Towards Sign Language Resources: Synergies between Empirical Work and Automatic Language Generation

Universität Hamburg

Thomas.Hanke@sign-lang.uni-hamburg.de

Introduction

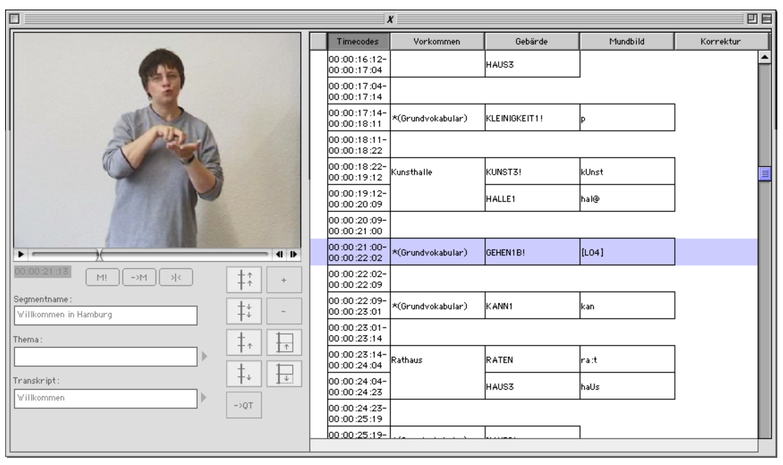
In ViSiCAST, a computer system was implemented that, from a semantic interlingua, generates sign language utterances performed by an avatar animated on screen. At the heart of the system, a Head-Driven Phrase-Structure Grammar fragment for DGS (German Sign Language) feeds HamNoSys 4 and coordinated non-manual codes into the animation pipeline. As can be expected from a lexicalist approach, the rules used do not differ too much from what you find in HPSGs for spoken language: Sign-language specifics (e.g. the mappings between semantic roles, syntactic functions and phonological loci for directional verbs) lead to a radically different type hierarchy in the lexicon.

Form description is split over several features to allow morphological operations modelled by unification. In the easiest cases (cf. example: I), many feature values are HamNoSys. In the next step (cf. example: MUG (locatable)), most features are HamNoSys values. For the types modelling the various kinds of directional verbs, feature sharing is more common than explicit values (cf. example: TAKE).

While the core lexicon was handcrafted in parallel with the type hierarchy used, another approach was needed to extend the lexicon for open sign classes to a size suitable for practical purposes.

Sign Language Corpus Transcription

Out of the many corpus transcription tools available today, some address the special needs of the sign language transcribers community, esp. tight integration of high-resolution video and support for non-standard fonts (for sign language phonetic notation). The distinctive feature of iLex, the tool we have developed for this purpose (Hanke, 2002 and Hanke et al., 2001), is that it links the tokens in signed texts to the types in a lexical database.



iLex vertical transcription window: Tiers are represented as columns

This means that tagging is mainly the task of token-type matching. The relational database model allows the user to search candidate types by meaning, form description (including support for fuzzy search), or grammatical class. When browsing through the candidate types, the user can immediately access video clips of prototype tokens for the types. At the same time, it is possible to verify tokens assigned to a type to be verified not only by inspecting descriptive features, but also by viewing the source video data.

Size considerations do not render this approach infeasible neither for the time being nor for the near future: Current sign language corpora do not exceed the magnitude of hundreds of thousands of tokens (sizes easy to handle for any database), and due to the effort in manual processing this will remain true until video image processing makes automatic tagging possible.

eSIGN Editing Environment

In the eSIGN project , our goal is to lower the barriers for Deaf people from participating in tomorrow's information society by creating efficient means to provide information in sign language. As the information in sign language is provided by an on-screen avatar driven by SiGML, an XML encoding for the HamNoSys sign notation (Elliott et al., 2000 and Kennaway, 2002), bandwidth

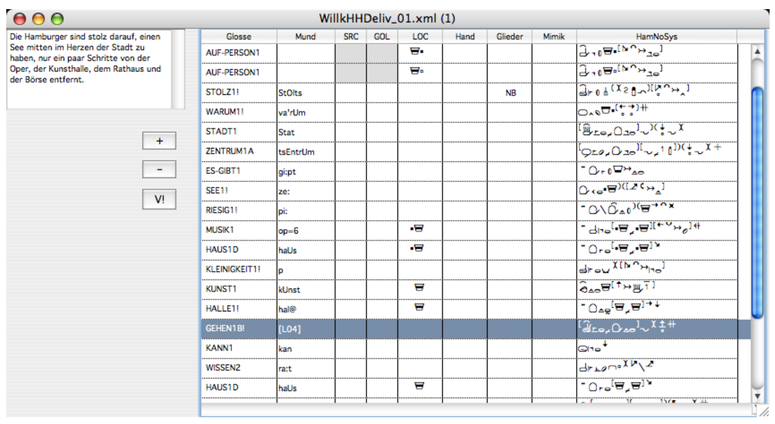
```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE sigml SYSTEM
                "http://www.visicast.org/sigml/SiGML_h4_10.dtd"!>
<sigml>
<hamgestural_sign gloss="HAMBURG2">
  <sign_nonmanual>
    <mouthing_tier>
      <mouth_picture picture="hambUrk"/>
    </mouthing_tier>
  </sign_nonmanual>
  <sign_manual>
    <handconfig handshape="ceeall" mainbend="bent"
                                                ceeopening="slack"/>
    <handconfig extfidir="ul"/>
    <handconfig palmor="d"/>
    <location_bodyarm location="forehead" side="right_beside"
                                                contact="close"/>
    <par_motion>
      <directedmotion direction="r"/>
      <tgt_motion>
        <changeposture/>
        <handconfig handshape="pinchall" mainbend="bent"/>
      </tgt_motion>
    </par_motion>
  </sign_manual>
</hamgestural_sign>
</sigml>
```

A sign that is glossed HAMBURG2 in our database together with its HamNoSys and SiGML representation

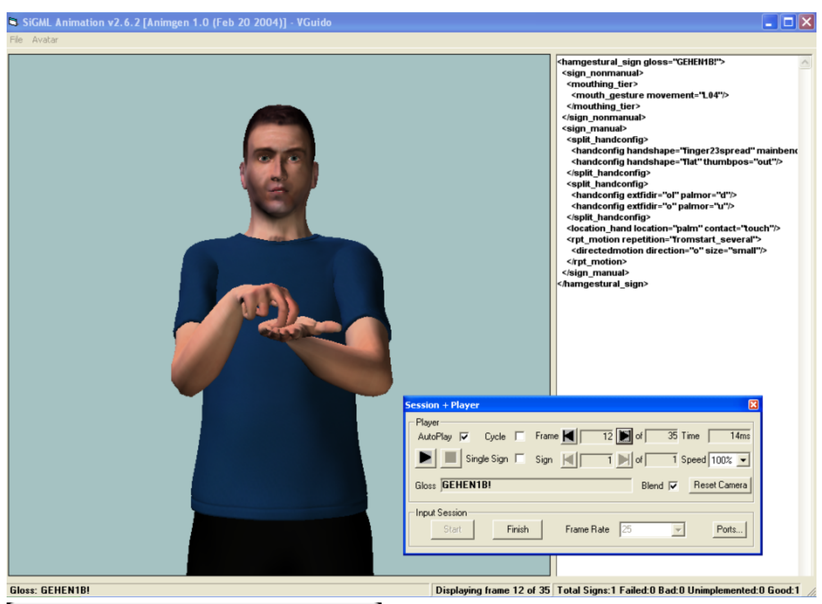
requirements are minimal. A key point here is the speed in which a translator can adapt the signed text to contents changes in the source material.

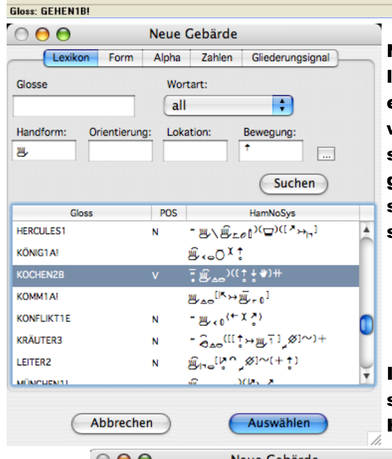
The editing environment (cf. Hanke et al., 2003) created for this purpose gives the user an economic approach to create signed sequences without restrictions on word order, grammatical constructions, or the choice of lexical items.

In the editor, each utterance of the signed text is handled separately. In order to create or modify an utterance, the user opens a window to specify the sequence of signs.



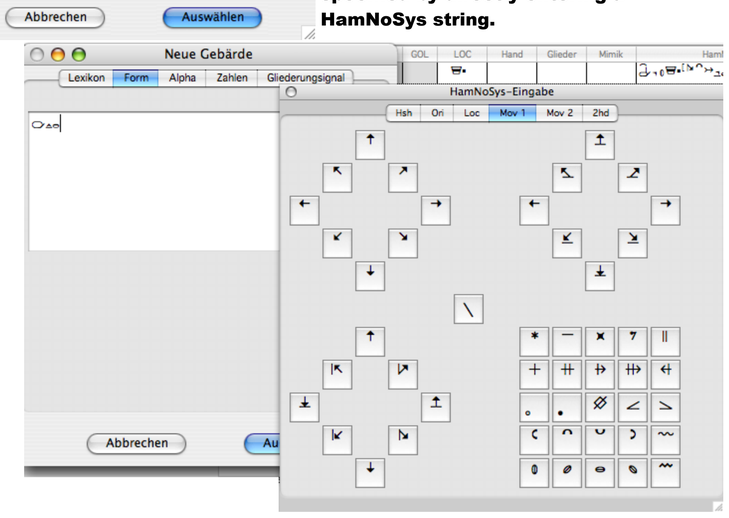
Signs are represented by glosses as well as a couple of form aspects. Some columns are governed by the lexical entries. i.e. the lexical entry (= its HPSG type) determines whether a field may be filled by the user (otherwise it is grey) and which default value to use. The user can view the utterance as a whole or sign-by-sign by using the avatar playback controls.





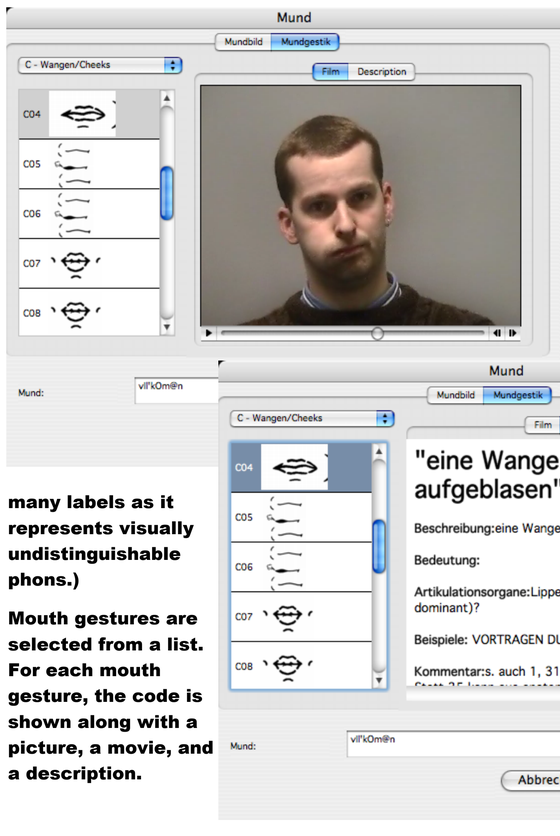
New signs are usually chosen from the lexicon, the resource continuously extended through corpus transcription work. A dialog window allows the user to specify search criteria (parts of the gloss, HamNoSys form aspects, or part of speech) and then select from the result set.

If a sign is not in the lexicon, it can be specified by directly entering a HamNoSys string.



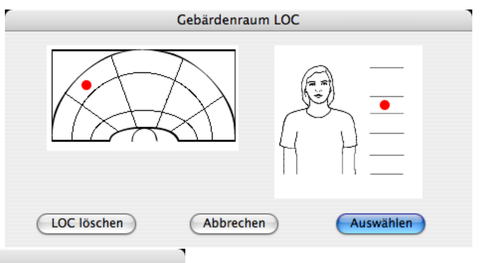
For numbers, fingerspelling as well as discourse structure signals, special editors are available.

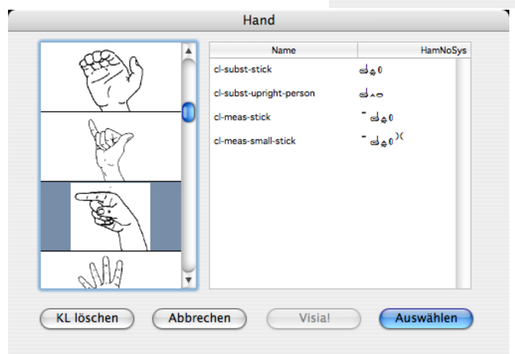
Lexical entries usually have a mouthing, either a mouth picture or a mouth gesture. As there is no strict one-to-one mapping, the user has the option to specify an alternate form. For mouth pictures, a spoken language text can be entered and then be converted to the SAMPA (Gibbon et al., 1997) pronunciation encoding used for viseme description. (The pronunciation database builds on the Bonn machine-readable pronunciation dictionary, Portele et al. 1995. The SAMPA codes are used for reading convenience, they are so to say labels of the visemes, with a viseme having as many labels as it represents visually undistinguishable phons.)



Mouth gestures are selected from a list. For each mouth gesture, the code is shown along with a picture, a movie, and a description.

Other editors allow the user to specify the kind of inflection that is to be applied to the sign. Values chosen here modify the HamNoSys string for the sign finally to be sent to the avatar.





Overlap and Synergies

Certainly the greatest time saver in creating signed contents with the eSIGN editor is the integration of the lexicon. Even if its main use as the repository for empirical work shows and requires some compromises on the side of the eSIGN contents creators, it saves the time consuming ad-hoc notation of signs in more than 90% of the cases. For the transcribers, on the other side, the animation path provides a convenient feedback loop which now forms an essential part of the strategy for quality assurance in the transcription database: The transcriber can immediately send any notation to the avatar and verify that it matches the observed token or the intended type citation form.

To a certain extent, an iLex transcription can be converted into an eSIGN document and vice versa: Both manual and nonmanual form can be converted back and forth. Differences in other tiers are by intention, as the normative use of higher-level concepts for efficient specification of sign modification is not acceptable for the transcription trying to minimise inherent interpretation of the data in the first step. (The transcript in the first screendump was created from the eSIGN document shown in the second screendump and then time-aligned to the video.)

The empirical data (token variation and token contexts) allow our system to hypothesise a linguistic classification of the iLex lexical entries and to automatically generate new (open-class) HPSG lexicon entries from there. Obviously, the quality of the hypotheses depends on the size and representativeness of the corpora analysed.

Outlook

The eSIGN approach to describe signed utterances as sequences of signs works quite well in the project's current domain, informative texts. In casual signing, however, co-articulation is a usual phenomenon. While two signs in parallel pose no problem at all for an interlinear transcription tool such as iLex, the eSIGN editor needs to become more flexible without loosing too much of its efficiency.

As animation quality improves, the integration of iLex and eSIGN technologies also offers a possibility of practical relevance for any sign language researcher: It allows the faithful reproduction of data where the original data cannot be made available as it is virtually impossible to anonymise sign language video.

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http://www.sign-lang.uni-hamburg.de/eSIGN/