TIB AV-PORTAL: A RELIABLE INFRASTRUCTURE FOR SCIENTIFIC VIDEOS

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Abstract

With the AV Portal[1], the German National Library of Science and Technology (TIB)[2] in collaboration with the Hasso Plattner Institute (HPI)[3] has developed a user-oriented platform for scientific films. This portal offers free access to high-quality computer visualisations, simulations, experiments and interviews as well as recordings of lectures and conferences from the fields of science and technology. The automatic video analysis of the TIB AV Portal includes not only structural analysis (scene recognition), but also text, audio and image analysis. Automatic indexing by the AV Portal describes videos at the segment level, enabling pinpoint searches to be made within videos. Films are allocated a Digital Object Identifier (DOI), which means they can be referenced clearly. Individual film segments are allocated a Media Fragment Identifier (MFID), which enables the video to be referenced down to the second and cited. The creator of the audiovisual media segment can choose between an Open Access licence and a declaration of consent, enabling them to decide how they wish

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[1] **https://av.tib.eu**

[2] **https://www.tib.eu/de/**

[3] **http://hpi.de/**

to permit TIB to utilise the material. TIB recommends the "CC-Namensnennung – Deutschland 3.0" licence, which ensures that the creator is acknowledged and permits the comprehensive use of audiovisual media in research and teaching.

Keywords

Audiovisual Media, Audiovisual Portal, Multimedia Retrieval, Semantic Analysis

Introduction

Nowadays, publications produced by researchers often include a combination of an article, a dataset and a code of the scientific model as well as video and animation (Kraft et al., 2015). However, all these media types have different search, indexing and archiving requirements. In addition, the objects must also be connected to each other to enable cross-media research.

In order to tackle these challenges, the Competence Centre for Non-Textual Materials (KNM)[4] was founded at TIB in 2011. At KNM, an interdisciplinary team of experts in IT development, multimedia retrieval and ontologies, media archivists, information scientists and legal experts is engaged in fundamentally improving conditions of access and use for media types such as audiovisual media, 3D objects and research data.

KNM focuses on developing innovative solutions to problems in the areas of collecting, indexing, providing and (digitally) preserving non-textual materials. In the future, it should be possible for such material to be published, located, cited and made available on a permanent basis as easily as textual documents are today. To make this happen, KNM strives to develop infrastructures, tools and services to actively support users throughout the scientific process. In addition to finding solutions to specific users' needs and other object types, the team also keeps an eye on new domains of knowledge. To ensure that research approaches are transferred efficiently and effectively to everyday practice in digital libraries, the developments are consistently supported by user-centred software design, ensuring optimal usability of the portals and tools. Last but not least, the competence centre supports additional information facilities and providers as a knowledgeable point of contact in all matters concerning non-textual materials.

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[4] **https://www.tib.eu/de/forschung-entwicklung/nicht-textuelle-materialien/**
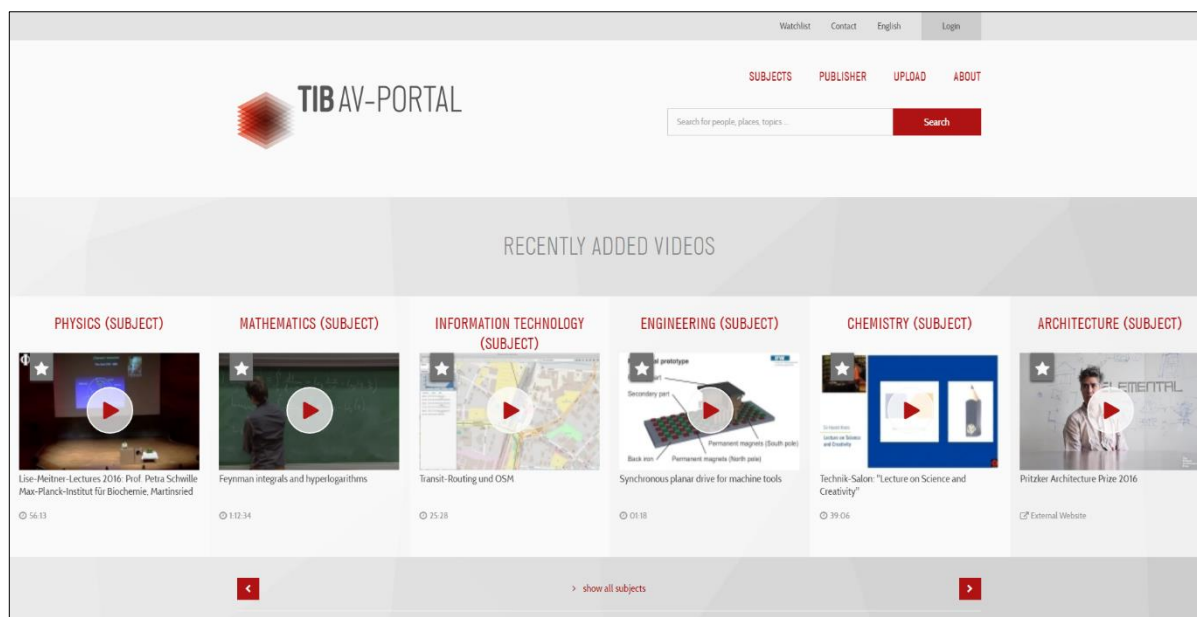
Figure 1: The home page of TIB's AV Portal (tib.av.eu)

The TIB AV Portal

In a joint project with the Hasso Plattner Institute (HPI), the University Centre of Excellence in Software Systems Engineering affiliated with the University of Potsdam, TIB created a portal in this context that optimises access to scientific videos such as computer visualisations, learning materials, simulations, experiments, interviews, and recordings of lectures and conferences from the areas of science and technology. The key feature of the portal is its combination of state-of-the-art methods of multimedia retrieval and semantic analysis (Snoek et al., 2007). In 2010, the project team used focus groups and semi-structured interviews to ask researchers about what they needed most from a search system, the AV Portal is based on further analyses of that (Plank, 2012). These requirements included:

> High-quality specialist content
> Preferably free access and use
> Long-term retrievability
> Citability of films, preferably at the segment level
> Good searchability
> Links to additional research information

In 2011, a semi-functional prototype of the AV Portal was developed; in 2012-2013, the system was further developed and the beta version was created. Since spring 2014, the system has been fully operational at TIB. The page impressions increased from 78.936 in 2014 to 155.723 in 2016 (information as of October 2016).

TIB's AV Portal currently contains around 5,000 videos from the field of science and technology, as well as some 2,400 film credits with external links to other websites. The collection of the former IWF (Institute for Knowledge and Media) is also gradually becoming accessible online via the portal. The collection, which covers 100 years of scientific film history, was transferred to TIB in 2012[5]. A total of around 1,400 IWF films can already be

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[5] **https://www.tib.eu/de/recherchieren-entdecken/sondersammlungen/iwf-medienbestand/**

accessed online; other titles are being added continuously as soon as the situation concerning rights can be clarified. In many cases, authors can be convinced to release their films under Open Access licences from the non-profit organisation Creative Commons[6] to make them freely accessible and usable for research and teaching.

Process chain

A media asset management system (MAM) professionally captures the videos. The system has its own transcoder that handles all established codecs and creates statistics. The MAM system's underlying metadata schema on standardised registration of non-textual materials is based on the current DataCite Metadata Schema[7] and has been expanded by a few elements required for the detailed description of an AV medium. The entire metadata schema is made available to media providers online[8].

```
                                     Mandatory Properties
  -->
- <creators>
  - <creator>
      <creatorName>name of the creator</creatorName>
      <nameIdentifier nameIdentifierScheme="String">any name identifier</nameIdentifier>
    </creator>
  </creators>
- <titles>
    <title>title of the video</title>
    <title titleType="Subtitle" language="eng">subtitle of the resource</title>
    <title titleType="AlternativeTitle" language="eng">alternative title of the resource</title>
  </titles>
- <publishers>
  - <publisher>
      <publisherName>name of the publisher</publisherName>
      <nameIdentifier nameIdentifierScheme="String">any name identifier</nameIdentifier>
    </publisher>
  </publishers>
  <publicationYear>2001</publicationYear>
  <language>ger</language>
```

Figure 2: Sample metadata record

To enable TIB to provide their users with videos via the AV Portal, media providers conclude a licence agreement with TIB and determine their terms of use. Simple licence agreements as well as various Creative Commons licences are available for selection. TIB explicitly recommends the Open Access "CC-Namensnennung – Deutschland 3.0" licence. This licence

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[6] **http://de.creativecommons.org/**

[7] **https://www.datacite.org/**

[8] **https://av.tib.eu/about**

entails the fewest restrictions for use in research and teaching, and simultaneously guarantees that the author has to be mentioned. Standard licence agreements have been developed by TIB and made available online to media providers.[9]

Non-textual materials are digitally preserved if they are particularly important for science and teaching and of appropriate technical quality. TIB operates a professional digital preservation system called "Rosetta", which is jointly used by the German National Library of Medicine (ZB MED)[10] and the Leibniz Information Centre for Economics (ZBW)[11]. If making a video available to users for viewing purposes or for downloading is permitted, that video is allocated a unique citation link (DOI name)[12]. DataCite registers the DOI via the API interface. In addition to carrying out DOI registrations of films, the AV Portal also offers a time-based citation link. Using the open standard Media Fragment Identifier (MFID)[13], a citable DOI is displayed for each film segment.
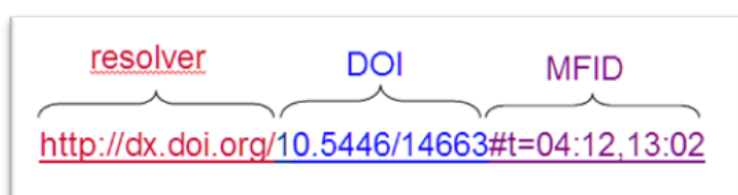

Figure 3: Digital Object Identifier allows for a precise citation of a videosegment

In light of the rapidly increasing number of digital AV media and the necessity to index them at the segment level, solutions for automatic indexing are very much needed, because this is not manageable manually (Neumann and Plank, 2013). The workflow for automatic video analysis in the TIB AV Portal includes the following steps:

First, the video is automatically segmented at the clipping boundaries on the basis of image characteristics. Key frames are extracted from the segments to create a visual index. After completion of this structural analysis, text overlays (e.g. on slides) are analysed using intelligent character recognition and stored in the form of a transcript. Likewise, a transcription is generated from spoken language using automatic speech recognition (Strobel and Plank, 2014). In the next step, visual concept detection classifies visual content by means of predefined specialised and generalised categories such as landscape, machine, drawing, animation and lecture (Blümel et al., 2012).

Within the TIB AV Portal, named entity recognition extracts terms listed in the **Integrated Authority File** (GND)[14] from audio transcripts and text overlays, meaning that the video is semantically tagged with keywords. The tags define entities of an ontology that are linked in semantic relations such as synonymy, hyperonymy and hyponymy. Videos from TIB's subjects

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[9] **https://av.tib.eu/about**

[10] **http://www.zbmed.de/**

[11] **http://www.zbw.eu/de/**

[12] TIB: DOI Service (see note 12).

[13] **https://www.w3.org/TR/media-frags/**

[14] **http://www.dnb.de/DE/Standardisierung/GND/gnd_node.html**

– technology, architecture, chemistry, computer science, mathematics and physics – are automatically tagged at the segment level with the corresponding GND tag. Semantic searches can be conducted using entities (GND tags). Entities have main identifiers (e.g. Kernenergie), synonymous identifiers (Nuklearenergie, Atomenergie, etc.) and in some cases they have English identifiers (Nuclear Energy). Some entities are additionally associated with sub-categories. When searching for the term Kernenergie, for example, the system also searches for all other identifiers (synonyms, English translations) and any sub-categories of the entity Kernenergie. This way, the number of relevant video documents returned is expanded considerably.

The English identifiers were obtained by mapping GND entities onto data from other standards. These standards include **DBpedia**[15], **Library of Congress Subject Headings** (LCSH)[16], mappings from the **Multilingual Access to Subjects** (MACS) project [17] and the **WTI "Technology and Management" thesaurus**.[18]
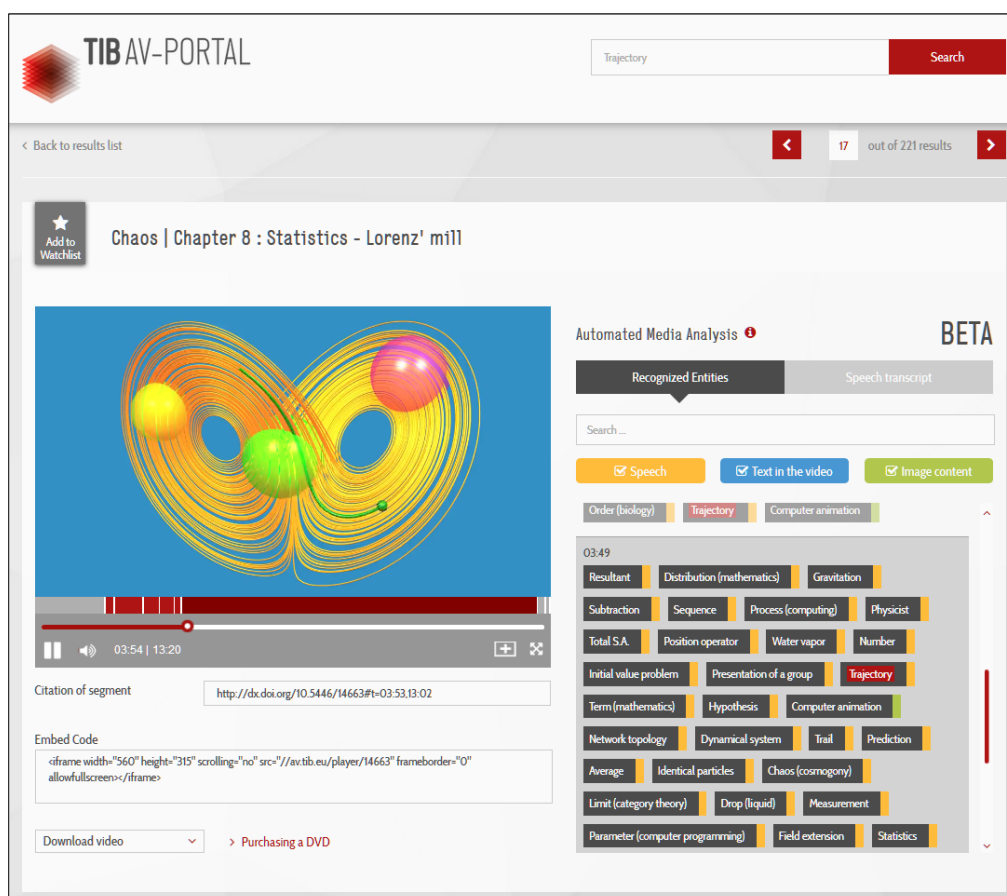

Figure 4: Detail page of TIB's AV Portal. The automatic, content-based indexing of individual videos at the segment level enables users to search in an accurate, content-based manner.

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[15] **http://wiki.dbpedia.org/**

[16] **http://id.loc.gov/authorities/subjects.html**

[17] **http://www.dnb.de/DE/Wir/Kooperation/MACS/macs_node.html**

[18] **https://www.wti-frankfurt.de/images/themenpakete/english/en-tema.pdf**

Thanks to automated, semantic video analysis, TIB's AV Portal offers cross-lingual, content-based access at the segment level, improving keyword-based search by tagging materials with entities. In a traditional keyword-based search, only those documents that contain the particular search term entered are returned. In contrast, semantic search takes advantage of its knowledge basis and, beyond that, can return video documents containing, e.g. synonyms, hypernyms or sub-categories of the search term entered. As a result, the comprehensiveness of the relevant video documents will be reflected in the increased number of hits. The search results of the AV Portal can also be specified thanks to content-based faceted navigation. The AV Portal contains facets for subject area, publisher, year of publication, licence, terms found in the video, images and organisations. The user starts with a textual search in the AV Portal and then refines the search results continuously by means of facets.

Services for AV

Producers of scientific films can also simply upload their videos via an online form to the TIB AV Portal free of charge, or ask TIB for an FTP access (file transfer protocol). The quality of the video is evaluated, hosted, published in a legally sound manner, indexed according to international standards, semantically enhanced, transcribed, digitally preserved and finally given a DOI name – all this optimises the material's discoverability (Löwe et al., 2015).

To make audiovisual media available beyond the AV Portal itself, TIB has made the metadata and preview files it has licensed available to partners such as EUROPEANA[19], the Deutsche Digitale Bibliothek[20] and the Deutsches Filminstitut (German Film Institute)[21], as well as to many other institutions. Further expansion of cooperative activities is underway.

Recently, TIB has started to publish authoritative as well as time-based, automatically generated metadata and thumbnails of films, for which a use has been agreed under the **CC0 1.0 Universal** licence, as linked open data for further use in the standard RDF format[22]. In the future, the datasets will be updated quarterly. In addition, users can attend a tutorial at https://av.tib.eu/opendata, providing a brief overview of the structures of the datasets of TIB's AV Portal. The tutorial explains how datasets can be imported into an RDF database and searched via SPARQL (Marin Arraiza and Strobel, 2015).

Finally, TIB provides advice on all matters concerning publishing media, including advice on technology, rights, metadata, digital preservation and DOI registration.

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[19] **http://www.europeana.eu/portal/**

[20] **https://www.deutsche-digitale-bibliothek.de/**

[21] **http://www.filmarchives-online.eu/**

[22] **https://av.tib.eu/opendata**

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Conclusion

With its AV Portal, TIB has provided a reliable infrastructure for scientific videos, and thus a valuable service. This infrastructure includes hosting capabilities, metadata enhancement, and media-specific search and retrieval tools as well as digital preservation. A DOI name and/or a Media Fragment Identifier (MFID) guarantees the citability of entire videos, video abstracts, or even individual video segments. In this way, researchers are able to reference and share video content, for example in teaching or in social networks. Recordings of conferences can be specified in lists of publications and identified, further used and cited by other scientists. In this way, scientific videos become reliable sources and can be preserved as cultural heritage.

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