



# PaN-data ODI

## Report on the Science3D workshop

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**Abstract**

This document provides a short summary of the Science3D workshop at DESY in June 2014, and an outlook for future activities.

**Keyword list**

PaN-data ODI, Virtual laboratories, Dissemination

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## 1 Introduction

The PaN-data consortium has been founded by European X-ray and Neutron institutes to collaboratively install a common e-infrastructure harmonizing various data management tasks. The relevant services and joint research activities are organized within the PaN-data ODI project comprising a common authentication system, a standardized metadata catalogue, a standardized data format, a concept to describe the data provenance, an analysis software database, a data preservation concept and investigations on parallel file systems. Addressing these issues in a collaborative approach saves resources at the participating research infrastructure because it avoids parallel developments. Scientists profit from this project in several ways: analysis programs can access data from various institutes uniformly because the data are organized in a standard format, file discovery can be done across facility borders because the metadata catalogue is standardized, authentication to digital user offices and metadata catalogues is simplified by the Umbrella system and data provenance helps them to keep track of the data processing steps.

Part of the work is the setup of three virtual laboratories to demonstrate the availability of the services and to allow for an evaluation. One of these (VL3) relates to open access tomography datasets as is realized as a Science3D-project:

- VL3: Access to tomography data exemplified through paleontological samples
  - Setup a public access database for storing tomographic raw and processed data of paleontological data e.g. 2D tomographs and 3D processed images.
  - Provide authorized access from multiple institutes to store processed data in the database.
  - Enable public access to data in database.
  - Implement long term archiving of database.

## 2 Science 3D – The Tomography Database

Imaging experiments at light- or neutron-sources can reveal intricate details of the 3-dimensional composition of materials and biological specimen. In particular micro-tomography allows illuminating all kind of specimen in a non-destructive manner. The application of tomography, in particular synchrotron radiation X-ray micro-tomography, permits for example to determine the stunning anatomy and morphology of ancient insects captured in amber or dinosaurs embryos in fossil dinosaur eggs. Comparative studies can shed light on evolutionary pathways and help to shape phylogenetic trees or assign proper evolutionary taxonomies.



**Figure 1:** H.Pohl et al., *Naturwissenschaften*. 2010 Sep;97(9):855-9. doi: 10.1007/s00114-010-0703-x: *Reconstructing the anatomy of the 42-million-year-old fossil Mengea tertiaria (Insecta, Strepsiptera)*.

The 3-D models are carefully segmented and annotated by the scientists, often a manual and rather tedious procedure. As such, 3D-models are fantastic materials for education and the general public. Common practice is however to publish the results in conventional print-journals showing selected 2D-projections of the full 3D-model, and occasionally add or rather hide the 3D-model in proprietary formats in supplements to the publication. Discovery of the materials and models becomes tremendously complicated for interested 3<sup>rd</sup> parties like students, educators or teachers. Likewise, quantitative comparative studies are severely hampered by the use of non-standard data formats and the lack of solid quality indicators. In brief: a substantial part of the scientists work creating a 3-dimensional model shamefully remains unpublished, undiscovered or unused.

The science3D project aims to overcome some of the hurdles in publishing, presenting and promoting data and models from tomographic reconstructions. The project focusses primarily on biological specimen investigated by SrX $\mu$ -tomography at the initial stage, but is open to all imaging techniques and 3D-models regardless if it originates for example from x-ray tomography or electron microscopy and studies materials, biological specimen or any other 3-D object. The common denominator is however the open accessibility of all data relating to a scientific investigation and the proper annotation of the materials supporting data sharing and re-use.

To achieve this, the consent and support by the researchers performing the experiments is indispensable. The Helmholtz-Center Geesthacht (HZG) is operating the imaging beamlines at PETRA III and is supporting their users in all aspects of the data analysis, and is hence a perfect partner to promote the Science-3D project in the SrX $\mu$ -tomography. Consequently the entire Science-3D project has been designed as a joint project of the HZG and PaNdata ODI. Deliverable D5.3 provides a more detailed view on the concepts and the current status.

The Science-3D data catalog serves as a Virtual Laboratory demonstrator for tomography (VL3), but extends beyond the original scope of the virtual lab, and is operated as a sustainable platform

for publishing, sharing and promoting research from imaging applications. Science3D receives strong support from various parties and is guaranteed to continue after the end of the project.

## 2.1 The Science 3D kick-off workshop

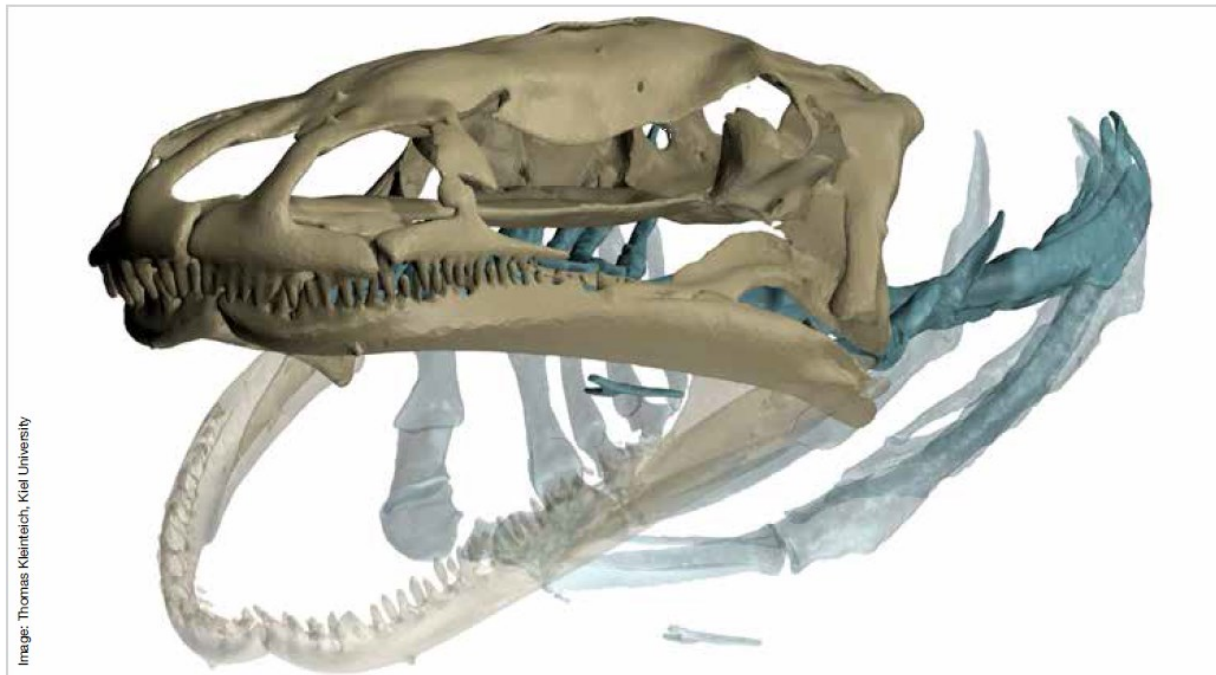
We have been in contact with several users of the tomography-community for quite a while to gather their requirements and concerns on the idea of an open access data catalogue. This dialog was quite fruitful in shaping the Science3D-portal. To increase the user base, we organized together with the HZG a Science3D workshop which brought together the user community, the Science3D team, the beamline scientists at PETRA III and a number of educators and teachers. The Science3D workshop served as a user-meeting as well as a project kick-off, covering different aspects of the data lifecycle from pre-experiment stages to the re-use after publication.

We specifically invited school teachers and teachers' educators to gather feedback from them on possible uses of Science3D materials in the classroom. Fortunately, six school teachers followed the invitation and joined the Science3D workshop on the first day, which was intended to provide talks in a scholarly manner. The speakers made accordingly quite an effort avoiding too much technical details and kept the presentations well understandable for non-experts.

The presentations covered a rather wide spectrum of topics around x-ray tomography, ranging from a basic introduction of the experimental and computational methods to unpublished results in evolutionary biology and nano-sciences. The presentations hence gave a very nice overview of the current status of the research at a non-expert-level. A particular emphasis was on the visualization of the 3D-models with free or affordable applications, a pre-requisite for the participation of students and schools.

The ability to use the 3D-models for rapid-prototyping (3D-print) is another particular appealing feature, since it permits to take real 3D-objects into the classroom. Models need however to be prepared in a specific manner, which isn't always easily achieved. To provide the tools and expertise to work with rapid prototyping of tomographic 3D-models we will organize another Science-3D hands-on workshop later on.

The science3D-workshop was held in Hamburg at DESY, June 02-04 2014 and was visited by roughly 50 participants (with some variations, since some sessions were dedicated to specific technical aspects). The slides are currently being prepared – avoiding premature release of unpublished data – and will be deposited on the meeting page under <https://indico.desy.de/event/science3d>.



Science3D is a joint project of the European Open-Data-Initiative PaNdata ODI, DESY and Helmholtz-Zentrum Geesthacht (HZG). The aim is to present imaging experiments and the corresponding data and models in a comprehensible way and make them available to the general public. X-ray tomography is a particularly suitable investigation method to study both biological organisms and various materials in detail. Accordingly, it is one of the main applications of the Science3D project.

The picture shows the skull of a larva of the Pacific salamander (*Dicamptodon ensatus*). The bones are depicted in brown and the cartilaginous gill basket in blue. When feeding, the gill basket is simultaneously widened with the opening of the lower jaw, thus causing an underpressure that sucks the prey into the mouth.

In June, DESY and HZG jointly organised the first Science3D workshop. About 50 participants came to DESY to discuss their recent micro-

tomography results, covering multifaceted themes ranging from cosmetic dentistry to fossil dinosaur eggs. A number of teachers also followed the invitation to the workshop and took home valuable ideas from the easily comprehensible presentations for their natural sciences lessons.

*By Frank Schlünzen*

**INFO**

[www.science3d.org](http://www.science3d.org)

**Figure 2: Science3D workshop in the press**

### 2.1.1 Agenda

The timetable is available from the Meeting page<sup>1</sup>.

<sup>1</sup> <https://indico.desy.de/getFile.py/access?resId=0&materialId=1&confId=9737>

2.1.2 Participants

Mr. ABIBE, Andre	Helmholtz-Zentrum Geesthacht
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