Synthesizing Sign Language by Connecting Linguistically Structured Descriptions to a Multi-track Animation System

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Linguistics and Animation

- Animation supports sign linguistics by providing
  - Target for synthesis and translation
  - Visualization of the linguistic encoding
  - Platform for testing theory
- Linguistics provides sign animation with rules that
  - Help structure human animation of sign
  - Specifies how human motion changes with meaning
  - Helps create novel utterances from prior animation

Goals of the present effort

- Diverse efforts around the world
  - Different sign languages
  - Different representations of sign
  - Different animation techniques
- Explore connecting
  - A structured linguistics description of sign (LIMSI's AZee)
  - A hybrid animation system (DePaul's Synthesizer)
- Neither specifically designed to work with the other

AZee description of SL

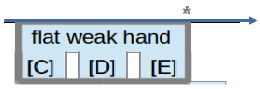
- Very basic assumptions:
  - language productions create observable forms carrying intended meaning
  - systematic links between the two specify the language (**production rules**)
  - languages allow for compositional structures
- No assumed language level or hierarchy:
  - **multi-linearity** at all levels
  - **no functional partitioning** of the articulator set (body)
- Experimental corpus search approach for rules to surface

AZee rules

- A production rule is a tuple:

  <semantic function, parameter list>

- Examples:
  <**restaurant**, [optional *loc*]>

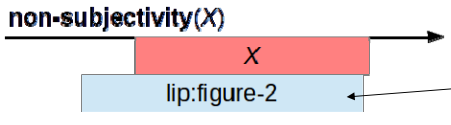


AZee rules

- A production rule is a tuple:

  <semantic function, parameter list>

- Examples:
  <**non-subjectivity**, [*X*: judgement]>



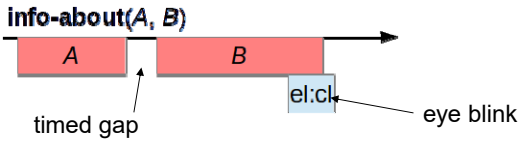
AZee rules

- A production rule is a tuple:

  <semantic function, parameter list>

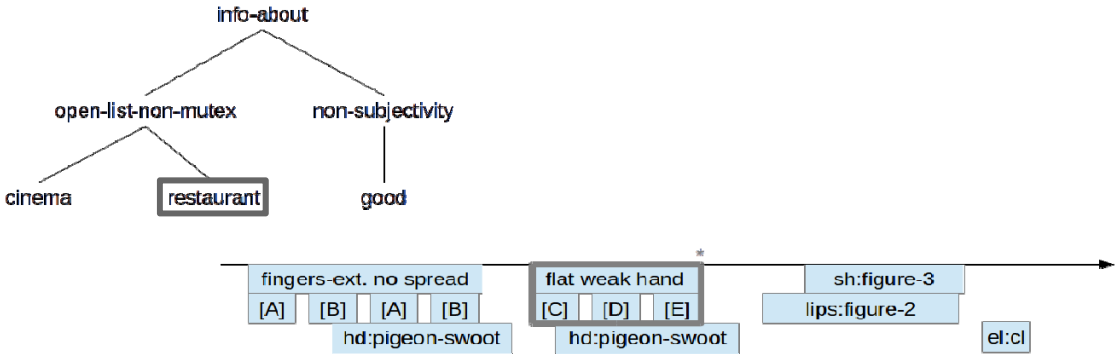
- Examples:

  <**info-about**, [*A*: topic, *B*: info]>



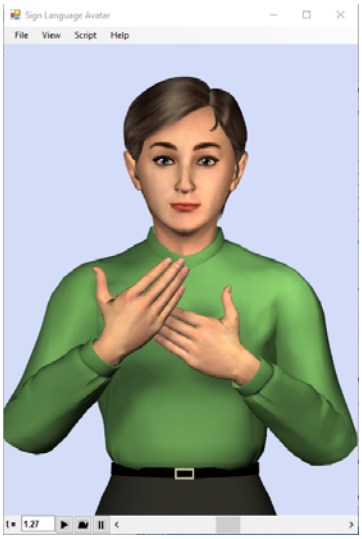
AZee rule nesting

- A parameter for one rule can be given as a signed form produced by another rule (recursive nesting)



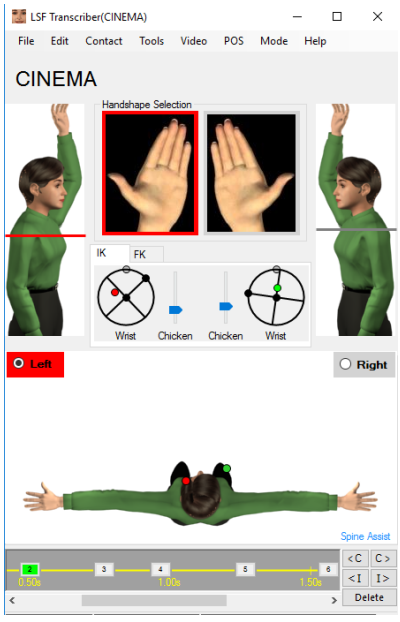
Hybrid animation

- Combine any or all of
  - Traditional animation
  - Procedural animation
  - Motion capture
- Use the technique most appropriate to each process



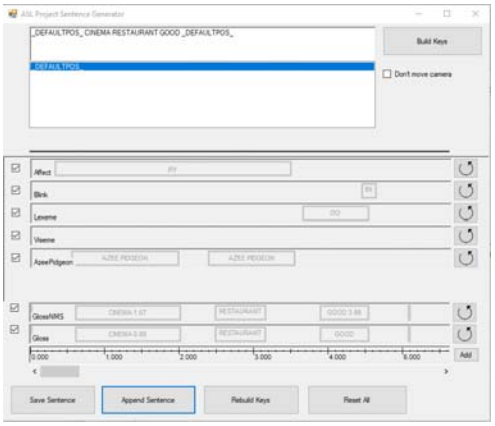
Paula: Tuned to Sign

- Interface tuned to SL
  - Uses language of sign (e.g. handshape)
  - Encourages **sparse** key frames
- Artists animate basic blocks
  - Build lexical blocks/glosses
  - Setup rules for procedures like spatial verb agreement
- Procedural techniques shorten animation cycle
  - Spine assist (McDonald, 2013)
  - Ambient motion (McDonald, 2015)



Paula: A layered, multi-linear approach

- Multiple processes layered to form utterances
  - Lexical units
  - Non manual syntax signals
  - Blinking
  - Head movement, etc.
- Complex timing
  - Asynchronous block timing
  - Possible to tie dependent together
- No track “owns” specific geometry



Comparing the two systems

Azee

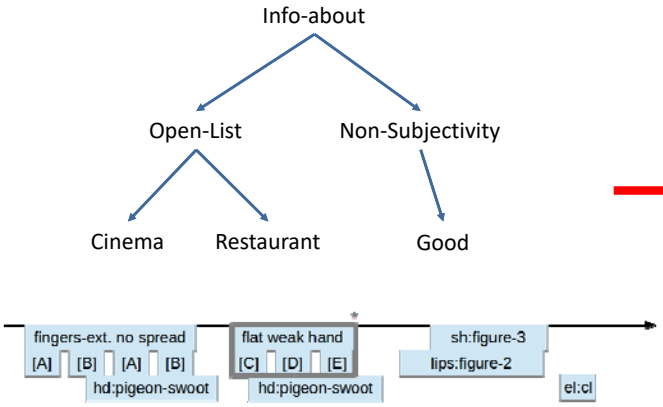
- Produces a multi-linear asynchronous representation
- No-functional partitioning
- Hierarchical representation with nested information

Paula

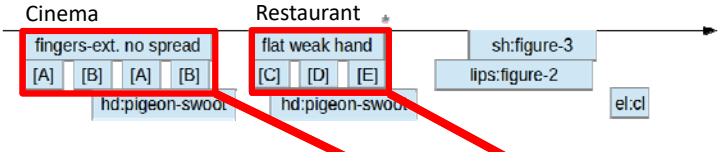
- Multi-linear asynchronous animation tracks
- Multiple tracks can affect same geometry
- Mixture of animation styles

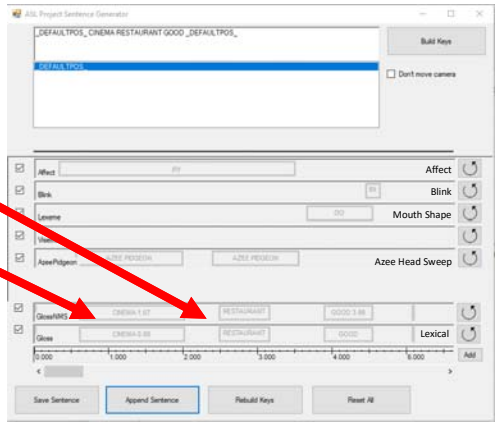
Guiding Principle: The coarser the basic animation blocks, the more natural the final animation

Animating AZee

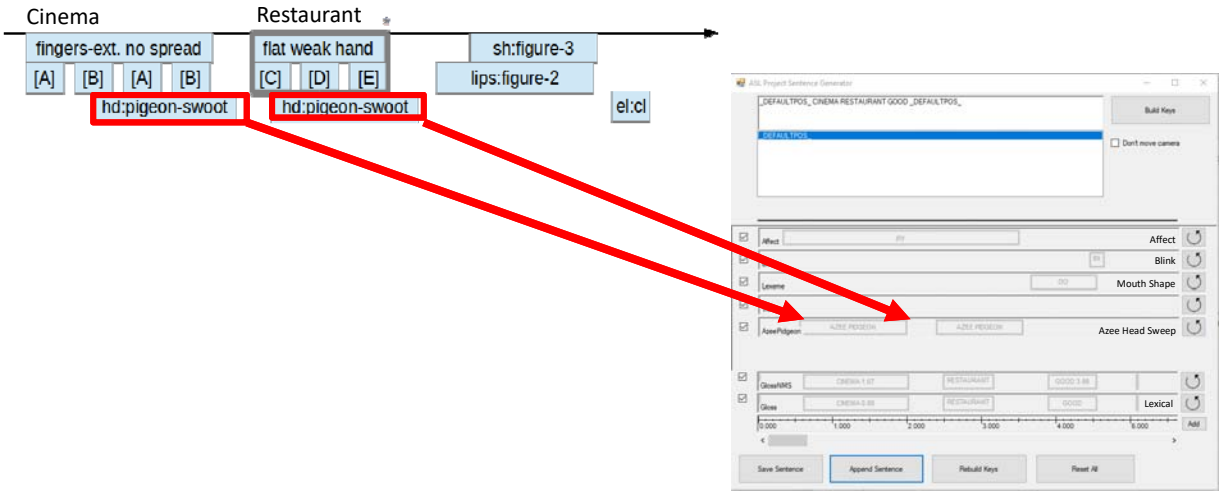


Animating AZee

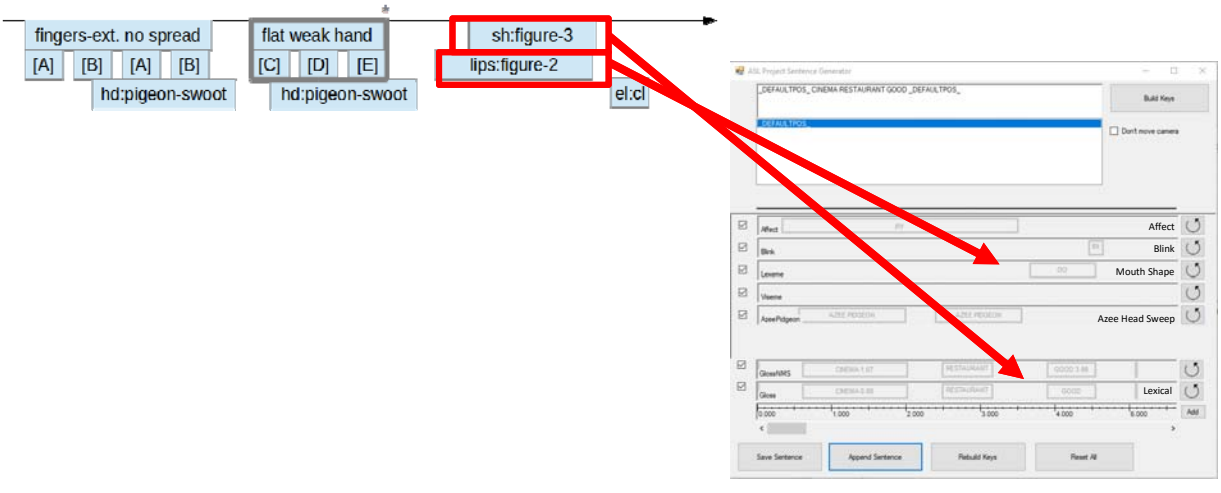




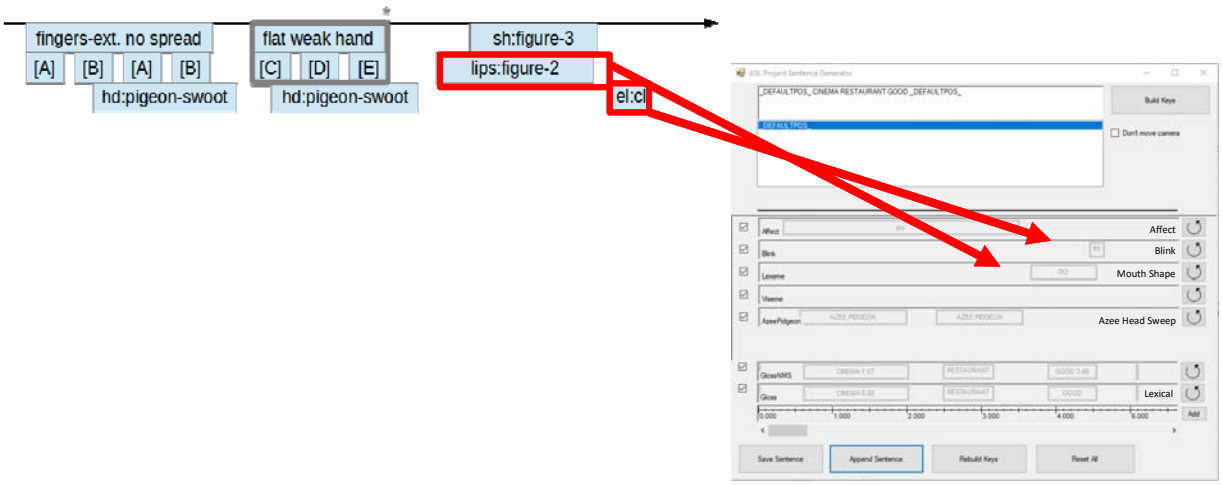
Animating AZee



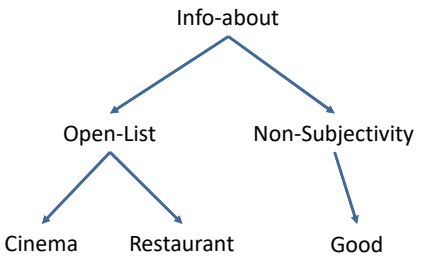
Animating AZee



Animating AZee



Results



Conclusion

- A first attempt at connecting two mature systems
- Capitalizes on the functional similarity of the two systems
- Bridges from the multi-linear block output of AZee to the multi-track animation system of the DePaul Synthesizer
- Future work:
  - Still relies on manual tuning of timing and duration
  - Need to expand the range of supported language processes and vocabulary

Thank You

Questions?

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