American Sign Language

Linguistic Research

Project

Update on Linguistically Annotated ASL Video Data Available through the American Sign Language Linguistic Research Project (ASLLRP)

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Abstract: The **American Sign Language Linguistic Research Project (ASLLRP)** provides Internet access to high-quality ASL video data, generally including front and side views and a close-up of the face. The manual and non-manual components of the signing have been linguistically annotated using SignStream®. The recently expanded **video corpora** can be browsed and searched through the **Data Access Interface** (**DAI 2**) we have designed; it is possible to carry out complex searches. The data from our corpora can also be downloaded; annotations are available in an XML export format. We have also developed the **ASLLRP Sign Bank**, which contains almost 6,000 sign entries with distinct English-based glosses, with a total of 41,830 examples (in addition to about 300 gestures, over 1,000 fingerspelled signs, and 475 classifier examples). The Sign Bank is likewise accessible and searchable on the Internet; it can also be accessed from within **SignStream®** to make annotations more accurate and efficient. Here we describe the available resources. These data have been used for many types of research into computer-based sign language recognition from video.

1. Introduction

Access to sufficient quantities of high-quality, linguistically annotated, American Sign Language (ASL) video data, with enforcement of a 1-1 relationship between the sign production and the text-based gloss label in the annotations, is essential for research in computer-based sign language recognition from video. This report is intended to make the community aware of resources that can enable and facilitate such research, by describing the datasets that are available and the tools provided on the Web for viewing and accessing the data.

The Data Access Interface (**DAI 2**) is a Web-based interface that has been designed to allow users to browse, search, and download linguistically annotated video data of various kinds from native signers of ASL collected as part of the ASLLRP, a collaborative venture that has included researchers from Boston University (BU), Rutgers University (RU), Rochester Institute of Technology (RIT), and Gallaudet University (GU), in collaboration also with DawnSignPress [1] (DSP).

2. Access to Continuous Signing Corpora

The data available through **DAI 2** **http://dai.cs.rutgers.edu/dai/s/dai** include a large set of utterances that are part of the expanding **ASLLRP SignStream® 3 Corpus**. The video examples for most of the utterances include 3 synchronized views – front, side, and close-up of the face. **DAI 2** provides various ways to browse, search, and download these data, as described in more detail in the rest of this report.

2.1 The ASLLRP Video Corpora: Data Sets of Continuous ASL Signing

This **ASLLRP SignStream® 3 Corpus** of is an expanding collection of continuous signing from ASL native signers, which was collected at Boston University. Synchronized videos display the signing from front and side, as well as providing a close-up view of the face. These videos were annotated with **SignStream® 3** (see **Section 4**) with labels and start and end frames for all events: manual English-based gloss labels (with information provided for both hands), sign type, start and end handshapes, as well as non-manual information, such as grammatical markings for things such as question status, negation, topic/focus, conditional/when, relative clauses, plus anatomical behaviors, such as head nods and shakes, eye aperture and gaze, etc.. As of June 2021, the BU data in this corpus consist of 43 SignStream® files containing a total of 2,048 utterances, with **16,659** total signs (representing 2,762 distinct signs or sign variants) from 4 native ASL signers. DSP recently contributed to this corpus 527 additional sentences from 15 native signers, with a total of 3,032 sign tokens (for a total of **19,691** example signs in all); the DSP videos each have a front and side view.

This is in addition to an older dataset, available separately from the same website: the **National Center for Sign Language & Gesture Resources (NCSLGR) SignStream® 2 Corpus**, although that does not include handshape annotations. That dataset, also searchable and downloadable, contains **10,719** signed examples (annotated with glossing conventions consistent with those used for other data available from this site; see [2, 3]).

2.2 Access to the Continuous Signing Corpora via DAI 2

2.2.1 Sign-level searches

The DAI 2 search interface[1] is here: **http://dai.cs.rutgers.edu/dai/s/dai**. Searches can be performed and constrained based on the following:

- A specific character string in the gloss label on the dominant or non-dominant hand (or either);
- Signs of particular types (lexical, number, loan, fingerspelled, gesture, classifier of various kinds, etc.); compounds, non-compounds, or either;
- Handshapes on the dominant and/or non-dominant hand, at the start or end; presence of reduplication or passive base arm;
- Specific SignStream® collection (=filename); available filenames are listed, with the number of signs contained in each listed in parentheses;
- Specific signer; available singers are listed, with the number of signs from each contained in parentheses.

Results are displayed in a table, as shown in Figure 1, which presents first the results from a search for the partial string "FATHER", and then the first two of ten examples shown when the user clicks on the circled cell for Rachel producing the sign glossed as FATHER.

Figure 1. Search results for partial string "FATHER"

The SignStream® filename plus the utterance number within that collection are included in the first column of **Figure 1**. The checkboxes make it possible to add specific examples to the Download Cart. Clicking on the icons in column 4 highlighted by the dark blue oval will display the sign or entire utterance videos–front, face, or side view; an example of the facial close-up for the sign video is shown in **Figure 2**. The arrow keys make it possible to step through the video frame by frame. The filename and time within the whole video are also displayed. Clicking on the blue Gloss button visible in the bottom screen shot of **Figure 1** reveals a more complete display of the non-manual events (a rough approximation of the precise time-alignment that would be visible in the SignStream® display).
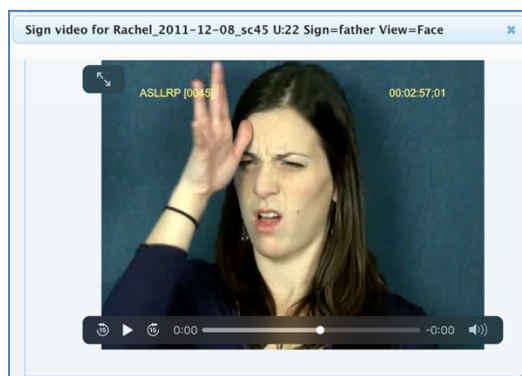

Figure 2. Playing the close-up face video for the selected sign from the search results

2.2.2 Utterance-level searches

Utterance-level searches make it possible to view all utterances in the collections, or to limit the selection based on any or all of the following:

- The presence of a specific grammatical marking and/or specific anatomical non-manual actions (e.g., wh-question, negation, raised eyebrows, head nod);
- The presence of a particular character string in the English translation of the sentence
- Specific SignStream® collection (=filename); available filenames are listed, with the number of utterances contained in each listed in parentheses;
- Specific signer; available signers are listed, with the number of utterances from each contained in parentheses.

For example, a search for the presence of negative marking would display the 532 utterances with that marking, the first two of which are shown in **Figure 3**. The utterance video—front, face close-up, or side view—can be played.

Figure 3. First two results of a search for utterances with negative

3. The ASLLRP Sign Bank via DAI 2

The *ASLLRP Sign Bank,* available from **http://dai.cs.rutgers.edu/dai/s/signbank**, was initially constructed from **the American Sign Language Lexicon Video Dataset** (**ASLLVD**), isolated, citation-form signs collected at BU through a collaborative effort of Stan Sclaroff, Vassilis Athitsos, Ashwin Thangali, and Carol Neidle, as well as many ASL consultants and BU students (**http://www.bu.edu/asllrp/people.html**), which consists of videos of >3,300 ASL signs in citation form, each produced one or more times by each of 1-6 native ASL signers, for a total of almost 9,800 tokens [10]. This dataset includes multiple synchronized videos showing the signing from different angles. Linguistic annotations include gloss labels, sign start and end time codes, start and end handshape labels for both hands, and morphological and articulatory classifications of sign type. For compound

signs, the dataset also includes annotations for each morpheme. Further information about this data set is available from **http://www.bu.edu/ asllrp/av/dai-asllvd.html.**

The *ASLLRP Sign Bank* accessible via DAI 2 has been expanded beyond the original **ASLLVD** to incorporate citation-form sign examples provided by RIT (collected under the direction of Matt Huenerfauth; a total of 10,561 sign tokens) and DSP (a total of 1,904 citation-form sign tokens). It also now provides access to all of the signs in the continuous signing corpora just described in Section 2.

3.1 Accessing the Sign Bank

The *Sign Bank* has a list at the left, arranged alphabetically by the glosses for the primary entries. This is shown in **Figure 4**. Multiple "entry/variants" may be grouped under a single primary entry in cases where there are lexical variants or closely related forms. The number in parentheses after each entry/variant corresponds to the total number of examples of that sign in the *Sign Bank*.

One canonical example of each entry/variant is displayed when the user clicks on that gloss. The right and left handshapes of the start of the sign are shown to the left of the thumbnails of the signer. In this case, since it is a one-handed sign, there is no handshape for the non-dominant hand. The handshapes of the two hands found at the end of the sign are shown, in the same order, to the right of the thumbnails. One can play that sign video by clicking on the button "Play Sign Video"), as shown in Figure 4. Clicking on "Play Composite Video" will simultaneously play all of the examples of citation-form signs available from the **ASLLVD**, as is shown in **Figure 5**.
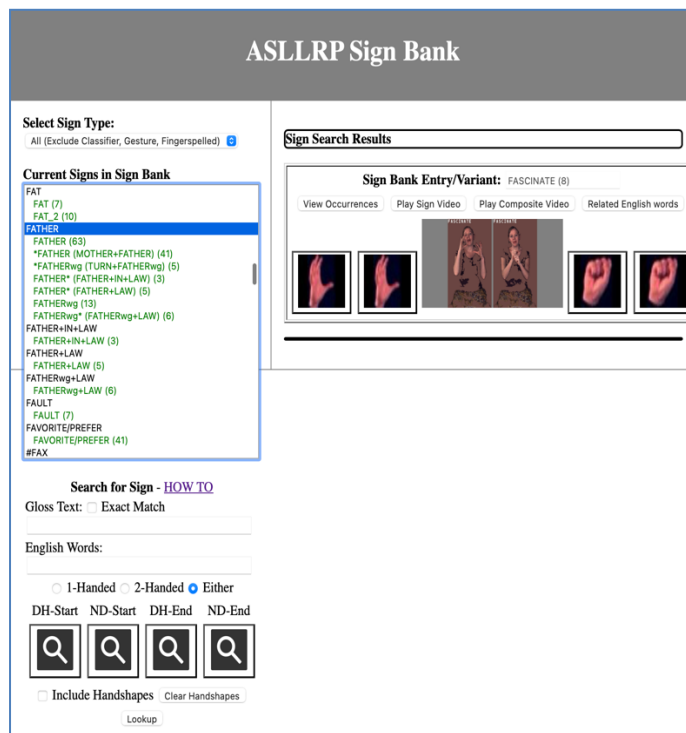

Figure 4. Alphabetical listing of *primary entries*, along with the corresponding *entry/variants*

Note that the ASLLVD video images on the left in **Figure 5** have undergone some post-processing.[2]

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[2] RAW frame captures → Bayer interpolation (un-calibrated color profile) → Skin color region detection and segmentation using skin color FG/BG model trained on signers in the data set → Background fill-in with average skin color → Crop the video frame to skin color segments → Color and contrast enhancement heuristic → Convert image sequence to .mov format video with gloss and frame number overlay. This was done was to facilitate presentation of video collated from several signers together for hand shape annotation purposes, to create videos that work within available screen real-estate and to provide consistent color, handshape contrast, and brightness across different signers.

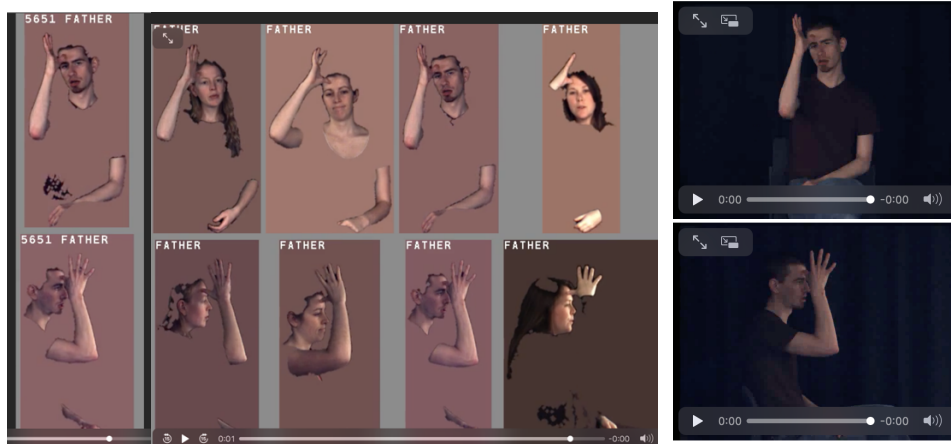There is also an option to "View Original Video, as shown on the right"

Figure 5. Playing the sign video (left) or the composite video (right)

Clicking the "View Occurrences" button will display examples in multiple parts of the window, arranged by data source: ASLLVD citation-form signs, ASLLRP signs from sentences, DawnSignPress (DSP) citation-form signs, DSP signs from sentences, and RIT citation-form signs. On top, as seen in **Figure 7**, are the examples of citation-form signs from the **ASLLVD**, and below are additional examples from the other data sets. For the continuous signing data, it is possible to view the video for just that sign, or for the entire utterance that contains the sign.

3.2 Navigation and Searching within the ASLLRP Sign Bank.

It is now possible to display specific types of signs, from the top of the Sign Bank window shown in **Figure 4**; the options are shown in **Figure 6**.
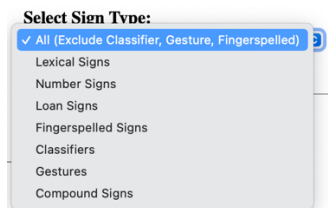
Figure 6. Selecting types of signs for Sign Bank display

If you click anywhere in the sign list shown in **Figure 4**, and then type a sequence of characters quickly, the selection will advance to the next sign that starts with those characters. So, if you are at the top of the list and start typing "FATH" the sign FATHER will be selected and will become visible. Alternatively, you can scroll to the entry you are interested in, or you can use the search tools at the bottom left in **Figure 4**. It is also now possible to search the ASLLRP Sign Bank for a gloss based on '**related English words**', from the lower part of the left-hand navigation area as shown in **Figure 4**. For more detailed information about how to use the DAI and about the options for searches, see [8]and **https://www.bu.edu/asllrp/New-features-DAI2.pdf**.

3.3 Further Information

The conventions used for annotations in all of our corpora are documented in [2, 3]. A list of the field and value names and labels for non-manual events is also contained in the Appendix of [6] as is the structure of the XML export format. For additional information about **DAI 2** and the datasets to which it provides access, see [7-9]. Statistics about the contents of the various datasets are provided through **DAI 2** at **http://dai.cs.rutgers.edu/dai/s/runningstats**.

Figure 7. Display of results from multiple sources, for LIVE

4. SignStream® – the Software used for the Linguistic Annotations

All of our video corpora have been linguistically annotated using SignStream®, an application for linguistic annotation of visual language data developed by our group and freely shared. It provides an intuitive interface for labeling and time-aligning manual and non-manual aspects of the signing while viewing up to 4 synchronized videos showing different views. See **http://www.bu.edu/asllrp/SignStream/3/**. The principal programmer is Gregory Dimitriadis, working with Douglas Motto at Rutgers University. A screen shot is shown in **Figure 8**. The annotations from SignStream® are uploaded to **DAI 2** to enable shared access, but are also available in an XML export format. See [4-6] for SignStream® 3 User's Guides.
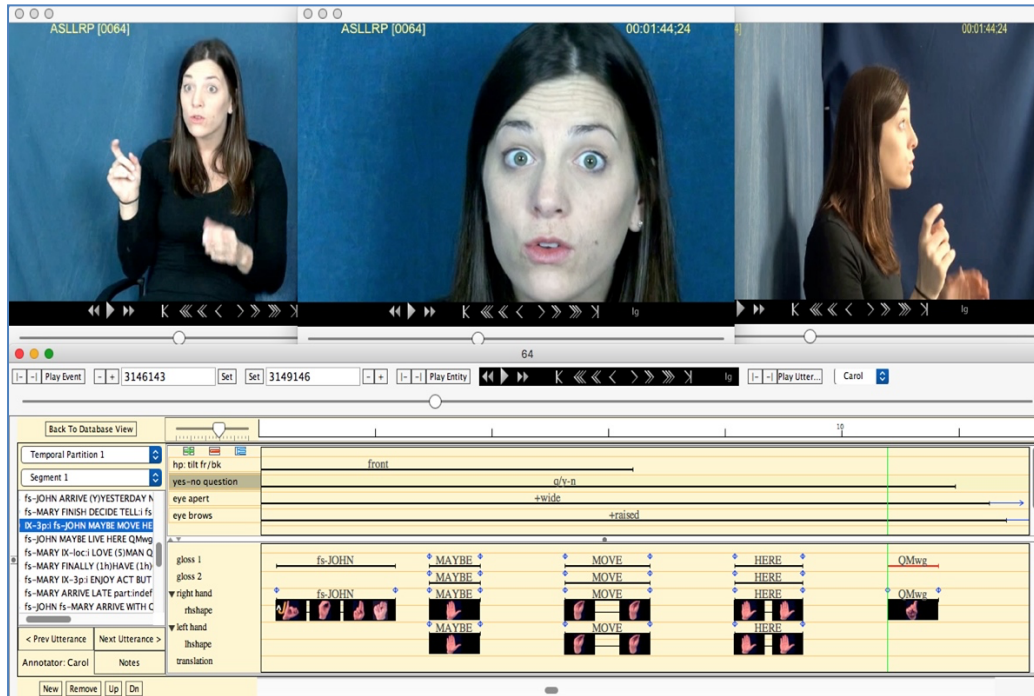

Figure 8. Screen shot of SignStream® Version 3

5. Future developments

Please note that this report provides information about the current state of the project. The data sets are expanding, and the features of the related software are being improved and enhanced. Please check back at the ASLLRP website for further updates (**http://www.bu.edu/asllrp/**).

Table of Figures

References

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[4] Neidle, C. (2017) A User's Guide to SignStream® 3, American Sign Language Linguistic Research Project Report No. 16, Boston University, Boston, MA.

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