

Medical Visualization Research at the VisGroup @ UiB.no/ii

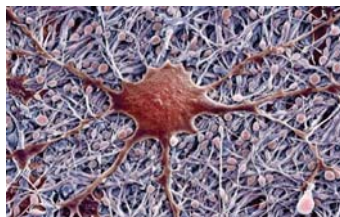
Helwig Hauser, *et al.*,
UiB Dept. of Informatics,
2015-11-25



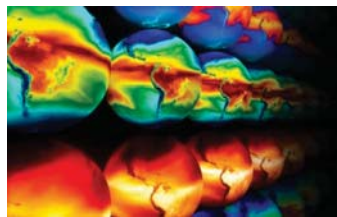
Data, models, etc. → visualization



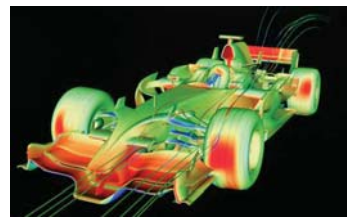
MEDICINE



BIOLOGY

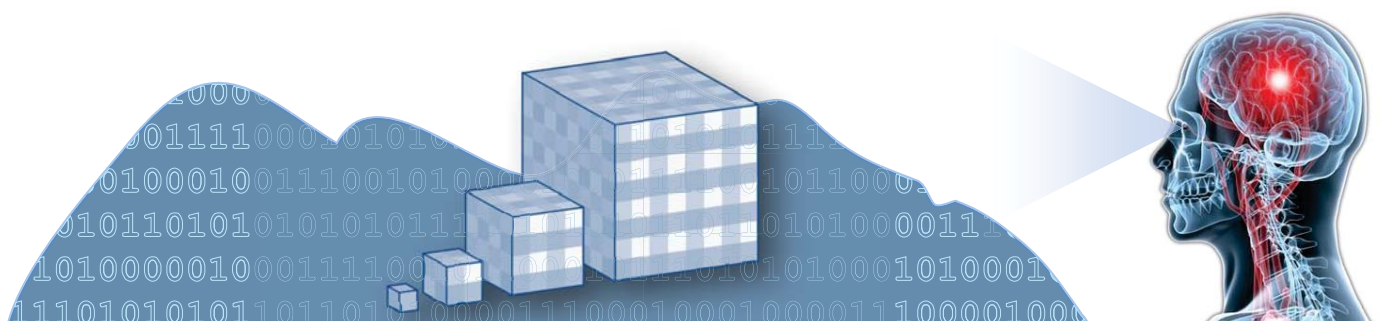


EARTH
SCIENCES



ENGINEERING

Visualization – from data/models/... to insight

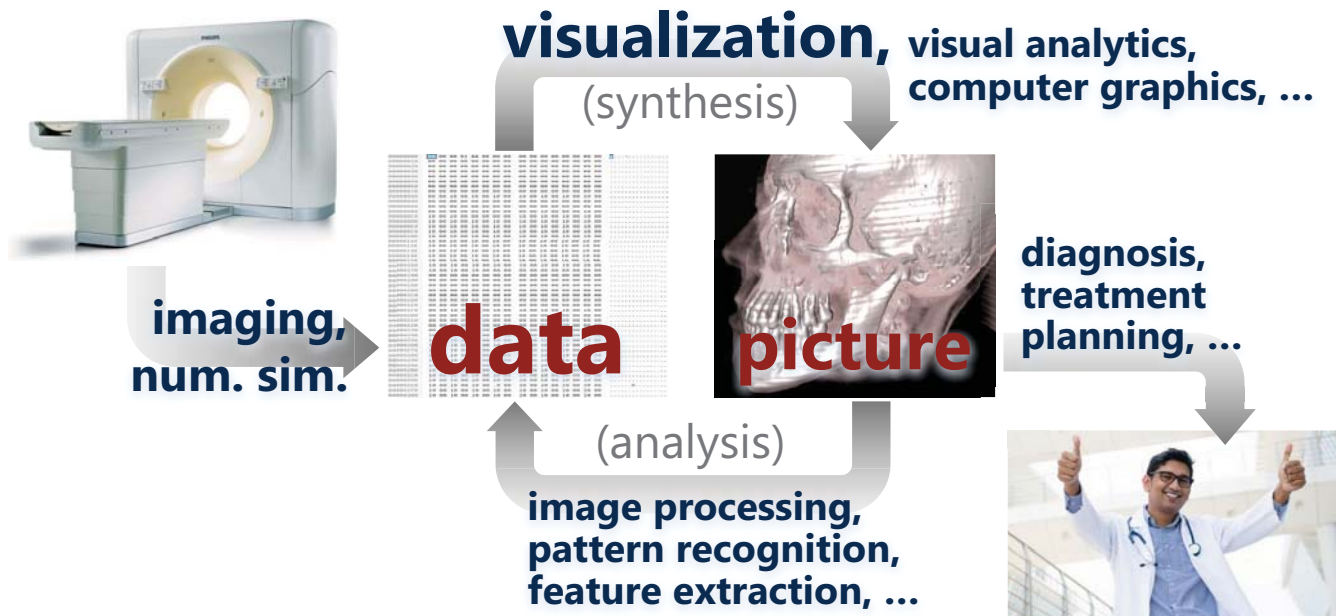


Visualization – a disambiguation

Imaging (medical imaging) delivers data (medical data)

Visualization (medical vis.) *synthesizes pictures* from **data**

Image processing (pattern recogn., etc.) *derives data* from **pics.**



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Visualization (medical vis.) *synthesizes pictures* from **data**

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Vis.-Research at UiB—selected facts



Research group at UiB's Dept. of Informatics (one of six) [1]

- profs. Helwig Hauser (20 years in vis.) & Stefan Bruckner (10)
- group established 2007 at UiB, currently 15 heads (Oct. 2015), 12 graduated visualization PhDs so far (2009–2014)
- grade 4.5 (out of 5) in NFR's 10 years evaluation of CS in Norway
- internationally recognized in (medical) visualization (Dirk Bartz prize, conf. chairing, steering comm., boards, conf. org., etc.)
- collaborative research (national & int'l) with medicine, biology, etc., incl. **MEDVIZ in Bergen**
- several larger projects (NFR, FP7, etc.), dozens of publs. in biomed. visualization (>30% on L2)



[1] www.ii.UiB.no/vis

Visualization Research @ ii.UiB.no



The purpose of visualization is insight, not pictures!
– Ben Shneiderman, 1999

Relatively new group at UiB Informatics,
today 15 heads (2 faculty, 1 ResEng, 4 PhD studs., *et al.*)

Application-oriented basic research in visualization – two aspects:

1. Researched visualization methodology (how to visualize)

- **Interactive Visual Analysis, nD data** (H. Hauser *et al.*)
- **Visual Knowledge Discovery, 3D data** (St. Bruckner *et al.*)

2. Applications at which this research is oriented (for whom)

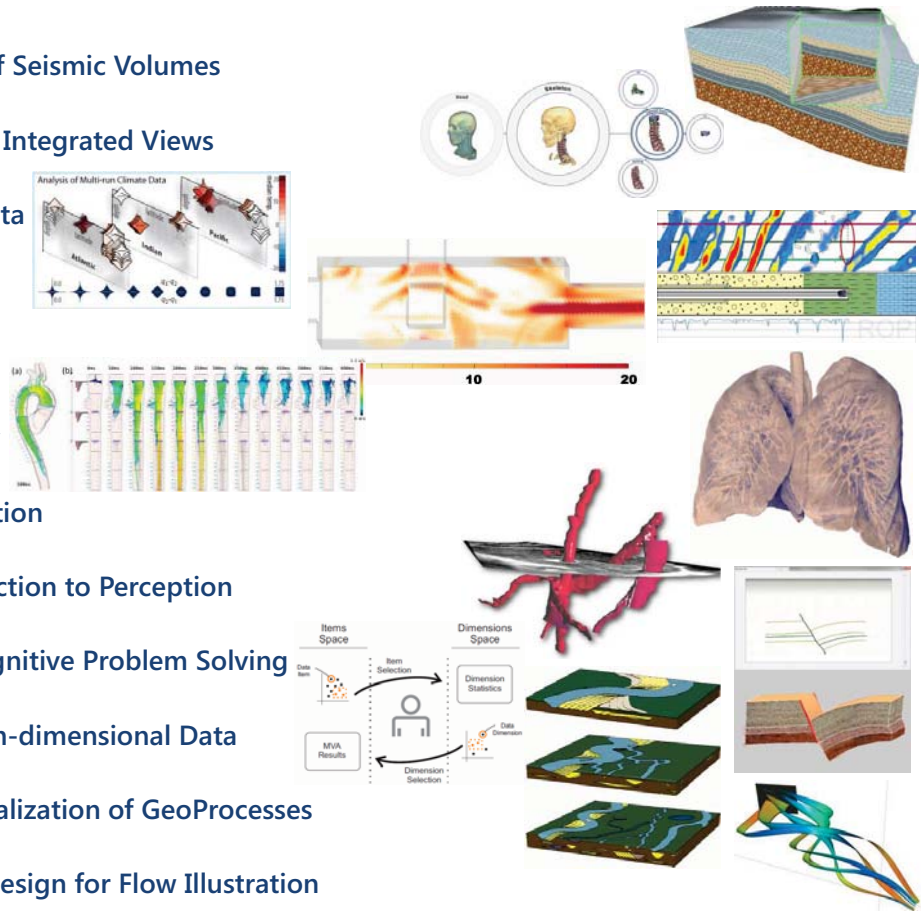
- **Medical Visualization** (partner in MedViz Bergen, etc.)
- **GeoSciences / Oil & Gas** (e.g., financed by Statoil's Akademiaavtale)
- **Biology / Bioinformatics** (with CBU@ii *et al.*)
- **Fluid Dynamics** (in collab. with FFI.no, for ex.)
- **Rich Data** (interactive visual analysis)

	2010	2011	2012	2013	2014	
General	11	11	6	12	8	48
BioMed	2	5	8	12	11	38
Flows	2	5	6	1	2	16
GeoSci	1		3	4	3	11
Eng.	2	1		1		4
Marine			1			1
Climate	1					1
	19	22	24	30	24	119

ii.UiB.no/vis PhDs (12 so far)



-  Daniel Patel (Oct. 2009):
Expressive Vis. & Rapid Interpr. of Seismic Volumes
-  Jean-Paul Balabanian (Jan. 2010):
Multi-Aspect Vis.: from Linked to Integrated Views
-  Johannes Kehrer (May 2011):
IVA of Multi-faceted Scientific Data
-  Ove Daae Lampe (Nov. 2011):
IVA of Process Data
-  Armin Pobitzer (June 2012):
IVA of Time-dependent Flows
-  Paolo Angelelli (June 2012):
Visual Expl. of Human Physiology
-  Veronika Šoltészová (Oct. 2012):
Perception-Augmenting Illumination
-  Åsmund Birkeland (May 2013):
Ultrasonic Vessel Vis.: From Extraction to Perception
-  Endre Lidal (May 2013):
Sketch-based Storytelling for Cognitive Problem Solving
-  Çağatay Turkey (Nov. 2013):
Interactive Visual Analysis of High-dimensional Data
-  Mattia Natali (Sept. 2014):
Sketch-based Modeling and Visualization of GeoProcesses
-  Andrea Brambilla (Dec. 2014):
Visibility-oriented Visualization Design for Flow Illustration

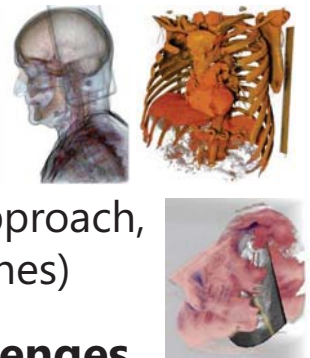


MedViz Research at UiB ii



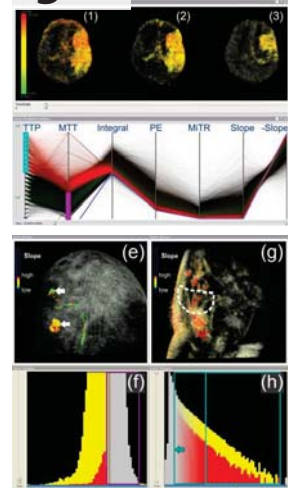
UiB Vis competence

- **medical data visualization** ([CT](#), [MRI](#), [US](#), etc., but also test data, [perfusion](#), [high-dim. data](#), etc.)
- **visual exploration & analysis** (user-in-the-loop approach, integration of interactive & computational approaches)



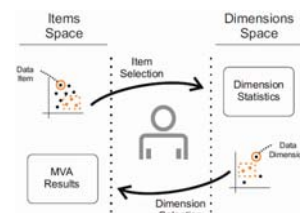
Initial research related to Medical Big Data challenges

- multi-modal medical data visualization
- new model for heterogeneous data studies
- dual framework for high-dim. data analysis



Well-working collab. with CMR

- basic research @ UiB,
prototype development @ CMR



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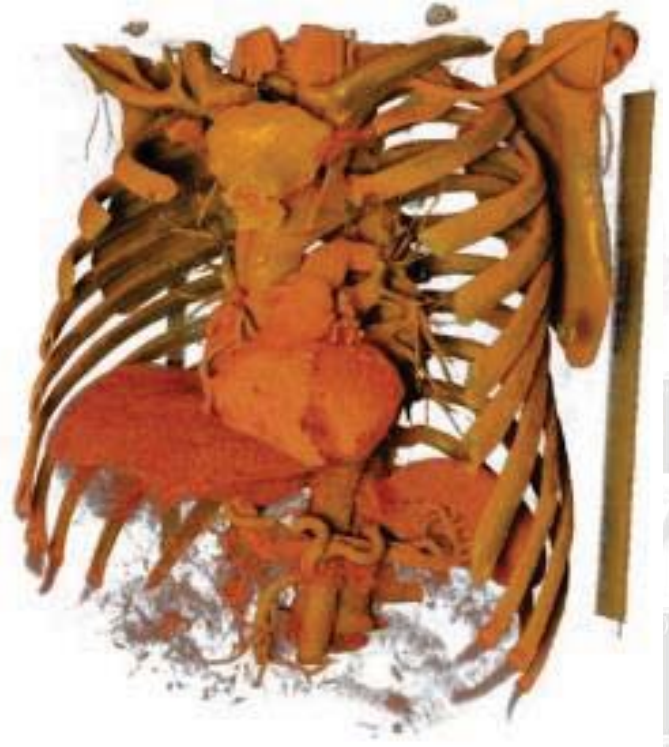
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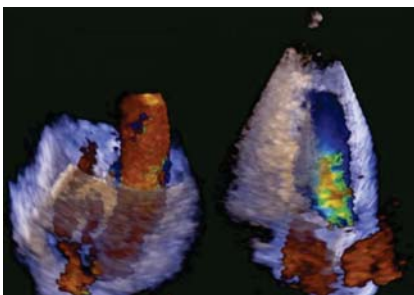


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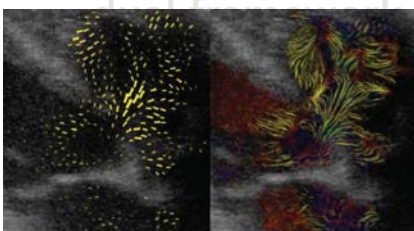
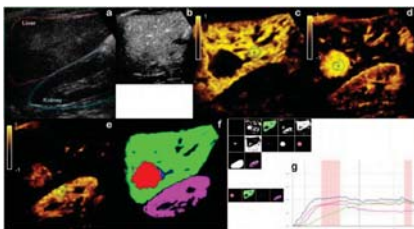
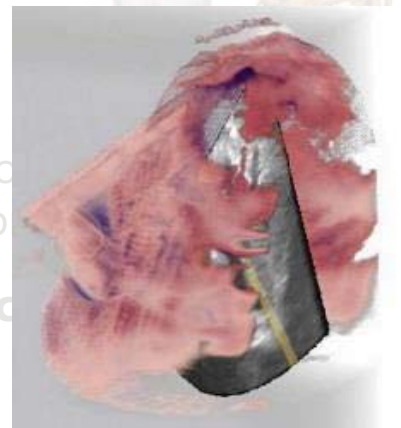
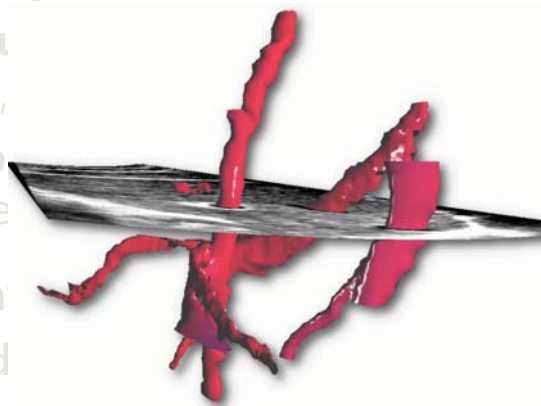


— basic research @ UiB,

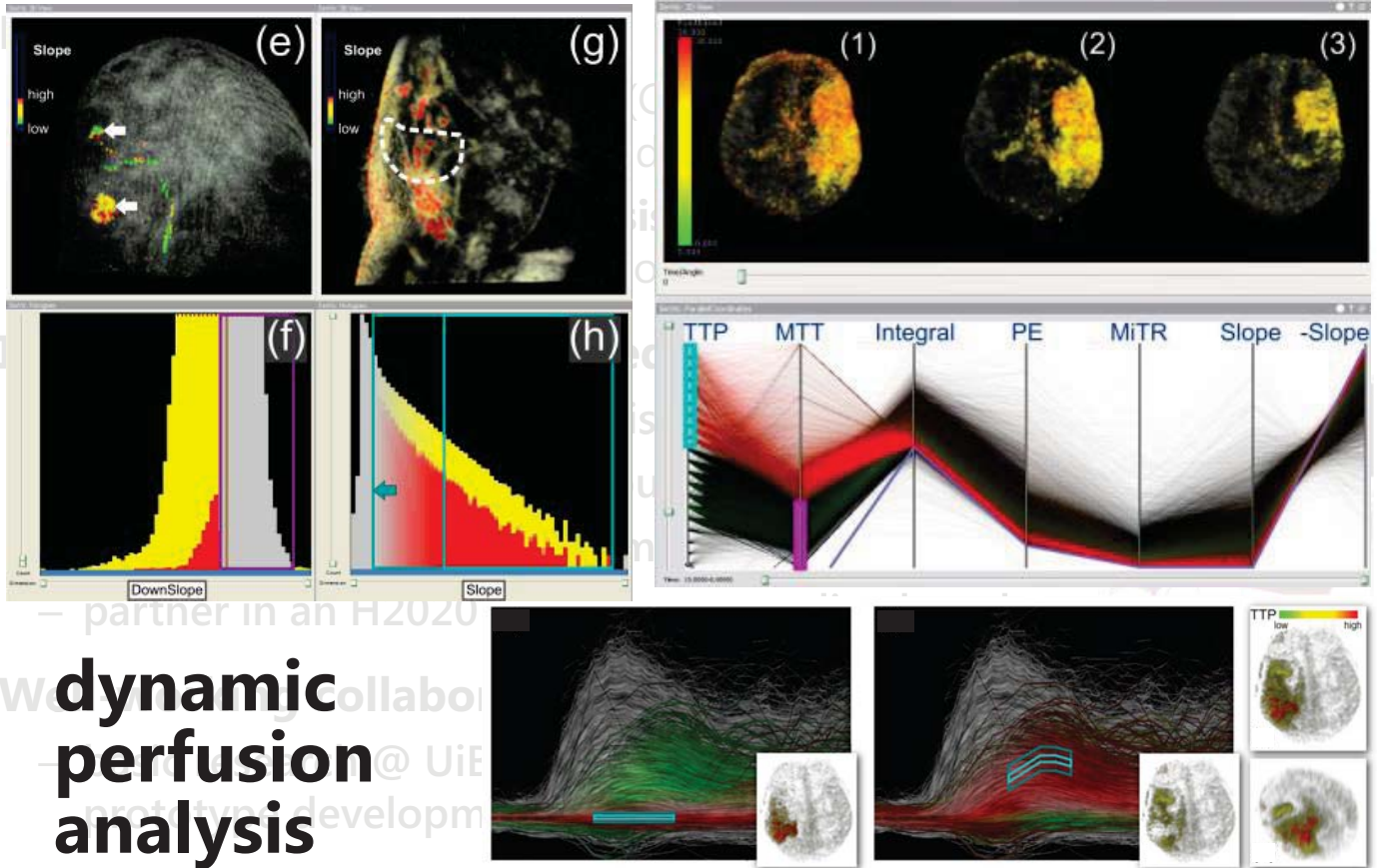
high-quality morphology visualization



mpetence



multi-modal ultrasound visualization



dynamic
perfusion
analysis

High-dim. data, for example

- biological microarray data, medical sequencing data
- epidemiological data (cohort studies)

etc.

Challenge: **exploration & analysis** (user-in-the-loop approach)

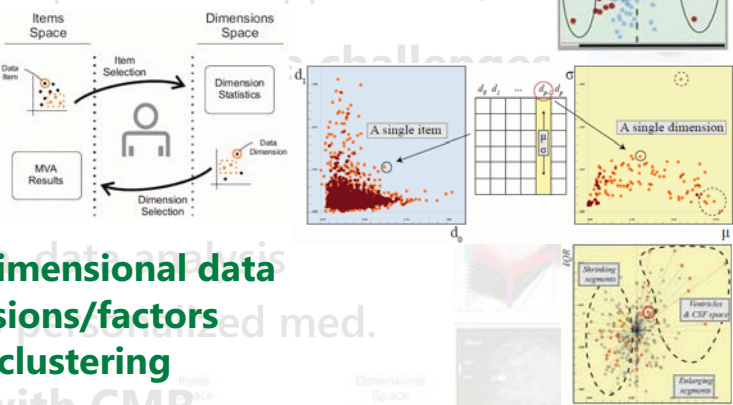
- **most analysis methods are not made for many dims.!**
(std. MVA approaches, i.e., multi-variate analysis, like PCA, etc., do not scale)

New approach:

- **dual analysis framework**

Achievements:

- hypothesis generation for high-dimensional data
- identifying discriminating dimensions/factors
- supervised dimension reduction, clustering



Well-working collaboration with CMR

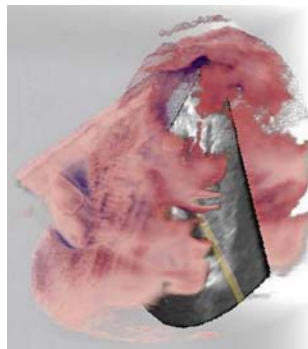
– basic research @ UiB,

high-dimensional data analysis

IllustraSound: NFR-funded project [1]



- aim: new visualization solutions for the interactive illustration of data from ultrasonography
- 2 PhD students (V. Šoltészová, Å. Birkeland), int'l Dirk Bartz prize (Eurographics Medical Prize)
- high-quality visualization of time-dependent 3D US data,
- partners in Bergen (gastroenterology center *et al.*, MedViz), in Munich, Germany, and in Vienna, Austria



[1] www.ii.UiB.no/vis/projects/illustrasound

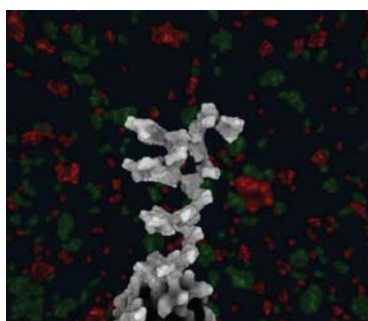
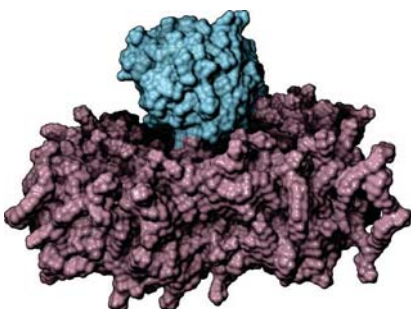
PhysioIllustration: NFR-funded project [1]



- aim: new visualization solutions for the interactive illustration of physiological processes
- total budget incl. 8.8 MNOK funding from NFR, 2012–
- selected efforts towards molecular biology, as well as towards larger scales
- partners in Bergen (molecular biology *et al.*), in Tromsø (modeling), and in Vienna, Austria (illustration, etc.)



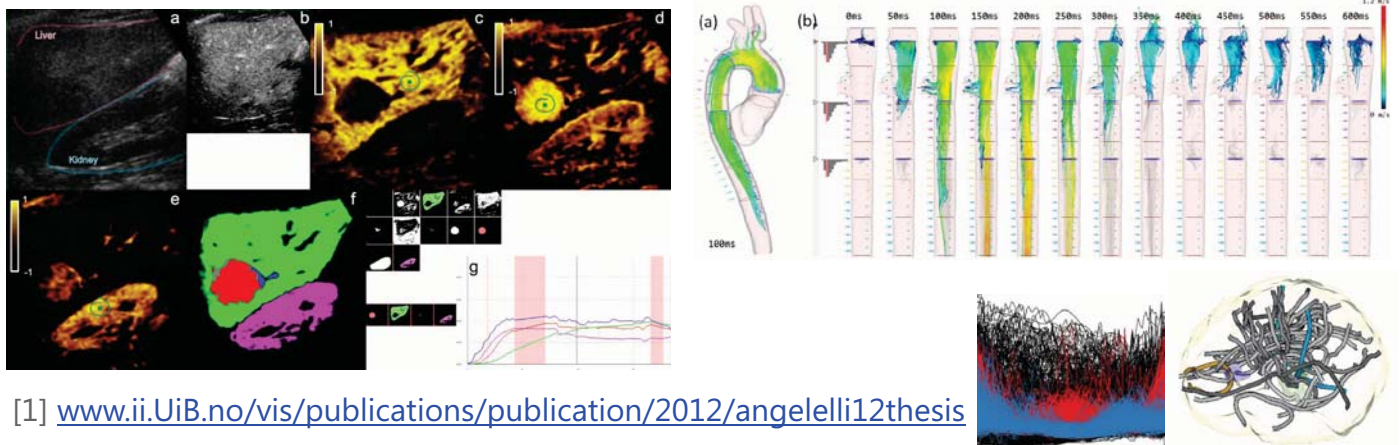
IFF Prize '15



[1] www.ii.UiB.no/vis/projects/physioillustration

PhD thesis "Visual Exploration of Human Physiology: Visualizing Perfusion, Blood Flow and Aging" [1]

- by Paolo Angelelli *et al.* (in 2012)
- pioneering new visualization solutions for the visualization of physiological data from medicine
- in collaboration with the **IllustraSound** project, **MedViz** in Bergen, and partners from **Magdeburg**, Germany



[1] www.i.uib.no/vis/publications/publication/2012/angelelli12thesis

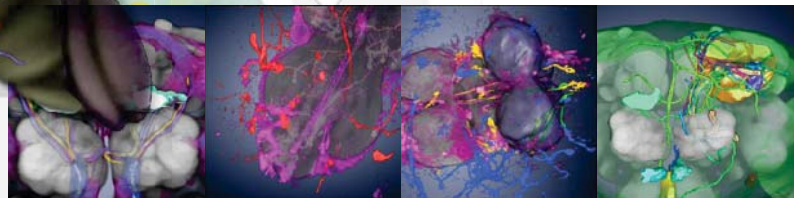
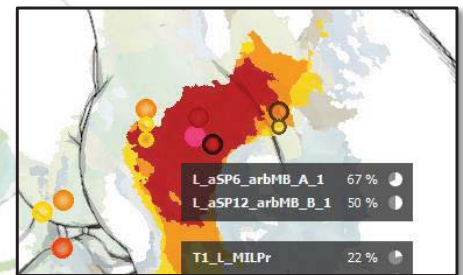
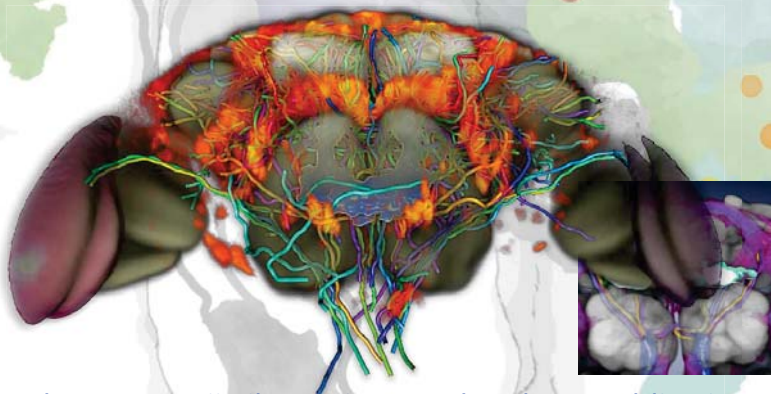
Illustrative visualization: interactive presentation of complex 3D datasets in an easily-understandable way using illustration techniques (e.g., for patient education)

- GPU-based methods for generating cutaway views, exploded views, stylized shading, etc.
- **VolumeShop** software framework: rapid-prototyping toolkit with a rich library of visualization techniques



Collaboration Visual Exploration of Neural Circuit Data

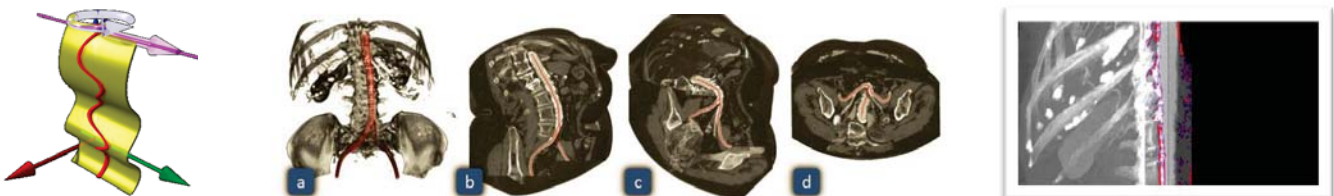
- visual exploration and analysis of confocal microscopy data and annotated anatomical structures [1,2]
- intuitive tools for potential connectivity exploration and quantification
- together with neurobiology and technology partners from Austria



[1] <http://www.i.uib.no/vis/team/bruckner/publication/Bruckner-2009-BVQ>
[2] <http://www.i.uib.no/vis/team/bruckner/publication/Swoboda-2014-VQA>

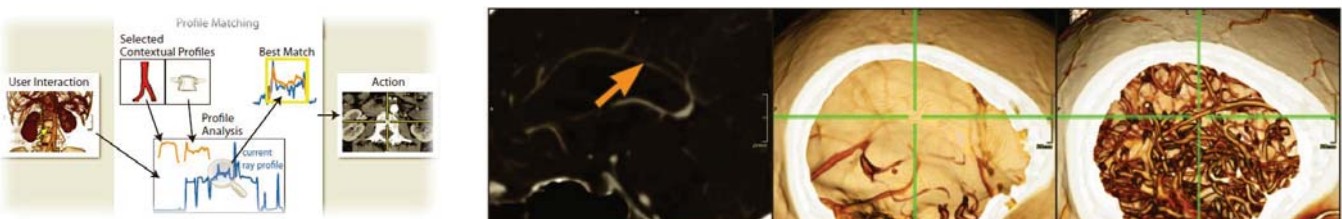
AngioVis: advanced visualization and smart interaction for improved diagnosis of vascular disease

- next-generation radiology workstation, in daily clinical use



LiveSync: synchronized interaction with 2D and 3D images in medical workstations

- integrated into AFGA HealthCare software, several patents

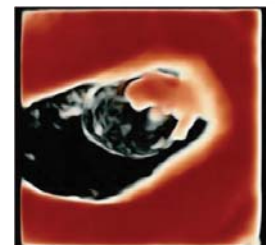


HDLive: real-time realistic volume visualization from live 4D ultrasound data

- high-quality rendering with at a fraction of the cost of previous methods
- research and technology transfer project with **GE Healthcare & TU Wien**
- successfully deployed and available on **GE Voluson US scanners** [1]



HDLive
Voluson GE Healthcare technology

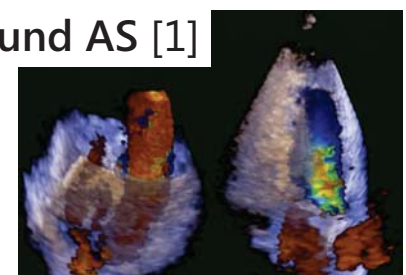


[1] www3.gehealthcare.com/.../HDLive

Picture of the month in the journal *Ultrasound in Obstetrics & Gynecology*, vol. 38, no. 5

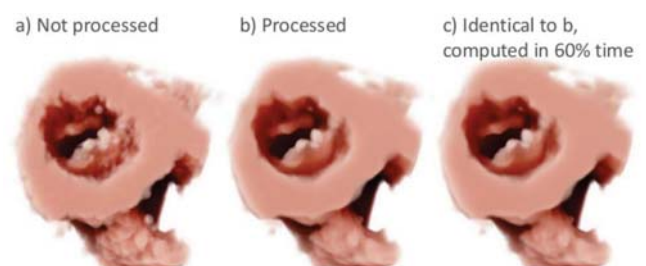
BIA project on high-quality cardiac visualization:

- together with **GE Healthcare VingMed Ultrasound AS** [1]
- focus on **cardiac ultrasound images**
- one PostDoc (Paolo Angelelli) in Bergen



VERDIKT Results project on commercializing earlier research results:

- together with **CMR** [2], **Haukeland** [3], **BTO** [4], **GE** [1]
- focus on **visibility-driven 3D ultrasound visualization**
- patent applied



[1] www.GE.com/no/contact/index.html

[2] www.CMR.no

[3] www.Helse-Bergen.no

[4] BergenTO.no



Events (co-)organized by the UiB VisGroup:

- EuroVis 2011 (in Bergen) [1] – Europe’s central conference on visualization!
- annual MedViz conference (in Bergen) [2]
- **VisBio 2013** (in Bergen) [3] and VisBio 2014 (in Vienna)
- **VCBM 2016** (in Bergen, also in coop. with MedViz) [4]: Visual Computing for Biology and Medicine

[1] www.UiB.no/eurovis2011

[2] MedViz.UiB.no

[3] www.ii.UiB.no/vis/events/VisBio13

[4] www.VCBM.org

UiB Visualization and MedViz

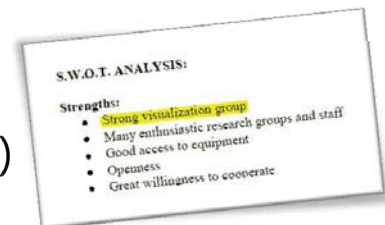
VisGroup: part of MedViz since its foundation
(HH member of MedViz leader team since 2007)



IllustraSound: 1 of 3 lighthouse projects
(in coop. with HUS and CMR)



Visualization: #1-strength of MedViz
(Nordic evaluation report of MedViz in 2013)



Coordinated Seminars

(about one every two weeks):

- MedViz Seminar
- Visual Computing Forum

2015-01-16	MedViz	Jarle Rørvik, Eli Eikefjord, Erlend Hodneland, Are Losnegård		
2015-02-06	VCF	Erlend Hodneland (MedViz)		
2015-02-20	MedViz	Bjørn Tore Gjertsen, Emmet Mc Cormack, Spiros Kotopoulos (HUS)		
2015-02-06	VCF	Barbora Kozlikova (Brno)		
2015-03-20	MedViz	Stefan Bruckner, Sergej Stoppel, Veronika Šoltészová (VisGroup)		
2015-02-06	VCF	Július Parulek (Metas & UiB)		
2015-04-24	MedViz	Judit Haász & Arvid Lundervold (BioMed)		
2015-05-20	VCF	Lars Linsen (Bremen)		
2015-05-29	MedViz	Jeremie Fromageau (London), Roald Flesland Havre (HUS)		
2015-08-28	VCF	Ivan Viola (Wien & UiB)		

[1] www.ii.UiB.no/vis/vcf

Acknowledgements & Contact



Helwig Hauser: Helwig.Hauser@UiB.no, 55584380
Høyteknologisenteret i Bergen (data blokk, etasje 3)
www.ii.UiB.no/vis

Thank you!

The screenshot shows the website for the Visualization Group at the Institute of Informatics, University of Bergen. The page features a navigation menu on the left with categories like 'about', 'team & contact info', 'research', 'publications', 'projects', 'teaching', 'seminars', 'resources', 'network', 'events', and 'links'. The main content area is titled 'News:' and contains three news items, each with a date, a title, a short description, an abstract, and a contact email. The first news item is dated 2016-11-13 and is titled 'VCF on November the 13th'. The second is dated 2016-10-18 and is titled 'VCF on October the 16th'. The third is dated 2016-09-18 and is titled 'VCF on September the 18th'. There are also two sidebar sections: 'Outlook:' with 'Job Opportunities' and 'VCF Seminars'.

INSTITUTT FOR INFORMATIKK
> Visualisering

You are here: Department of Informatics > Visualization Group

Visualization

- > about
- > team & contact info
- > research
- > publications
- > projects
- > teaching
- > seminars
- > resources
- > network
- > events
- > links

News:

2016-11-13
VCF on November the 13th
On October 13th Morten Brun will give a talk at VCF, with the title "Topological methods for data analysis".

Abstract
I will explain how we have used persistent homology to examine meteorological data. In particular we have studied patterns of weather fronts that have reached Bergen. This is an ongoing joint project between the department of geophysics and the department of mathematics here in Bergen. If time permits, at the end of the talk I will sketch how we envision to use topological data analysis in the study of the stress imposed on cod liver by pollution.

Questions to Sergej.Stoppel@iuh.no or Helwig.Hauser@iuh.no

2016-10-18
VCF on October the 16th
On October 16th Junyong You will give a talk at VCF, with the title "Perceived visual quality assessment".

Abstract
Visual signals are often distorted due to unavoidable factors, e.g., lossy compression, transmission over error prone networks. Accurate assessment of visual quality plays an important role in multimedia services in order to provide the best viewing experience to end-users. Traditionally used quality metrics, e.g., PSNR (peak signal-to-noise ratio) often cannot accurately represent the actual distortions perceived by human users. For example, the distorted images below all have same PSNR values with respect to the original reference image, while they present different levels of perceived distortions. This talk presents methodologies of perceived visual quality assessment, including visual mechanism modeling and applications in objective visual quality metrics. A video quality metric driven visual attention and foveation mechanism that was developed by the presenter will be introduced as an example. Applications in other areas will also be briefly mentioned.

Questions to Sergej.Stoppel@iuh.no or Helwig.Hauser@iuh.no

2016-09-18
VCF on September the 18th
On September 18th Jan Bjåke will give a talk at VCF, with the title "Visualizations for conveying biochemical properties across and along protein voids".

Abstract
Proteins are highly complex systems contributing to all functions in living organisms. Understanding their function helps to reveal the fundamentals of biochemical processes that are taking place in living cells. This search process, however, consumes an enormous amount of time and resources, due to the internal protein dynamics, which constantly change structural and

Outlook:

2014-04-10
Job Opportunities
We have several upcoming job opportunities. For more information, please see the [JOB-SECTION](#) or contact us directly.
Questions to: Helwig.Hauser@iuh.no or Stefan.Bruckner@iuh.no

2012-06-29
VCF Seminars
Our series of seminar, the Visual Computing Forum, is currently ongoing. All the details can be found in the dedicated [seminars section](#).
Questions to vcf.bergen@gmail.com