NOVA Core meeting 27/11/17

Sebastian Schmelzle

TECHNISCHE UNIVERSITÄT DARMSTADT

nova

Overview

- **10 Teilnehmer**
- **Berichte:**
  - (WP 1) Schmelzle – *Work package 1 | TUD*
  - (WP 2) Hammel – *Status quo HZG*
  - (WP 3) Vogelgesang – *Status of the NOVA portal*
  - (WP 3) Jerome – *AP3: Visualisation*
  - (WP 3) van de Kamp – *Hochdurchsatz-µCT von Insekten und Herausforderungen an die Datenanalyse*
  - (WP 3) Faragó – *Image-based Control and Automation of High-speed X-ray Imaging Experiments*
  - (WP 4) Lösel – *AP 4 - Image Segmentation*
  - Heethoff – *DISC3D*

Work package 1 | TUD

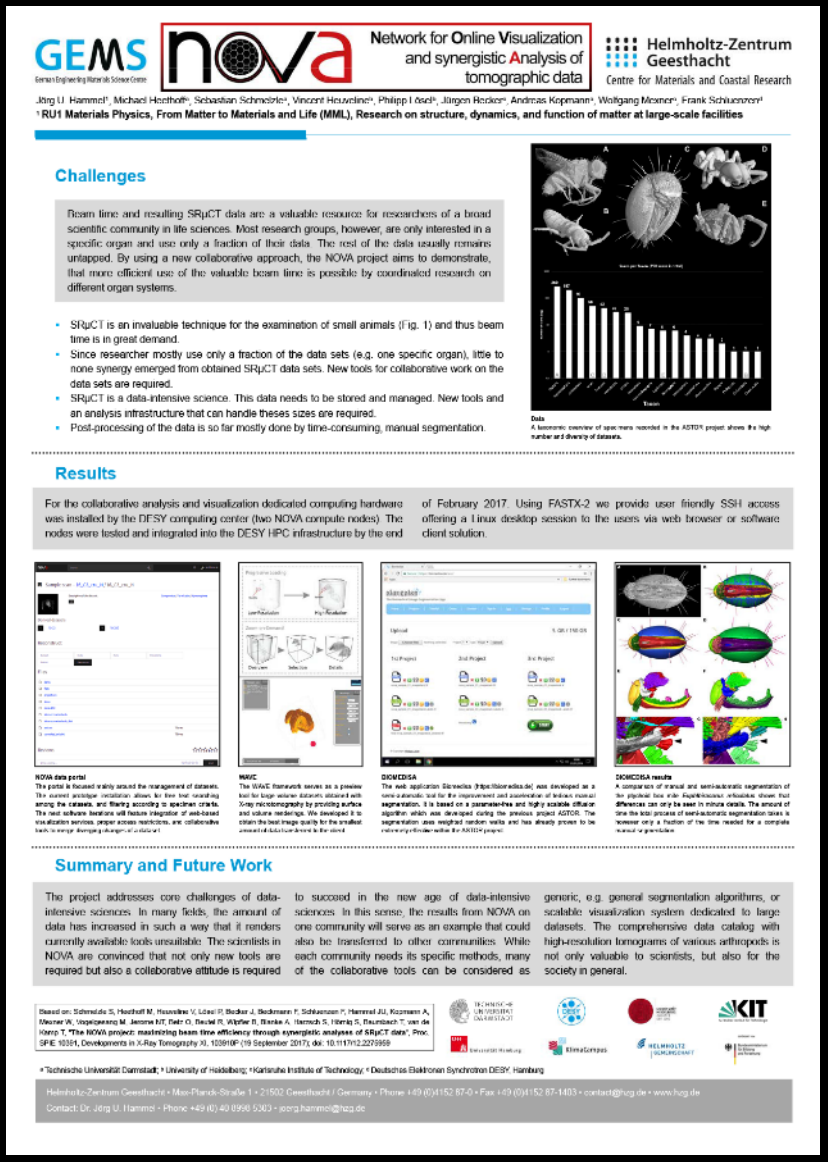
The paper

The NOVA project - maximizing beam time efficiency through synergistic analyses of SRμCT data

Sebastian Schmelzle*[a], Michael Heethoff[a], Vincent Heuveline[b], Philipp Lösel[b], Jürgen Becker[c], Felix Beckmann[d], Frank Schluenzen[e], Jörg U. Hammel[df], Andreas Kopmann[g], Wolfgang Mexner[h], Matthias Vogelgesang[g], Nicholas Tan Jerome[g], Oliver Betz[i], Rolf Beutel[f], Benjamin Wipfler[f], Alexander Blanke[j], Steffen Harzsch[k], Marie Hörnig[k], Tilo Baumbach[l,m], Thomas van de Kamp**[l]

Developments in X-Ray Tomography XI, edited by Bert Müller, Ge Wang, Proc. of SPIE
Vol. 10391, 103910P · © 2017 SPIE · CCC code: 0277-786X/17/$18 ·
doi:10.1117/12.2275959

The poster



GEMS German Engineering Materials Science Centre

nova Network for Online Visualization and synergistic Analysis of tomographic data

Helmholtz-Zentrum Geesthacht Centre for Materials and Coastal Research

Jörg U. Hammel[1], Michael Hoethoff[2], Sebastian Schmelzle[2], Vincent Heuveline[2], Philipp Lösel[3], Jürgen Becker[4], Andreas Kopmann[5], Wolfgang Mexner[4], Frank Schluenzen[5]
[1] RU1 Materials Physics, From Matter to Materials and Life (MML), Research on structure, dynamics, and function of matter at large-scale facilities

Challenges

Beam time and resulting SRμCT data are a valuable resource for researchers of a broad scientific community in life sciences. Most research groups, however, are only interested in a specific organ and use only a fraction of their data. The rest of the data usually remains untapped. By using a new collaborative approach, the NOVA project aims to demonstrate, that more efficient use of the valuable beam time is possible by coordinated research on different organ systems.

- SRμCT is an invaluable technique for the examination of small animals (Fig. 1) and thus beam time is in great demand.
- Since researcher mostly use only a fraction of the data sets (e.g. one specific organ), little to none synergy emerged from obtained SRμCT data sets. New tools for collaborative work on the data sets are required.
- SRμCT is a data-intensive science. This data needs to be stored and managed. New tools and an analysis infrastructure that can handle theses sizes are required.
- Post-processing of the data is so far mostly done by time-consuming, manual segmentation.

Data
A taxonomic overview of specimens recorded in the ASTOR project shows the high number and diversity of datasets.

Results

For the collaborative analysis and visualization dedicated computing hardware was installed by the DESY computing center (two NOVA compute nodes). The nodes were tested and integrated into the DESY HPC infrastructure by the end of February 2017. Using FASTX-2 we provide user friendly SSH access offering a Linux desktop session to the users via web browser or software client solution.

NOVA data portal

WAVE

DIOMEDISA

DIOMEDISA results

Summary and Future Work

The project addresses core challenges of data-intensive sciences. In many fields, the amount of data has increased in such a way that it renders currently available tools unsuitable. The scientists in NOVA are convinced that not only new tools are required but also a collaborative attitude is required to succeed in the new age of data-intensive sciences. In this sense, the results from NOVA on one community will serve as an example that could also be transferred to other communities. While each community needs its specific methods, many of the collaborative tools can be considered as generic, e.g. general segmentation algorithms, or scalable visualization system dedicated to large datasets. The comprehensive data catalog with high-resolution tomograms of various arthropods is not only valuable to scientists, but also for the society in general.

Based on: Schmelzle S, Hoethoff M, Heuveline V, Lösel P, Becker J, Beckmann F, Schluenzen F, Hammel JU, Kopmann A, Mexner W, Vogelgesang M, Jerome NT, Betz O, Beutel R, Wäfler B, Blanke A, Harrisch S, Hörnig S, Baumbach T, van de Kamp T, "The NOVA project: maximizing beam time efficiency through synergistic analysis of SRμCT data", Proc. SPIE 10391, Developments in X-Ray Tomography XI, 103910F (19 September 2017); doi: 10.1117/12.2279959

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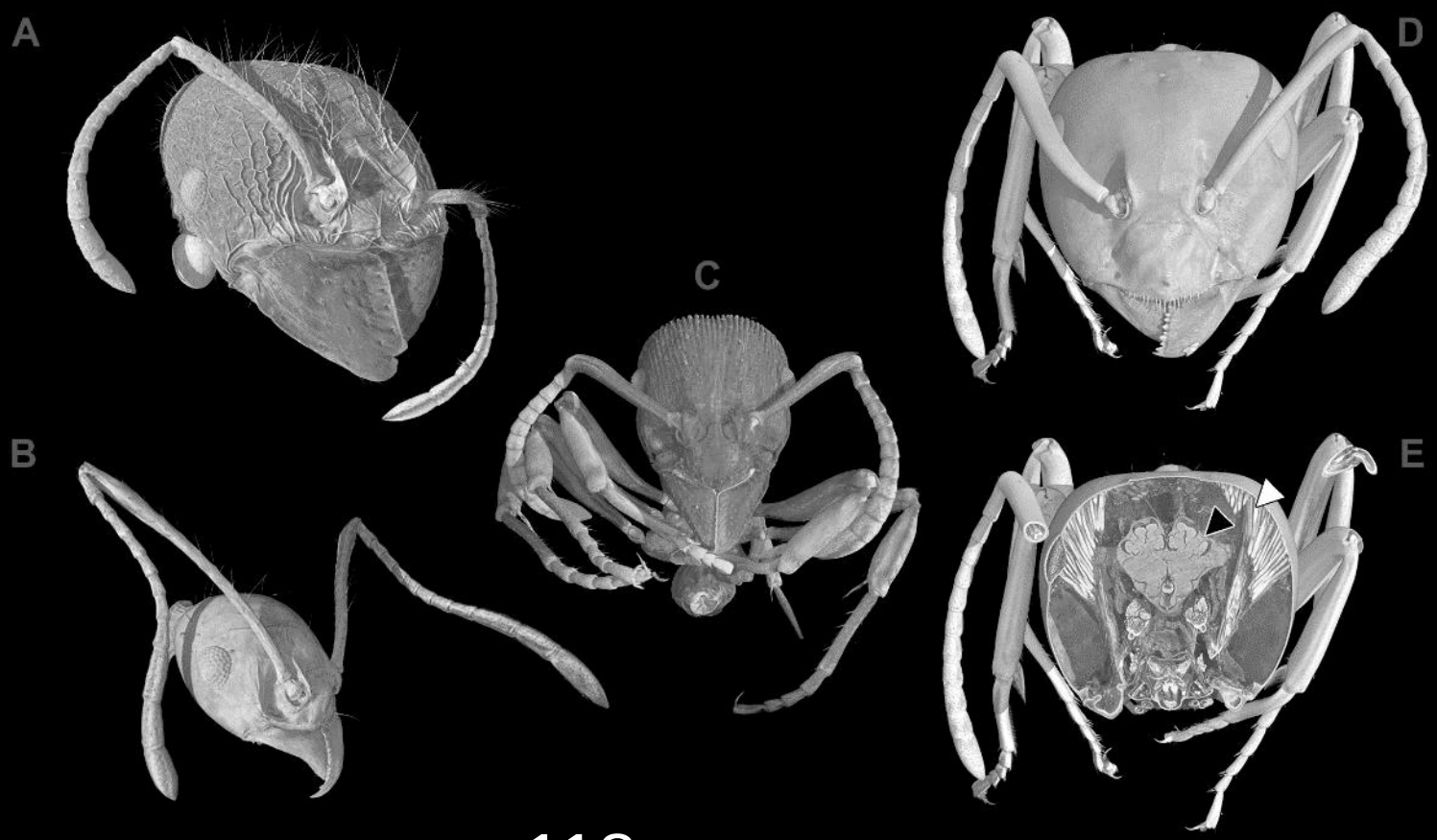
Beam time I-20160035: Ants (09/2016)



- 118 scans
- 59 specimens
- 35 species

Beam time I-20160657: Broad spectrum of insects (06/2017)

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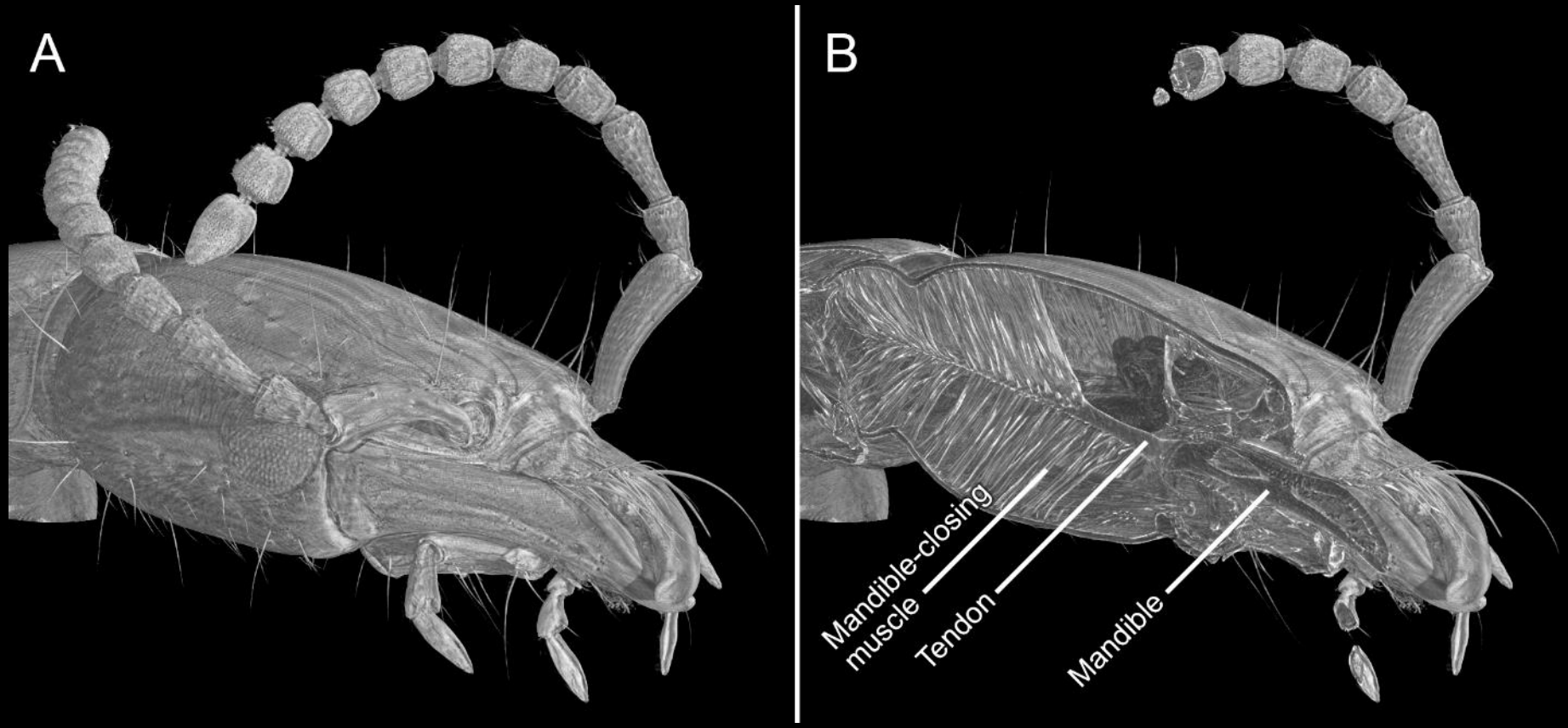
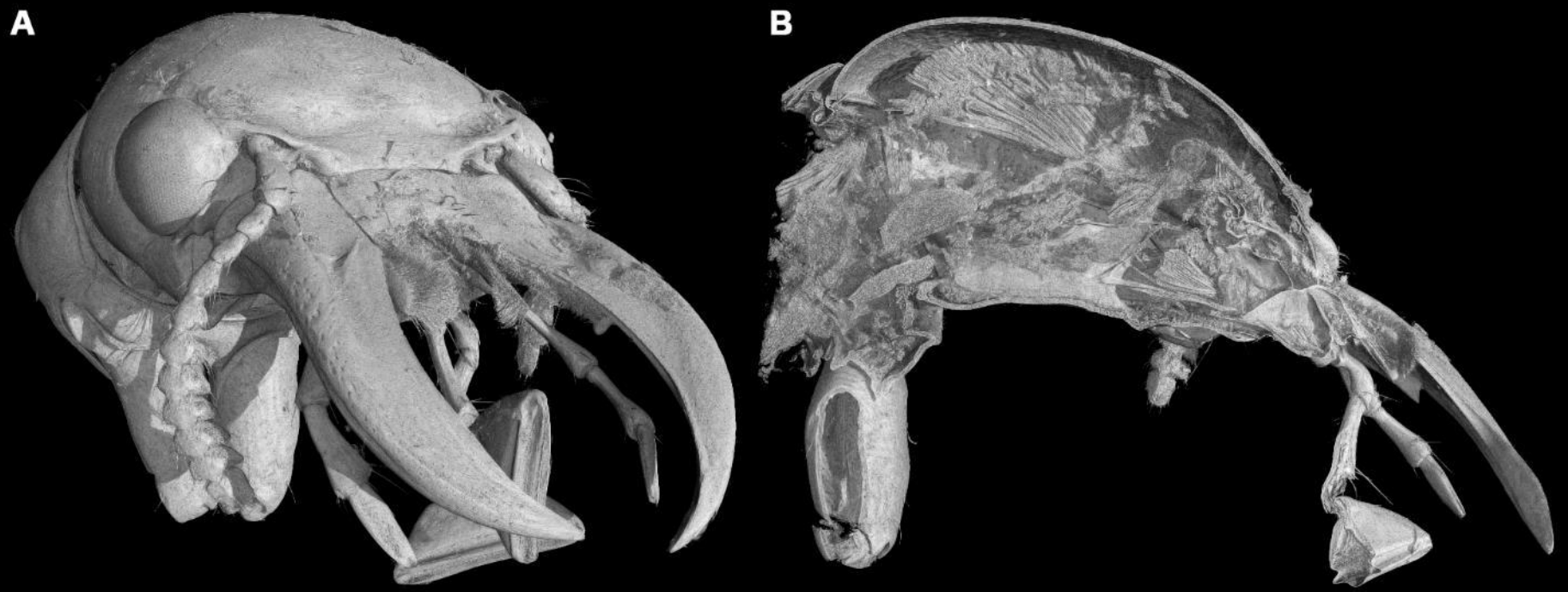


- 60 scans
- 25 specimens
- 21 species

Beam time @ANKA (07/2017)

- 66 scans
- 48 specimens
- 22 species

Beam time I-20170141: Staphylinidae (09/2017)



- 122 scans
- 62 specimens
- 39 species

Beam time I-20170710: Broad spectrum of insects

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Proposal I-20170710
29.3. - 03.04.2018

Last edited/submitted
01-SEP-2017 17:09 (Status: Editing)

Title
Morphology of the insect head ? maximizing beamtime efficiency through synergistic analyses of different morphology-related aspects (Arthropoda) [Part 2]

Leader	
Name	Dr. Sebastian Schmelzle
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City/Country	Darmstadt/Germany

Principal Investigator	
Name	Dr. Sebastian Schmelzle
Institute	Technische Universitaet Darmstadt
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Co-Proposers
Dr. Joerg Hammel (Helmholtz-Zentrum Geesthacht HZG/Germany)
PD Dr. Michael Heethoff (Technische Universitaet Darmstadt /Germany)

Experiment Specifications	
Proposal Type	Regular
Research Area	Imaging (full-field, scanning, coherent)
Primary Research Field	Earth and environment
Secondary Research Field	
Research Category	Fundamental science
User Group/Collaboration	General user

Description
Beamtime and resulting SRμCT data are a valuable resource for researchers of a broad scientific community. Most research groups, however, only use a small part of the dataset. A good example is the insect head comprising data related to different fields of research. This study is part of the BMBF funded NOVA project involving five academic research groups. We will again use a cooperative, synergistic approach to analyze various questions with the data sets acquired at DESY.

Beam time I-20170710: Broad spectrum of insects

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No.	Order	Species	Sex	Sample	Fixation	Staining
TvdK_01	Phasmatodea	Sipyloidea sipylus	f	head & thorax parts	EtOH	1% I2 in 100% EtOH overnight
TvdK_02	Phasmatodea	Sipyloidea sipylus	f	head & thorax parts	EtOH	1% I2 in 100% EtOH overnight
TvdK_03	Phasmatodea	Sipyloidea sipylus	f	head & thorax parts	EtOH	none
TvdK_04	Phasmatodea	Sipyloidea sipylus	f	head & thorax parts	EtOH	none
TvdK_05	Phasmatodea	Sipyloidea sipylus	f	head & thorax parts	EtOH	none
TvdK_06	Phasmatodea	Peruphasma schultei	f (subadult)	head & thorax parts	EtOH	none
TvdK_07	Phasmatodea	Peruphasma schultei	m (subadult)	head & thorax parts	EtOH	1% I2 in 100% EtOH overnight
TvdK_08	Phasmatodea	Peruphasma schultei	m (subadult)	head & thorax parts	EtOH	none
TvdK_09	Phasmatodea	Extatosoma tiaratum	f	head	EtOH	none
TvdK_10	Orthoptera	Metrioptera roeselii	f	head & thorax parts	EtOH	1% I2 in 100% EtOH overnight
TvdK_11	Orthoptera	Metrioptera roeselii	f	head & thorax parts	EtOH	none
TvdK_12	Orthoptera	Metrioptera roeselii	m	head & thorax parts	EtOH	1% I2 in 100% EtOH overnight
TvdK_13	Orthoptera	Metrioptera roeselii	m	head & thorax parts	EtOH	none
TvdK_14	Orthoptera	Metrioptera roeselii	f	abdomen & thorax parts	EtOH	1% I2 in 100% EtOH overnight
TvdK_15	Orthoptera	Metrioptera roeselii	f	abdomen& thorax parts	EtOH	none
TvdK_16	Orthoptera	Metrioptera roeselii	m	abdomen & thorax parts	EtOH	1% I2 in 100% EtOH overnight
TvdK_17	Orthoptera	Metrioptera roeselii	m	abdomen & thorax parts	EtOH	none
TvdK_18	Isoptera	Hospitalitermes sp.	queen (?)	complete specimen	EtOH	none
TvdK_19	Isoptera	Hospitalitermes sp.	worker	complete specimen	EtOH	none
TvdK_20	Isoptera	Hospitalitermes sp.	soldier	complete specimen	EtOH	none
TvdK_21	Rhaphidioptera	Rhaphidia sp. (?)	?	complete specimen	EtOH	none
TvdK_22	Neuroptera	Chrysoperla sp. (?)	?	complete specimen	EtOH	none
TvdK_23	Coleoptera	Sitophilus granarius	?	complete specimen	EtOH	1% I2 in 100% EtOH overnight
TvdK_24	Coleoptera	Sitophilus granarius	?	complete specimen	EtOH	1% I2 in 100% EtOH overnight
TvdK_25	Coleoptera	Sitophilus granarius	?	complete specimen	EtOH	1% I2 in 100% EtOH overnight
TvdK_26	Coleoptera	Sitophilus granarius	?	complete specimen	EtOH	none
TvdK_27	Coleoptera	Sitophilus granarius	?	complete specimen	EtOH	none
TvdK_28	Coleoptera	Sitophilus granarius	?	complete specimen	EtOH	none
TvdK_29	Phasmatodea	Peruphasma schultei	m	defensive gland	EtOH	none
TvdK_30	Blattodea	Elliptorhina chopardi	m	complete specimen	EtOH	none

Block allocation group proposal

Proposal BAG-20180003

Last edited/submitted
23-JAN-2018 16:15

Title
The NOVA project - maximizing beamtime efficiency through synergistic analyses of different aspects of insect head morphology

Leader	
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BAG Coordinator/Principal Investigator	
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Institute	Technische Universitaet Darmstadt
City/Country	Darmstadt/Germany

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Dr. Alexander Blanke (Universitaet zu Koeln/Germany)
Dr. Benjamin Wipfler (Friedrich-Schiller-Universitaet/Germany)
Dr. Thomas van de Kamp (Karlsruher Institut fuer Technologie (KIT)/Germany)
PD Dr. Michael Heethoff (Technische Universitaet Darmstadt /Germany)
Dr. Sebastian Schmelzle (Technische Universitaet Darmstadt /Germany)
M. Sc. Felix Baumgarten Rosumek (Technische Universitaet Darmstadt /Germany)
Prof. Dr. Oliver Betz (Universitaet Tuebingen/Germany)
Ms. Marie Hoernig (Ernst-Moritz-Arndt-Universitaet Greifswald/Germany)
Prof. Dr. Steffen Harzsch (Ernst-Moritz-Arndt-Universitaet Greifswald/Germany)

Experiment Specifications	
Proposal Type	BAG Proposal
Total number of shifts required	72
Research Area	Imaging (full-field, scanning, coherent)
Primary Research Field	Earth and environment
Secondary Research Field	Enabling technologies
Research Category	Fundamental science
User Group/Collaboration	General user

Description
SRμCT is a valuable resource for researchers of a broad scientific community. Most research groups are only interested in a specific organ and use only a fraction of their data. The NOVA project aims to maximize beamtime efficiency through synergistic analyses of different aspects of insect head morphology. The associated biological partners cover different scientific aspects (morphology, phylogeny, neurobiology) and investigate different aspects of insect head morphology on the same data sets.

Equipment for associated partners

Greifswald	Jena	Köln	Tübingen
Wacom Cintiq 13HD	Fractal Design Define R5	Workstation X5 Threadripper 1950X	Qnap Turbo Station TS-1635-8G
HP Pavilion 15-bc202ng Notebook	Be quiet! Pure Power 10 CM 700W		3x WD RED 8TB
3x WD Elements Desktop 3TB	MSI X99 SLI Plus		
3x WD My Passport Ultra 2TB	Intel i7-5820K		
	be quiet! Dark Rock 3		
	MSI GeForce GTX 1060		
	Corsair 64GB DDR4-2133 Quad-Kit		
	Corsair 64GB DDR4-2133 Quad-Kit		
	Samsung 850 Pro 256GB		
	LG GH24NS DVD-Brenner		
	Fractal design dynamic x2 gp14		
	2te ssd		
	Windows 10		
		Summe	**10001.12**

NOVA acknowledgements

Data and/or analytical tools used in this study were provided by the projects ASTOR and NOVA (Michael Heethoff, TU Darmstadt; Vincent Heuveline, Heidelberg University; Jürgen Becker, Karlsruhe Institute of Technology), funded by the German Federal Ministry of Education and Research (BMBF; 05K2013, 05K2016). We especially thank the following co-workers: Felix Beckmann, Jörg Hammel, Andreas Kopmann, Philipp Lösel, Wolfgang Mexner, Tomy dos Santos Rolo, Nicholas Tan Jerome, Matthias Vogelgesang, Tomáš Faragó, Sebastian Schmelzle, Thomas van de Kamp.

Work package 2 | HZG

Work package 3 | KIT

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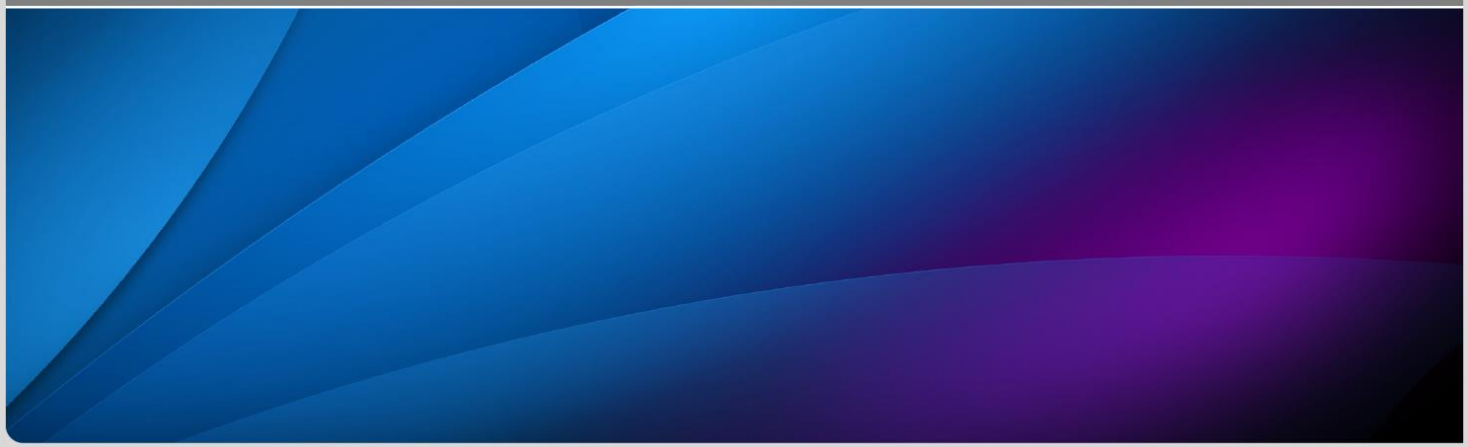
Karlsruhe Institute of Technology

Status of the NOVA portal

Matthias Vogelgesang

matthias.vogelgesang@kit.edu

NOVA Projekttreffen 2017



KIT – University of the State of Baden-Wuerttemberg and
National Research Center of the Helmholtz Association

www.kit.edu

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Status

Karlsruhe Institute of Technology

Requirements

- [x] Creating a data portal to find existing data sets and corresponding analyes
- [ ] Use interactive 3D previews from a visualization server built in WP 3
- [ ] Archiving of finished data sets
- [x] Management of analysis systems
- [x] Useful mapping of the full value chain
- [ ] Definition of arbitrary metadata for different applications

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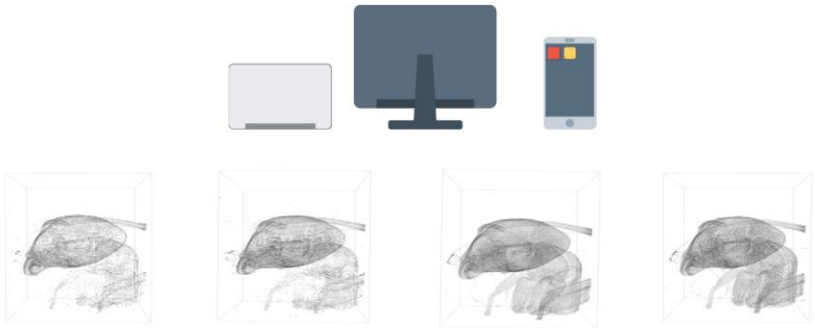
Karlsruher Institut für Technologie

AP3: Visualisation

Nicholas Tan Jerome, Andreas Kopmann

Institute for Data Processing and Electronics (IPE), Karlsruhe Institute of Technology, Germany



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5. Where do we currently stand?

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- Data management system that manages the preprocessing of the visualization input data structure.
- Automatic adaptation on visualization parameter, i.e. opacity, grey value threshold, transfer function, ROI, orientation, …).
- Multimodality visualization. (Study a NOVA data set)
- Using segmented dataset as mask to show partial visualization. (Start from Phillip algo).
- Feature extraction from segmented dataset. (Start from Phillip algo. Use histogram analysis).

- VR activities
- Data Publication Page

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Karlsruhe Institute of Technology

Image-based Control and Automation of High-speed X-ray Imaging Experiments

Tomáš Faragó

Institute for Photon Science and Synchrotron Radiation (IPS)

KIT – The Research University in the Helmholtz Association

www.kit.edu

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Conclusion

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- New possibilities
  - Prior optimization of experimental and data processing parameters
  - Online 3D reconstruction with automatic parameter determination
  - Image-based experiment control and automation
- Further *syris* applications
  - Investigation of novel imaging methods
  - Benchmarking of image processing algorithms
- Future Outlook
  - Optimization for full-volume online reconstruction
  - Integration of 3D reconstruction parameter finding into UFO
  - Online Visualization and Analysis

Work package 4 | UHD

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AP 4 - Image Segmentation

Philipp Lösel

Engineering Mathematics and Computing Lab
Interdisciplinary Center for Scientific Computing
Heidelberg University

Hamburg, 27.11.2017

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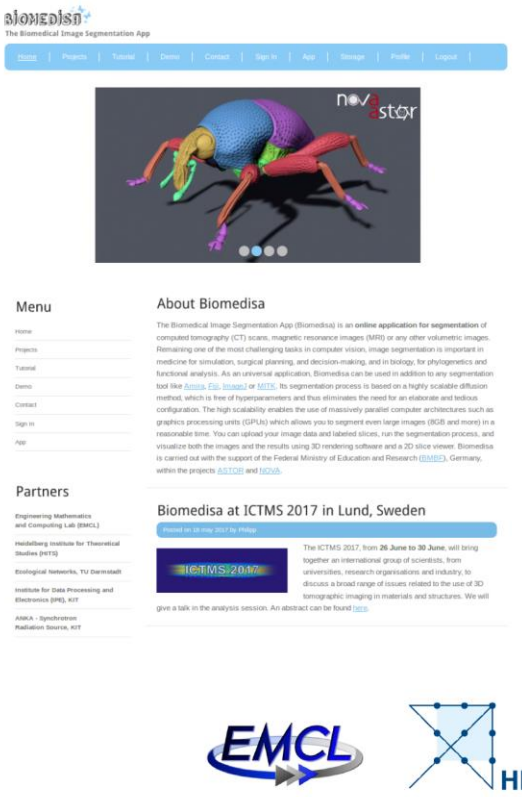
Overview

UNIVERSITÄT HEIDELBERG
Zukunft. Seit 1386.
IWR Interdisciplinary Center for Scientific Computing

- **New features**
  - Labeling in any axis
  - Removing outliers
  - Supporting Amira label files
  - 3D printer
  - Uncertainty localization
- **Fourier Transform for image registration**
  - Removing sample holder
  - Merging Objects
- **Deep learning for image segmentation**



EMCL HITS