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► **To cite this version:**

Annelies Braffort, Laurence Bolot, Jérémie Segouat. Virtual signer coarticulation in Octopus, a Sign Language generation platform. International Gesture Workshop, Jan 2011, Athens, Greece. hal-01634112

HAL Id: hal-01634112

<https://hal.science/hal-01634112>

Submitted on 20 Dec 2023

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Virtual Signer Coarticulation in Octopus, a Sign Language Generation Platform

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Abstract. *This work is related Sign Language utterance generation and coarticulation. It first lists the important feature to tackle in such systems, and introduce the notion of coarticulation in SL. Then, we describe one of our SL generation platforms, and the way coarticulation is integrated. The current version allows us to evaluate the settings for some coarticulation effects, such as transition and sign durations.*

Keywords: Sign Language coarticulation, Virtual Signer Animation

1. Introduction

Limsi initiated a few years ago a virtual signer project [4] with the purpose of generating French Sign Language (LSF). There already exist European projects capable of producing sequences of signs [3], but we would like to take them a step further on various aspects: linguistic modelling allowing us to generate sentences making use of space, naturalness of body animation, non-manual features, and coarticulation. We have recently integrated in one of our generation platforms, called Octopus, a module dedicated to coarticulation.

This paper describes the coarticulation module used in Octopus. Section 2 goes through the main characteristics of LSF and addresses the consequent problems posed for coarticulation phenomenon. Section 3 presents the Octopus software platform as well as the methodology we chose for coarticulation management. Section 4 states our progress and discusses some of the prospects.

2. SL utterance generation: tackling coarticulation

The number of body features involved in LSF communication allows for a lot of information at once: Sign Languages (SLs) do not only use hands, but also shoulders, eye gaze, facial expression, head movements; linguistic studies of LSF show a heavy and consistent use of the signing space, i.e. the portion of space in which the signs are performed; iconicity is also an important feature of both its lexicon and its grammar. It is proven by linguists that often neglected details such as eye gaze or tension all contribute to the construction of meaning in a more than significant way [8, 2].

Another important factor concerns coarticulation. Coarticulation is interested in all the consequences generated by the simultaneous operation of several articulators. In addition, numerous studies related to speech have shown that the effects of coarticulation extend well beyond the immediate neighbouring phonemes, thus proving that this phenomenon is not completely due to physical constraints or inertial effects. Coarticulation is crucial to the intelligibility of the sentence. If a sentence is synthesized without any constraint of coarticulation between phonemes, this sentence is incomprehensible. Thus this factor must be taken into account in SL generation for a better understandability of the animations.

Linguistic studies have studied coarticulation effects on handshape [1] and place of articulation [9, 5]. But at this moment, most of the SL generation systems don't tackle coarticulation, but only transition from one gesture to another, generally by means of a simple interpolation [3], or based on biological knowledge [7]. We try at Limsi to handle studies on coarticulation [11] in order to integrate knowledge on that factor in our SL generation platforms. The first effect that we want to integrate is a control on the transition between the signs, and modification of the sign duration. We present now the first steps of such integration in one of our platform, Octopus.

3. Coarticulation management into LIMSI's Octopus platform

One of the LIMSI's SL generation platforms, called Octopus [4], allows us to evaluate the coarticulation models we are elaborating. Octopus handles the generation of a SL utterance as follows:

- There is no animation generation: a list of predefined animation of signs or sequences of sign is stored in a database; we will keep called them *sequences* in the following.
- A SL utterance is built by a concatenation of sequences.
- For all signs the realisation of which varies regarding to the context (e.g. pointing), for simplification, we predefine several realisations [10].
- Lastly, each utterance contains prologue and epilogue gestures, allowing the virtual signer to begin and to end the utterance in a rest posture.

These sequences are built using rotoscoping, including prologue and epilogue gesture, in order to build as realistic animations as possible, and to keep the isolated sequences in the context of a continuous flow, which is useful for coarticulation studies.

In the very first version of Octopus, coarticulation was implemented as a simple interpolation between the last frame of a sequence and the first frame of its following sequence. Thus the rest posture was interposed between each sequence. Fig. 1 shows an example of animation containing two sequences: the signs for the numbers one (2nd image) and two (4th image), with intermediate rest postures at the beginning and the end of the utterance, and between the two sequences (1st, 3rd and 5th images).



Fig. 1. Transition between signs [ONE] and [TWO] using an intermediate rest posture.

The current version of Octopus now allows specifying the frames that can be excluded from the transition and the duration of the transition. Fig. 2 shows the same succession of signs [1] and [2], but with a more realistic transition (3rd image).



Fig. 2. Transition between signs [ONE] and [TWO] using coarticulation parameters

Moreover, it allows setting another coarticulation parameter, the modification of sequence duration: each sequence can be extended or shortened in context. This effect has been studied in [6] and [11]. What have been implemented here corresponds to a global effect: duration of sign in context is shorter than duration of isolated sign. Fig. 3 shows the interface that allows duration parameters to be modified, tested by hand, and stored in an XML file.



Fig. 3. Interface for selecting some coarticulation parameter values.

4. Current progress and prospects

We have presented in this paper a work related to Sign Language utterance generation and coarticulation. We have described Octopus, one of our SL generation platforms,

and the way it integrates coarticulation. The current version of Octopus allows us to set and evaluate some of the coarticulation rules, related to the transition and sequence durations. For the next steps, we will integrate more coarticulation effects: modification of handshape and of place of articulation. Evaluation will be performed using a subjective method, by showing to a sufficient number of subjects various utterances, with several versions of the coarticulation parameters. In the future, the XML file containing the coarticulation parameters will be automatically generated using coarticulation rules integrated in a set of SL grammar rules.

Acknowledgment

The research leading to these results has received funding from the European Community's Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 231135.

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