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SLP-AA: Tools for Sign Language Phonetic and Phonological Research

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Abstract

This paper describes the features of a free, open-source software tool, *Sign Language Phonetic Annotator+Analyzer* (SLP-AA), which is designed to facilitate phonetic/phonological transcription and analysis on sign languages.

The software supports two modes: the Annotator mode allows the user to build phonetically transcribed corpora of sign languages, and the Analyzer mode lets the user perform phonological searches or analyses on the built corpora. We give a detailed description of one type of phonological search — the extended finger search function — and point out a potential application of this function with respect to sign language research.
Index Terms: sign language, corpus linguistics, computer application

1. Introduction

In a landmark paper, Stokoe [1] showed sign languages to be on par with spoken languages in terms of being full-fledged languages, with both demonstrating highly similar structural properties and being different more in modality than in linguistic character. There has since been much research done on various aspects of sign languages. The piece of software presented in the current paper — Sign Language Phonetic Annotator+Analyzer (SLP-AA) — aims to facilitate research focusing on the phonetic/phonological aspects of sign languages.

This paper is organized as follows; demonstrations at our station will follow a similar order. First, Section 2 contextualizes the software by briefly describing the transcription system, known as Sign Language Phonetic Annotation (SLPA), that forms the backbone of SLP-AA. Section 3 then explains the interface and features of SLP-AA, and one linguistic application of SLP-AA is provided in Section 4.

2. Sign Language Phonetic Annotation

Sign Language Phonetic Annotation (SLPA) is a system for transcribing hand configurations, along with other parameters, for sign languages [2, 3, 4, 5]. Compared with other transcription systems, SLPA is highly phonetically detailed. In particular, it requires specifications for the degree of flexion and extension for each joint of each finger and the degree of separation between fingers. Figure 1 illustrates the (slightly modified) SLPA transcription for the word PAIR in American Sign Language (ASL). Each symbol in the transcription represents a certain finger configuration. For instance, [H], [e], and [E] indicate various degrees of (hyper)extension; for full explanations of each symbol, the reader is referred to [6] and the references therein. (Compare this to other systems in which holistic phonological labels are provided; e.g., in [7], this would be simply described as a "U" shape.) This transcription system forms the foundation on which all the functions in SLP-AA are built, as explained in the next section.

(a) 

(b) O=FF frd∅/bm--3- 1HEE {2EEE <3FFe =4fee

Figure 1: *(a) ASL hand configuration for PAIR; (b) Sign Language Phonetic Annotation encoding of this sign in SLP-AA.*

3. Sign Language Phonetic Annotator+Analyzer

SLP-AA is a free, open-source software program written in Python 3 that comes with a graphical user interface implemented using PyQt 5. The code for the program is available from `https://github.com/PhonologicalCorpusTools/SLP-Annotator`. SLP-AA supports two modes — the Annotator mode and the Analyzer mode. The user can easily switch between these two modes in the same program, so that constructing and analyzing corpus data can be streamlined.

3.1. Annotator mode

Upon entering the Annotator mode, the user is presented with an interface in which a sign can be transcribed. A collection of such transcriptions forms a corpus, which can also be exported. As the Annotator interface has been presented at INTERSPEECH 2017, we omit its features here and refer the reader interested in its design and infrastructure to the proceedings paper [8].

3.2. Analyzer mode

The Analyzer mode is a new addition to the original software program and is the focus of the current demonstration. The Analyzer interface allows the user to search for specific signs and to perform phonological analyses. On entering the Analyzer mode, the user is shown a corpus overview, with the signs from the loaded corpus listed and corresponding transcriptions displayed (see Figure 2). The user can then analyze the corpus by choosing desired analysis functions from the menu bar on the top. In what follows, we demonstrate the utility of this mode with the extended finger search function.

3.2.1. The extended finger search function

The extended finger search function is a special type of phonological search: it allows the user to search for signs with hand configurations that specifically involve extended fingers (roughly analogous to what are known as "selected fingers" in the sign language literature). The user input interface is shown

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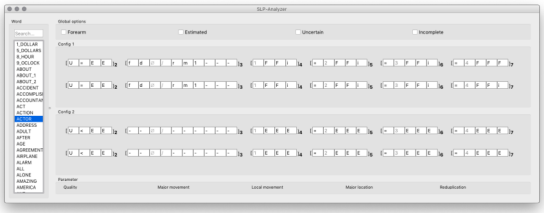

Figure 2: *User interface for the Analyzer mode of SLP-AA.*

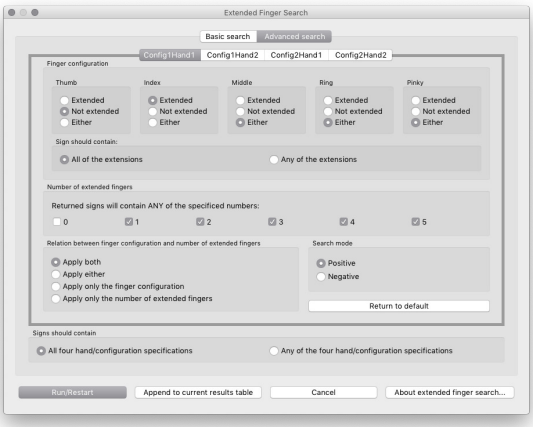

Figure 3: *User interface for the extended finger search function.*

in the accompanying video, and a screenshot is shown in Figure 3. First, the user can choose between a basic search and an advanced search: The basic search allows the user to specify the extended finger(s) for one handshape, while the advanced search (shown in Figure 3) enables the user to specify the extended finger(s) for both hands in two configurations each.

In addition, the user is able to do searches by simply specifying the *number* of extended fingers (i.e., regardless of which fingers). The search interface also supports both positive and negative search modes for each hand/configuration combination. For example, the specifications in Figure 3 result in a search for signs in which the first hand in the first configuration contains a non-extended thumb and at least one extended finger that must include the index finger. In short, with this function, the user can easily find signs with particular hand configurations that are otherwise time-consuming to find manually.

4. Potential linguistic applications

One place where the extended finger search function is useful in the context of sign language research is in the verification and quantification of commonly assumed generalizations. For instance, the concept of *handshape markedness* has been a recurrent theme (e.g., [9, 10, 11]), where certain handshapes are thought to be more basic (i.e., less "marked") than others, as illustrated in Figure 4. This claim about markedness is interesting both from a physiological perspective (e.g., are certain handshapes actually easier to produce or perceive?) and from an explanatory perspective (e.g., does markedness help explain certain commonalities across languages, various frequency effects within a language, or patterns of acquisition during the

(a) *Some frequent, unmarked handshapes. Based on [12].*

(b) *Some similar but more marked handshapes.*

Figure 4: *Unmarked vs. marked handshapes. All images made using the handshape fonts created by CSLDS, CUHK (*`http://www.cslds.org/v3/resources.php?id=1`*).*

timecourse of development of a child learning a language?). Ann [10], for example, makes claims about which handshapes in Taiwanese Sign Language are easier or harder, and relates the notion of ease of articulation to frequency effects within a corpus of the language. To gather her data, she manually counted the number of occurrences of each handshape within her corpus; having a tool like SLP-AA makes this kind of research faster, more reliable, and more possible for larger corpora.

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