

## Realistically Animating Proforms Involving Placement and Movement in Sign Languages

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Portraying sign languages via an avatar is an essential component for noninvasive technologies whose goal is better Deaf-hearing communication. The legibility of an avatar's signing hinges on the naturalness of its motion. Achieving natural motion requires a linguistic system to structure communication content and a mathematical system to animate it. Without each the effort fails, and the result is robotic motion that is difficult to read.

*Proforms* in sign language are gestural units which consist of a handshape whose linguistic function is to reference an entity generally signed prior to the proform (i.e. Engberg-Pedersen et al 1985, Sutton-Spence et al 1999). Proforms are extensively used in depicting structures to express location and placement of entities or spatial relationships among entities. For example, in French Sign Language (LSF), the sign CAR has a related proform with a horizontal flat handshape to show the location and orientation of the car and the car's movement in signing space. In American Sign Language (ASL), the same is accomplished with a '3' handshape. To communicate such constructs legibly, the avatar's motion must be natural, and previous attempts have fallen short in this regard (Kacorri et al 2013)

Synthesizing proforms is challenging because they are among the least lexical constructs in sign languages, exploiting both gesture and semantic structures as the signer depicts a scene in space (Morgan-Woll 2007). The descriptive and productive nature of proforms precludes the use of pre-recorded or captured animations. Any effective solution must strike a balance between pre-recorded motion, which limits flexibility, and linguistically driven generation, which results in unnatural poses and robotic motion.

This presentation will describe a novel method for synthesizing proforms that builds on prior avatar and linguistic systems (Wolfe-McDonald-Schnepp 2011) (Filhol-Hadjadj 2016), and which allows the avatar system the freedom to choose natural postures and motions. This freedom arises from the fact that proforms are under-specified geometrically (Filhol, et. al. 2006), leaving open a range of degrees of freedom in placement and movement. The method allows the linguistic system to specify placement and motion by linguistic category, e.g. the straight or ballistic motions of (Liddell & Johnson 2011). An example for a straight movement can be found at <http://asl.cs.depaul.edu/proforms/moveperson.mp4>. The new method achieves this naturality via a system of non-linear motion controllers that can be tuned to linguistic styles. It produces natural proform placement and motion that can provide a test-bed for linguistic theory and a powerful tool for linguistic modeling and experimentation. The presentation will detail the linguistic descriptions and the mathematical models that comprise the method, and will demonstrate how the method exploits under-specification to choose postures and movement that communicate proforms legibly and flexibly.

## References

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