Machine Learning Models through Motion Capture Data: Revealing Mechanisms for Person Identification from Sign Language Motion

Félix Bigand[1], Elise Prigent[1] and Annelies Braffort[1]
[1]LIMSI-CNRS, Paris-Saclay University - Orsay, France
felix.bigand@limsi.fr

I. Introduction

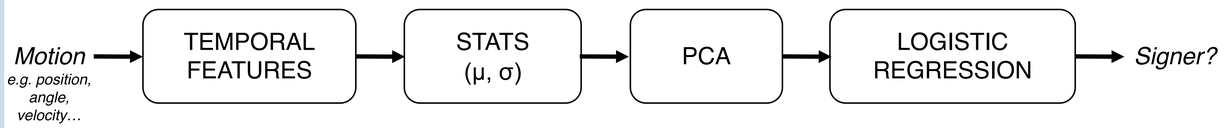
- Despite numerous advantages, using motion capture data to animate virtual signers could convey the identity of the real signer (such as voice for speakers).
- Recognizing the identity of signers is an important issue in Sign Language (e.g. anonymous testimony on TV).

- **Problem:**
  - Which motion features are responsible for identification?
  - How these features could be manipulated in Sign Language animations?

- We present a **computational model of person identification** based on motion capture (mocap) data and machine learning.
- **Aim:** extracting critical features for identification and allowing for the synthesis of *identity-controled* motion.

II. General workflow of the model

- The signer is identified using Principal Component Analysis and multinomial logistic regression based on statistics of motion features (19 upper-body markers).



III. Anthropometric normalizations

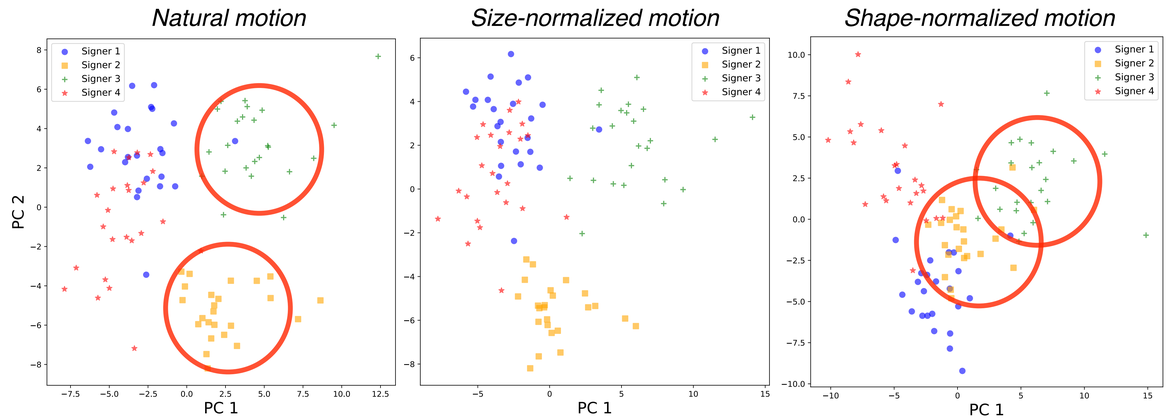
- Similarly to Troje et al. (2005) [1], the input motion data can undergo:
  - **Size normalization:** Using linear regression of the mocap data, all signers then have the same size but relative positions of the articulations still differ, keeping shape intact.
  - **Shape normalization:** Each signer's skeleton is substracted and replaced by the average skeleton across signers.

References

[1] Troje, Nikolaus F., Cord Westhoff, and Mikhail Lavrov. "Person identification from biological motion: Effects of structural and kinematic cues." *Perception & Psychophysics* 67.4 (2005): 667-675.
[2] Bigand, Félix, Elise Prigent, and Annelies Braffort. "Person Identification Based On Sign Language Motion: Insights From Human Perception And Computational Modeling." *Proceedings of the 7th International Conference on Movement and Computing*. 2020.
[3] Carlson, Emily, et al. "Dance to your own drum: Identification of musical genre and individual dancer from motion capture using machine learning." *Journal of New Music Research* 49.2 (2020): 162-177.

IV. The role of size and shape differences

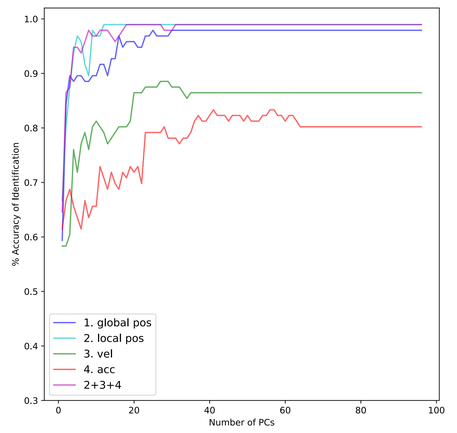
- The first 2 principal components (PCs) extracted by the model when trained on [2]:



- Signers 2 and 3 have different morphologies, but the two-step normalization allows for the assessment of further discriminant features, such as kinematic ones.

V. Feature comparison and interpretation

- Accuracy of identification, with the first 4 PCs:
  - local positions: **93.8%**
  - {local positions, velocities, accelerations}: **94.8%**



- **Main takeaways:**
  - The model is able to identify signers, as recently reported for dance motion [3].
  - It still identifies even after having normalized for size and shape, in line with prior human data [1].

- **Interpreting the PCs (ongoing):**
  1. Which signers are identified by the PC?
  2. Interpreting the PC in terms of correlation with the input data. *(e.g. body inclination)*
  3. Visualizing the PC using motion synthesis. *(e.g. exaggerating the PC score)*

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