukergrensesnitt og grafisk presentasjon, uavhengig av om basisen er *The X window System*, *Microsoft Windows* eller andre systemer. NORSIGD arrangerer møter og seminarer, formidler informasjon fra internasjonale fora og distribuerer fritt tilgjengelig programvare. I tillegg formidles kontakt mellom brukere og kommersielle programvareleverandører.

NORSIGD har lang tradisjon for å støtte opp om bruk av datagrafikk. Foreningen bidrar til spredning av informasjon ved å arrangere møter, seminarer og kurs for brukere og utviklere.

GPGS

GPGS er en 2D- og 3D grafisk subrutinepakke. GPGS er maskin- og utstyrsuavhengig. Det vil si at et program utviklet for et operativsystem med f.eks. bruk av plotter, kan flyttes til en annen maskin hvor plotteren er erstattet av en grafisk skjerm uten endringer i de grafiske rutinekallene. Det er definert grensesnitt for bruk av GPGS fra FORTRAN og C.

Det finnes versjoner av GPGS for en rekke forskjellige maskinplattformer, fra stormaskiner til Unix arbeidsstasjoner og PC. GPGS har drivere for over femti forskjellige typer utsyr (plottere, skjermer o.l.). GPGS støtter mange grafikkstandarder slik som Postscript, HPGL/2 og CGM. GPGS er fortsatt under utvikling og støtter stadig nye standarder.

GPGS eies av NORSIGD, og leies ut til foreningens medlemmer.

Eurographics

NORSIGD samarbeider med Eurographics. Personlige medlemmer i NORSIGD får rabatt på medlemskap i Eurographics, og vi formidler informasjon om aktuelle aktiviteter og arrangementer som avholdes i Eurographics-regi. Tilsvarende får Eurographics medlemmer kr 100 i rabatt på medlemskap i NORSIGD.

Eurographics ble grunnlagt i 1981 og har medlemmer over hele verden. Organisasjonen utgir et av verdens fremste fagtidsskrifter innen grafisk databehandling, *Computer Graphics Forum*. *Forum* sendes medlemmene annen hver måned. Eurographics konferansen arrangeres årlig med seminarer, utstilling, kurs og arbeidgrupper.

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Svarkupong

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- ◯ Innmelding – personlig medlem (Kr 250)
- ◯ Innmelding – Eurographics medlem (Kr 150)
- ◯ Ny kontaktperson
- ◯ Adresseforandring

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