Facial Expressions for Sign Language Synthesis using FACSHuman and AZee

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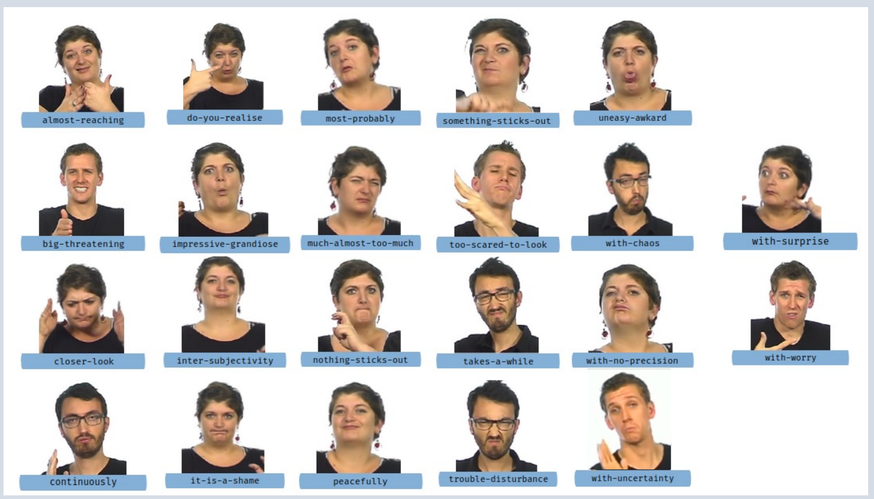
Abstract

- ***Objective***: *Facial expression synthesis for signing avatars from AZee.*
- ***Methodology:***
  - *action unit analysis with computer vision;*
  - *morph target animation.*
- ***Result***: *full set of synthesized 22 facial expressions recently discovered for LSF*

Background

- Facial expressions: essential in Sign Language (SL)
- Avatars: indispensable for software tools
- AZee: a formal model allowing SL synthesis

Study on non-manual gestures with AZee (Challant & Filhol, 2024): **22** AZee production rules concerning facial expressions were identified



Extended Morphs in AZee (Sharma & Filhol, 2023): An implementation of morphs/blendshapes was added in the AZee language's posture level description.

Morphs constraints in AZee:

```
morph
    'morph id
    weight [0 , 1]
```

Morphs used for both skeleton and facial expressions between 0 and 1.

GOAL: Facial expression synthesis to support the 22-rule set

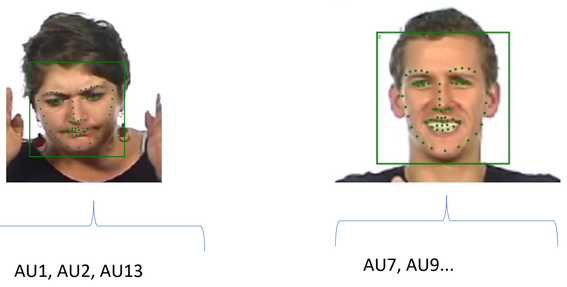
Methodology

- Defining facial expressions in FACS space

Upper Face Action Units					
AU 1	AU 2	AU 4	AU 5	AU 6	AU 7
Inner Brow Raiser	Outer Brow Raiser	Brow Lowerer	Upper Lid Raiser	Cheek Raiser	Lid Tightener
*AU 41	*AU 42	*AU 43	AU 44	AU 45	AU 46
Lid Droop	Slit	Eyes Closed	Squint	Blink	Wink
Lower Face Action Units					
AU 9	AU 10	AU 11	AU 12	AU 13	AU 14
Nose Wrinkler	Upper Lip Raiser	Nasolabial Deepener	Lip Corner Puller	Cheek Puffer	Dimpler
AU 15	AU 16	AU 17	AU 18	AU 20	AU 22
Lip Corner Depressor	Lower Lip Depressor	Chin Raiser	Lip Puckerer	Lip Stretcher	Lip Funneler
AU 23	AU 24	*AU 25	*AU 26	*AU 27	AU 28
Lip Tightener	Lip Pressor	Lips Part	Jaw Drop	Mouth Stretch	Lip Suck

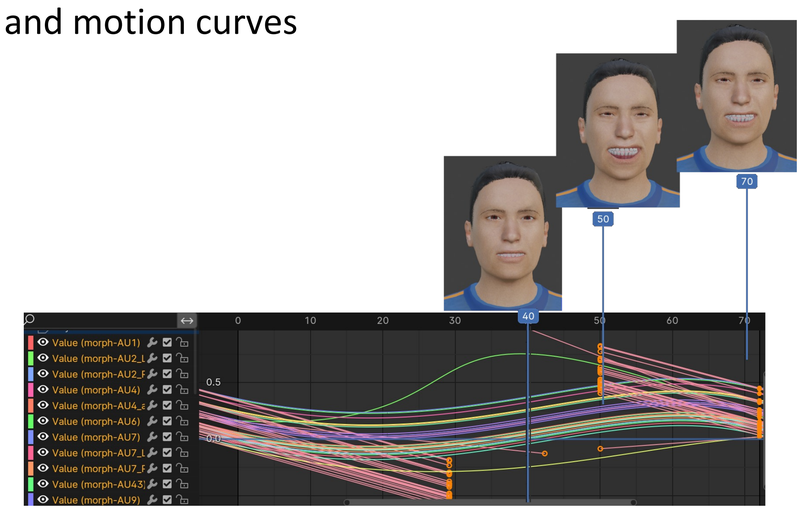
FACS

- Detection of AUs using Multi-dimensional Edge Feature Learning (MEFL) (Luo et al., 2022)



- Starting point for subsequent manual modelling using FACSHuman (Gilbert et al., 2018)
- Facial expressions implemented in the existing AZee animator (Sharma et al., 2022)

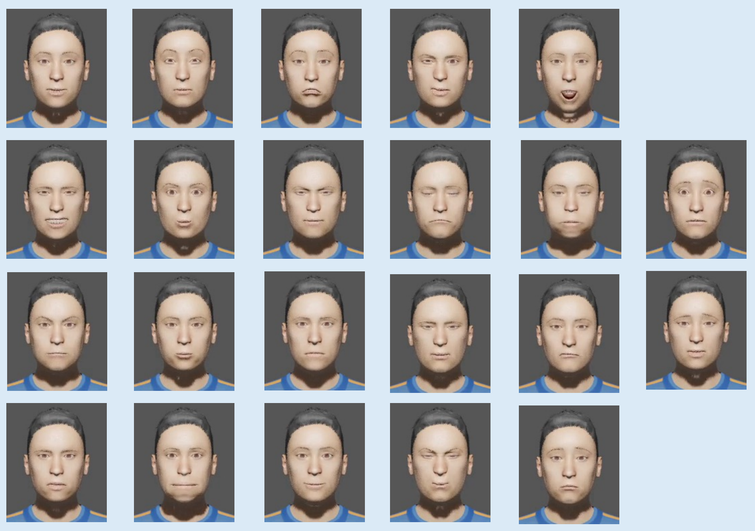
- All FACSHuman AUs modeled as Blender shape keys and motion curves



Motion Template for the production rule `big-threatening`

- Shape keys can work on different avatars

Result



All facial expressions with AUs here →

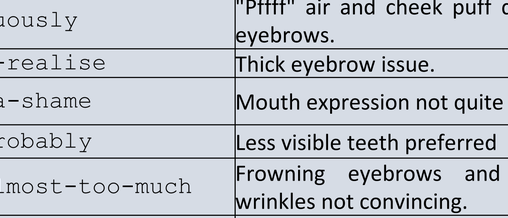
Try the animator ! →

Evaluation

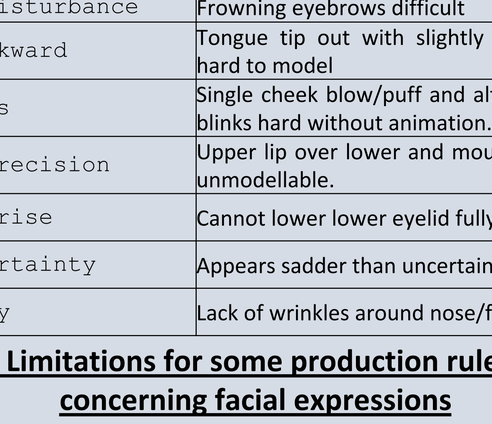
Production rules	Limitations
`almost-reaching`	Mouth modeling unconvincing.
`continuously`	"Pffff" air and cheek puff difficult, neutral eyebrows.
`do-you-realise`	Thick eyebrow issue.
`it-is-a-shame`	Mouth expression not quite real.
`most-probably`	Less visible teeth preferred
`much-almost-too-much`	Frowning eyebrows and lack of eye wrinkles not convincing.
`nothing-sticks-out`	Tucked lips difficult to model.
`something-sticks-out`	Interpreted as confusion
`trouble-disturbance`	Frowning eyebrows difficult
`uneasy-awkward`	Tongue tip out with slightly open mouth hard to model
`with-chaos`	Single cheek blow/puff and alternating eye blinks hard without animation.
`with-no-precision`	Upper lip over lower and mouth near nose unmodellable.
`with-surprise`	Cannot lower lower eyelid fully
`with-uncertainty`	Appears sadder than uncertain
`with-worry`	Lack of wrinkles around nose/forehead.

Limitations for some production rules concerning facial expressions

Future Work



FLAME (Li, et al, 2017)



NFR (Qin et al., 2023)

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