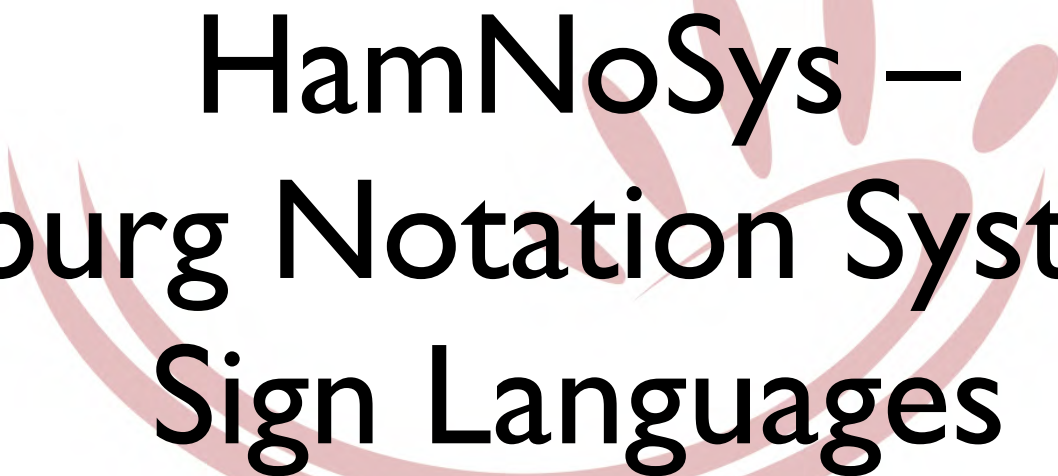


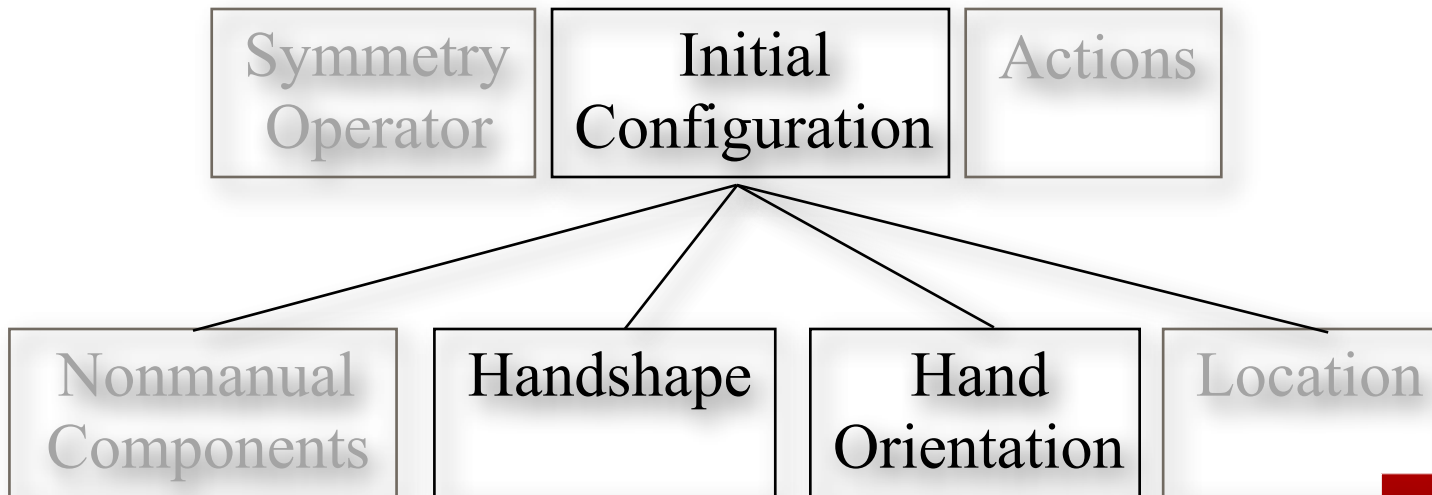
HamNoSys – Hamburg Notation System for Sign Languages



Thomas Hanke
Universität Hamburg
thomas.hanke@uni-hamburg.de

HamNoSys

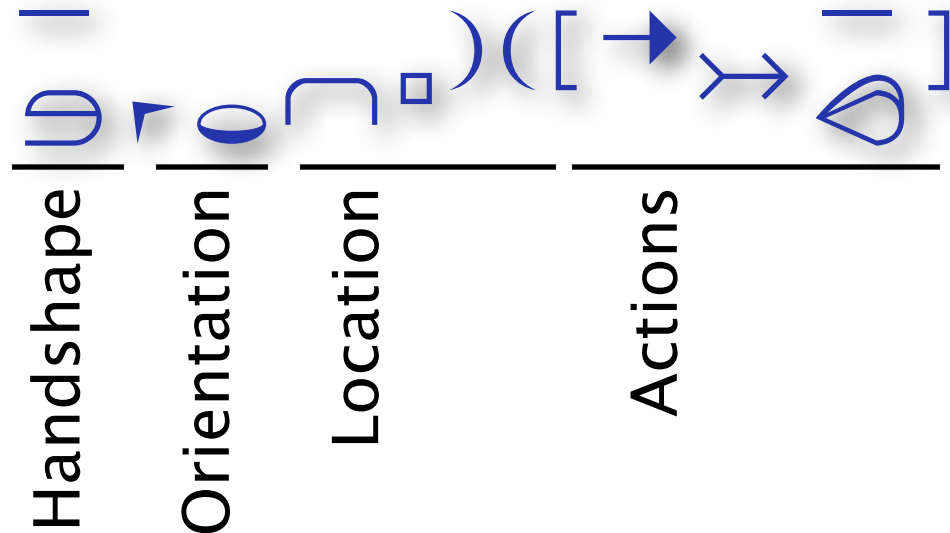
- Alphabet with a symbol inventory of ~210 characters
- Overall Structure:



HamNoSys Structure: DGS Example



HAMBURG





ulna

radius

Joints

DIP: distal interphalangeal joint
 PIP: proximal interphalangeal joint
 MCP: metacarpophalangeal joint
 CMC: carpometacarpal joint

Metacarpus
 (metacarpals)

CMC: carpometacarpal joint
 Carpus



Options for Defining Handshapes

- Manual Alphabet (fingerspelling)
- Joint Positions
- Iconic Names
- Derivation from Basic Types by Movement
- Derivation from Basic Types by Systematic Modifications
- Arbitrary Codes
- HamNoSys combines these principles



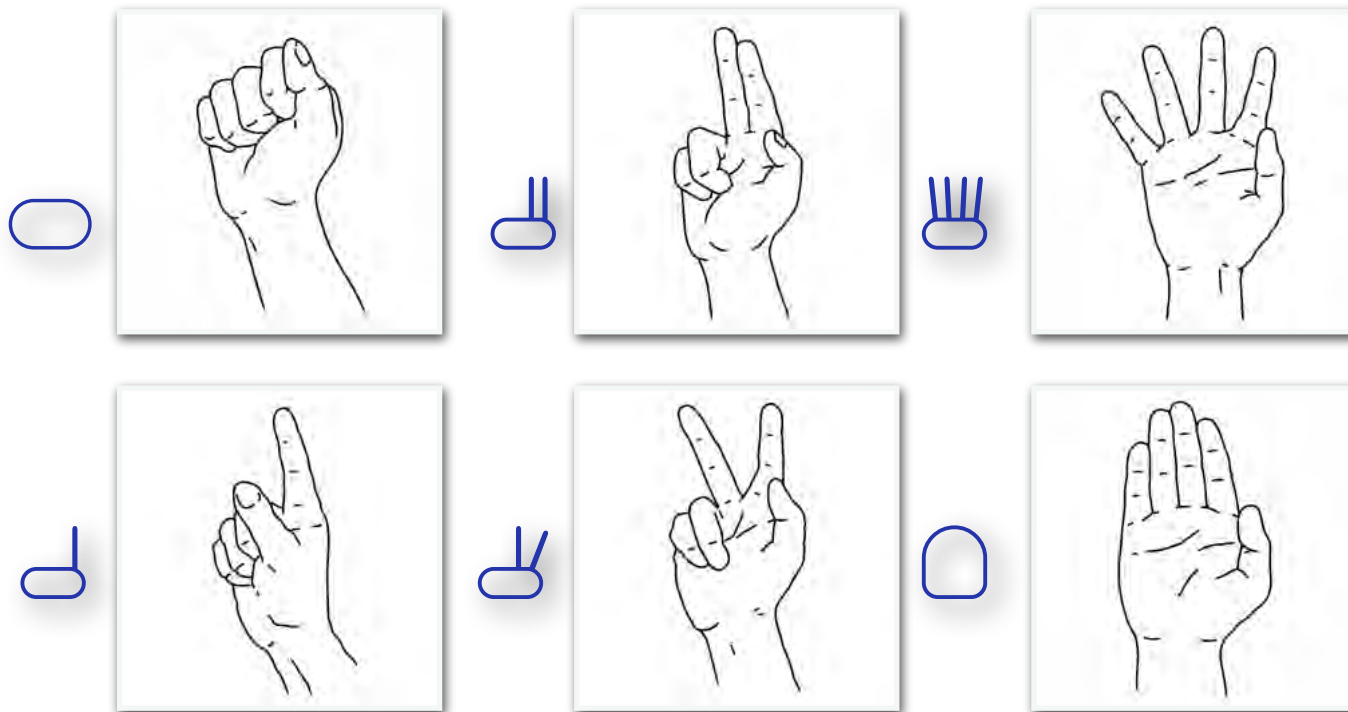
Handshape Descriptions

- Describes several 100 handshapes
- Very precise \leftrightarrow relatively coarse
 - Precise in contacts or oppositions
 - Coarse wrt joint angles in open handshapes
- Level of detail motivated by sign language phonology



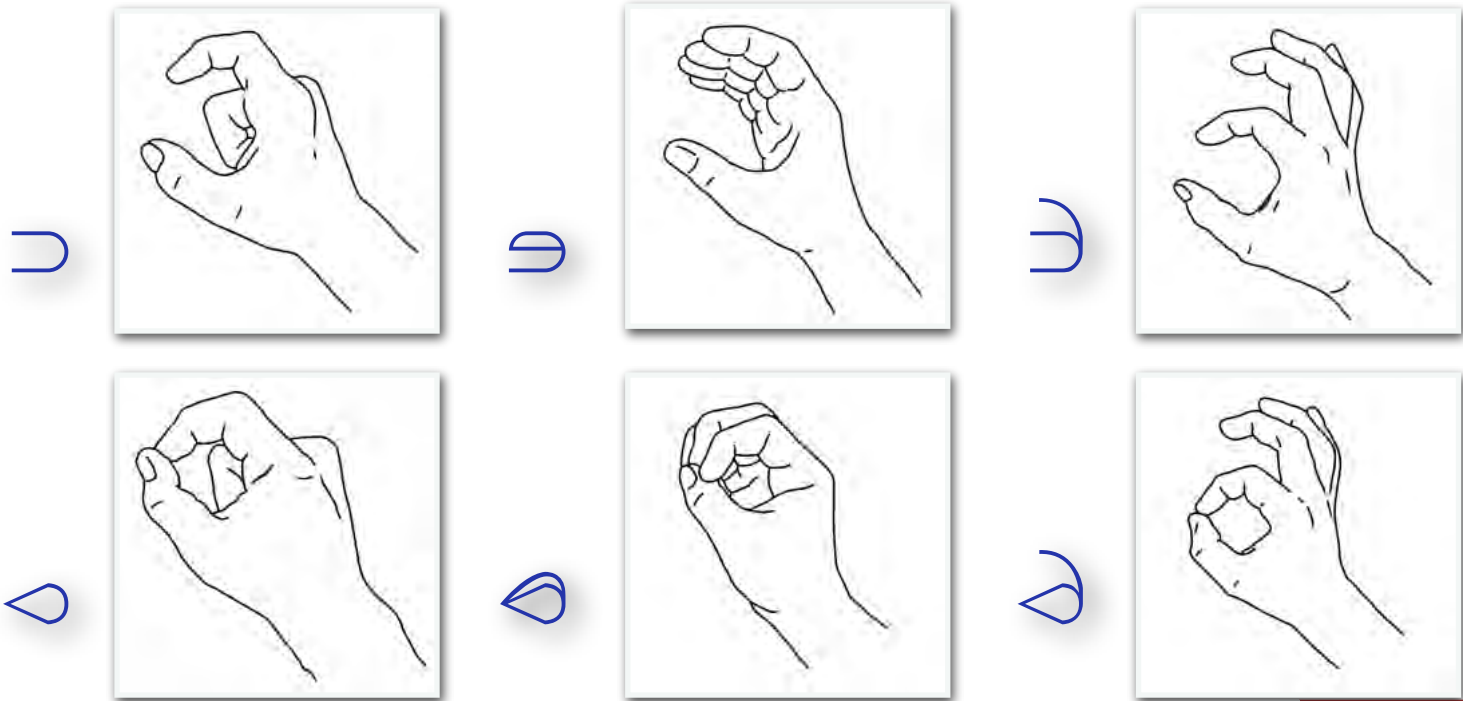
Basic Handshapes

- Six open handshapes



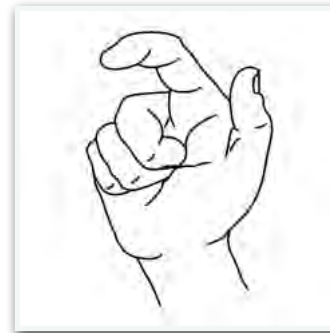
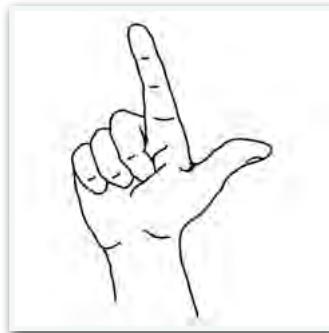
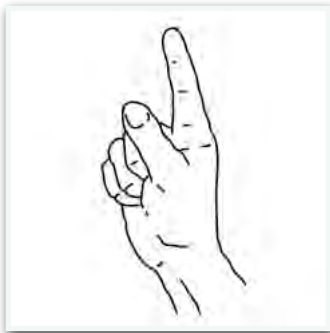
Basic Handshapes (2)

- ...and six thumb combinations



Handshapes from Basic Handshapes

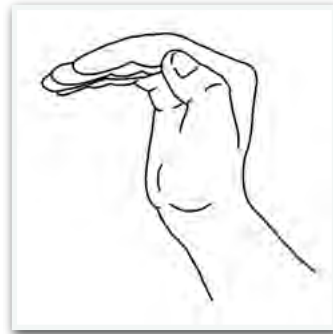
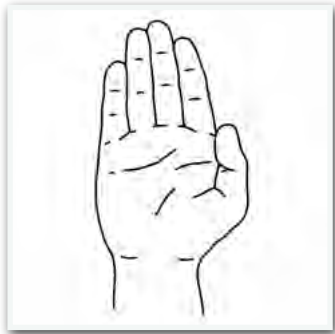
- plus thumb position
- plus bending



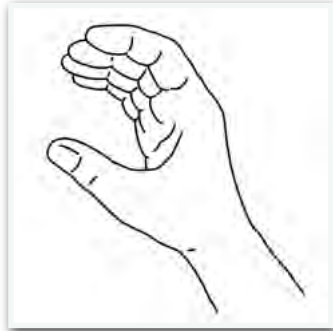
Thumb Positions



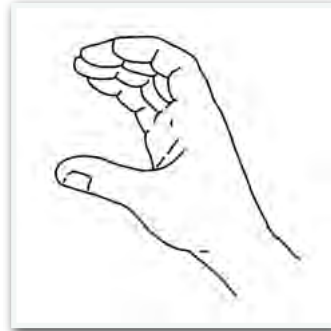
Bending



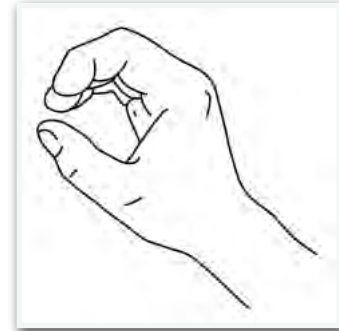
Width of Opening in Thumb Combinations



⇒



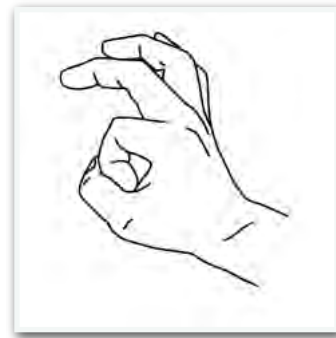
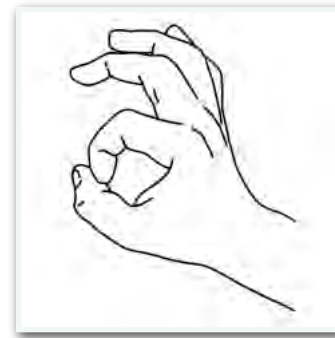
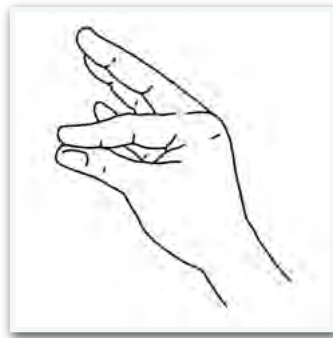
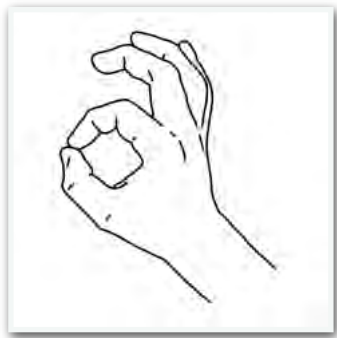
⇒



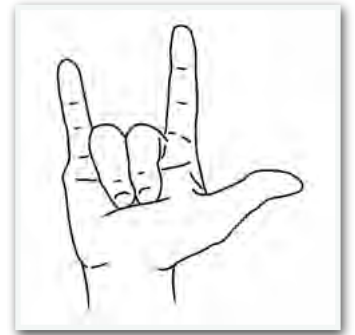
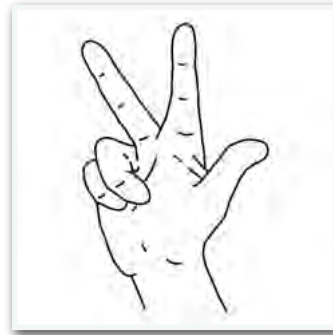
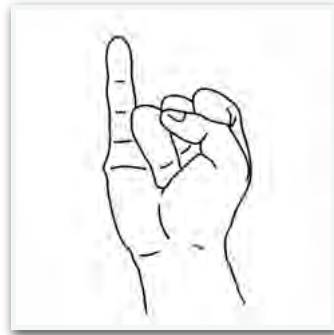
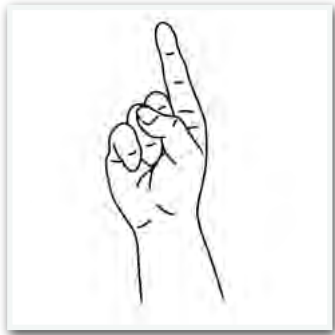
⇒



Thumb Combinations: Bending of Selected Fingers



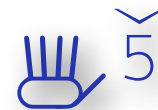
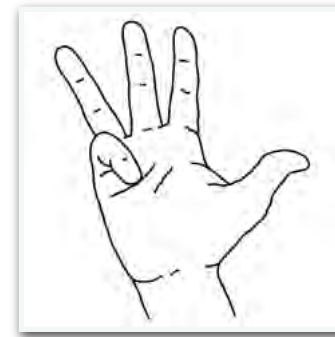
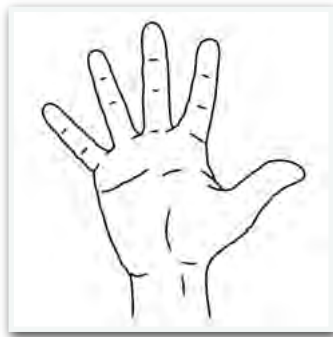
Finger Specifications Override Defaults



Fingers are numbered from 1-Thumb to
5-little finger/pinky





Finger Specifications Allow Individual Bending



For this, additional bending operators exist:

• Fist Position 

• Fist Position with unbent distal joint 

 = 

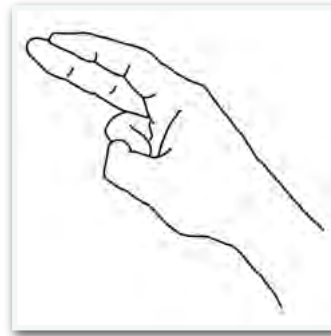
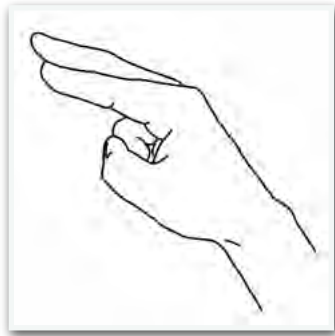


For thumb combinations, finger specifications specify the selected fingers



Handshapes: Finger Parts

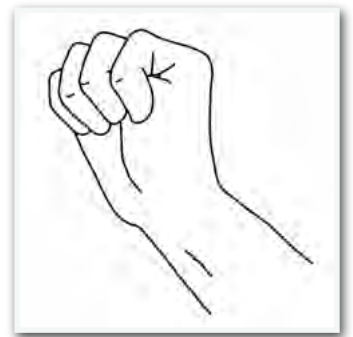
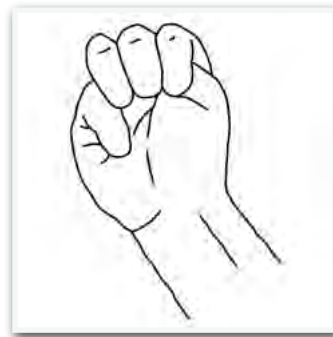
- Crossing Fingers are notated as:
 - Lower Finger > Point of Contact > Upper Finger



| | |
|---|----------------|
|  | Finger Tip |
|  | Finger Nail |
|  | Finger Pad |
|  | Middle Joint |
|  | Base of Finger |
|  | Side of Finger |



Thumb inbetween Fingers



○

○² \ 3

○³ \ 4

○⁴ \ 5

○ \



Handshapes

HamNoSys 4 Handshapes Chart

Please note that this chart aims at demonstrating how HamNoSys handshape notations are constructed, by no means is this chart an exhaustive list of HamNoSys handshape notations.

| Selection | Selected Fingers Extended | | | | Selected Fingers Flattened | | | | Selected Fingers Bent | | | | Selected Fingers Hooked | | | | Derivation Examples | | | | |
|--|--|--------|--|--|--|--------|--|-------|---|---|---|---|-------------------------|--|--|--|---------------------|--|--|--|--|
| Fist | | | | | | | | | | | | | | | | | | | | | |
| One Finger | | | | | | | | cf. 1 | | | | | cf. 2 | | | | | | | | |
| Two Fingers nonspread | | | | | | | | cf. 3 | | | | | cf. 4 | | | | | | | | |
| Two Fingers spread | | | | | | | | cf. 5 | | | | | cf. 6 | | | | | | | | |
| Flatland (Four Fingers nonspread) | | | | | | | | cf. 7 | | | | | cf. 8 | | | | | | | | |
| Four Fingers spread | | | | | | | | | | | | | | | | | | | | | |
| Thumb Opposition | Fingerip-Thumbip Opposition w/ fingers rounded | | | | Fingerip-Thumbip Opposition w/ fingers flattened | | | | Fingerip-Thumbip Opposition w/ fingers straight | Fingerip-Thumbip Opposition w/ hitchhiker's fingers | Fingerip-Thumbip's Interphalangeal Joint Opposition | Fingerip-Thumb's Metacarpophalangeal Joint Opposition | Derivation Examples | | | | | | | | |
| One Finger, others in fist position | | | | | | | | | cf. 9 | | | | SYS 10 | | | | | | | | |
| Two Fingers (nonspread), others in fist position | | | | | | | | | cf. 11 | | | | | | | | | | | | |
| Two Fingers (spread), others in fist position | | cf. 12 | | | | cf. 13 | | | cf. 14 | | | | | | | | | | | | |
| Four Fingers (nonspread) | | | | | | | | | cf. 15 | | | | | | | | | | | | |
| Four Fingers (spread) | | cf. 16 | | | | cf. 17 | | | cf. 18 | | | | | | | | | | | | |
| One Finger, others extended (spread) | | | | | | | | | cf. 19 | | | | | | | | | | | | |









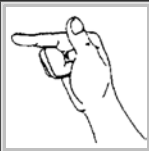


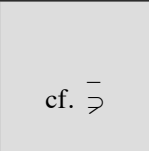







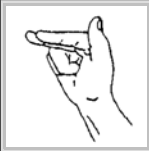

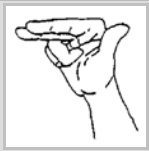
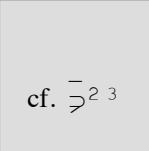






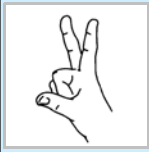
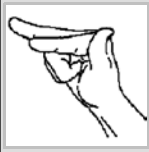






Thomas Hanke, 2010-06-10. Drawings by Heiko Ziemert, Olga Jezioraki, Andreas Hanß



Handshapes


HamNoSys 4 Handshapes Chart

Please note that this chart aims at demonstrating how HamNoSys handshape notations are constructed, by no means is this chart an exhaustive list of HamNoSys hand








| Selection | Selected Fingers Extended | | | | Selected Fingers Flattened | | | | Selected Fingers | | |
|-----------------------|---|---|---|---|--|---|---|---|---|---|---|
| Fist |  |  |  |  | | | | | | | |
| One Finger |  |  |  |  |  |  |  | cf.  |  |  |  |
| Two Fingers nonspread |  |  |  |  |  |  |  | cf.  |  |  |  |
| Two Fingers spread |  |  |  |  |  |  |  |  |  |  |  |

HamNoSys 4 Handshapes Chart

Please note that this chart aims at demonstrating how HamNoSys handshape notations are constructed, by no means is this chart an exhaustive list of HamNoSys hand

| Selection | Selected Fingers Extended | | | | Selected Fingers Flattened | | | | Selected Fingers | | | |
|-----------------------------------|---|---|---|---|--|---|---|---|---|---|---|--|
| Fist |  |  |  |  | | | | | | | | |
| One Finger |  |  |  |  |  |  |  | cf.  |  |  |  | |
| Two Fingers nonspread |  |  |  |  |  |  |  | cf.  |  |  |  | |
| Two Fingers spread |  |  |  |  |  |  |  |  |  |  |  | |
| Flathand (Four Fingers nonspread) |  |  |  |  |  |  |  | cf.  |  |  |  | |
| Four Fingers spread |  |  |  |  |  |  |  |  |  |  |  | |

s handshape notations.

| Selected Fingers Bent | | | Selected Fingers Hooked | | | | Derivation Examples | | | | |
|--|---|---|---|---|---|--|---|---|---|---|---|
|  | |  | | |  | |  |  |  |  |  |
| $\hat{\circ}$ | | $\hat{\circ}$ | | | $\hat{\circ}$ | | $\hat{\circ} 2 \setminus 3$ | $\hat{\circ} 3 \setminus 4$ | $\hat{\circ} 4 \setminus 5$ | $\hat{\circ} \setminus$ | $\hat{\circ}$ |
|  |  | cf. \supset |  |  |  |  |  |  |  |  |  |
| $\hat{\circ}$ | $\hat{\circ} 1$ | | $\hat{\circ}$ | $\hat{\circ}$ | $\hat{\circ}$ | $\hat{\circ} 1$ | $\hat{\circ} 3$ | $\hat{\circ} 5$ | $\hat{\circ} 5$ | $\hat{\circ} 1$ | $\hat{\circ} \setminus$ |
|  |  | cf. $\supset 2 3$ |  |  |  |  |  |  | | | |
| $\hat{\circ}$ | $\hat{\circ} 1$ | | $\hat{\circ}$ | $\hat{\circ}$ | $\hat{\circ}$ | $\hat{\circ} 1$ | $\hat{\circ} 2 \hat{\circ} 3$ | $\hat{\circ} 3 \hat{\circ} 2$ | | | |
|  |  |  |  |  |  |  |  |  | | | |
| $\hat{\circ}$ | $\hat{\circ} 1$ | $\hat{\circ}$ | $\hat{\circ}$ | $\hat{\circ}$ | $\hat{\circ}$ | $\hat{\circ} 1$ | $\hat{\circ} 2 5$ | $\hat{\circ} 2 5$ | | | |
|  |  | cf. \supset |  |  |  |  |  | | | | |
| $\hat{\circ}$ | $\hat{\circ} 1$ | | $\hat{\circ}$ | $\hat{\circ}$ | $\hat{\circ}$ | $\hat{\circ} 1$ | $\hat{\circ} 5$ | | | | |
|  |  |  |  |  |  |  |  |  |  |  |  |
| $\hat{\circ}$ | $\hat{\circ} 1$ | $\hat{\circ}$ | $\hat{\circ}$ | $\hat{\circ}$ | $\hat{\circ}$ | $\hat{\circ} 1$ | $\hat{\circ} 2$ | $\hat{\circ} 3$ | $\hat{\circ} 4$ | $\hat{\circ} 5$ | $\hat{\circ} 2 \hat{\circ} 3 4 \hat{\circ} 5$ |

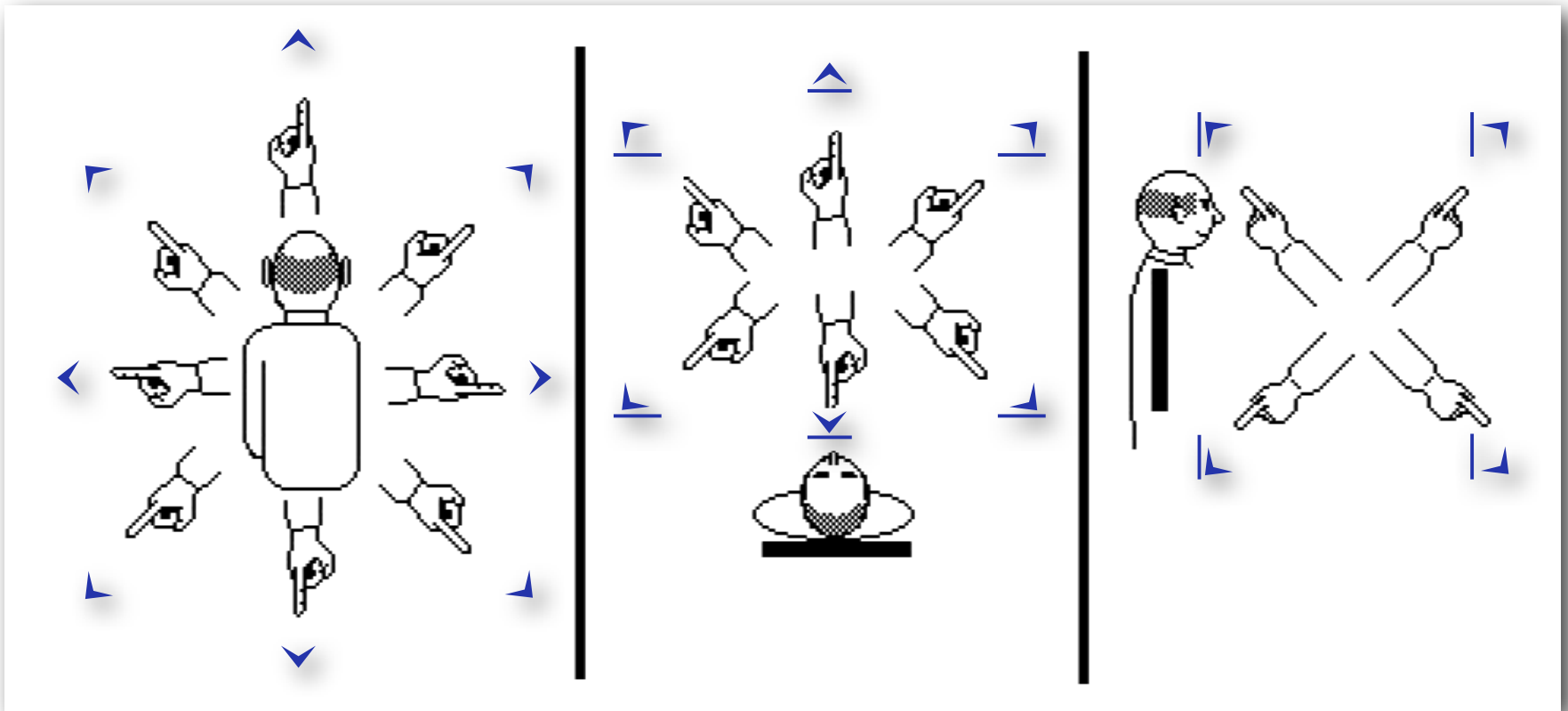
| | | | | | | | | | | | |
|--|--|-----|--|--|--|--|-----|--|---|---|--|
| spread | | | | | | | | | | | |
| Thumb Opposition | Fingertip-Thumbtip Opposition w/ fingers rounded | | | | Fingertip-Thumbtip Opposition w/ fingers flattened | | | | Fingertip-Thumbtip Opposition w/ fingers straight | Fingertip-Thumbtip Opposition w/ hitchhiker's fingers | Fingertip-Thumb's Interphalangeal Joint Opposition |
| One Finger, others in fist position | | | | | | | | | cf. | | |
| Two Fingers (nonspread), others in fist position | | | | | | | | | cf. | | |
| Two Fingers (spread), others in fist position | | cf. | | | | | cf. | | | | |
| Four Fingers (nonspread) | | | | | | | | | cf. | | |
| Four Fingers (spread) | | cf. | | | | | cf. | | | | |
| One Finger, others extended (spread) | | | | | | | | | cf. | | |

Hand Orientation









- 3 degrees of freedom info split into 2 parameters:
 - Extended Finger Direction
 - Defines the Orientation of the Hand Axis
 - Palm Orientation
 - For a given extended finger direction, defines palm orientation



Primary (Extended Finger) Directions

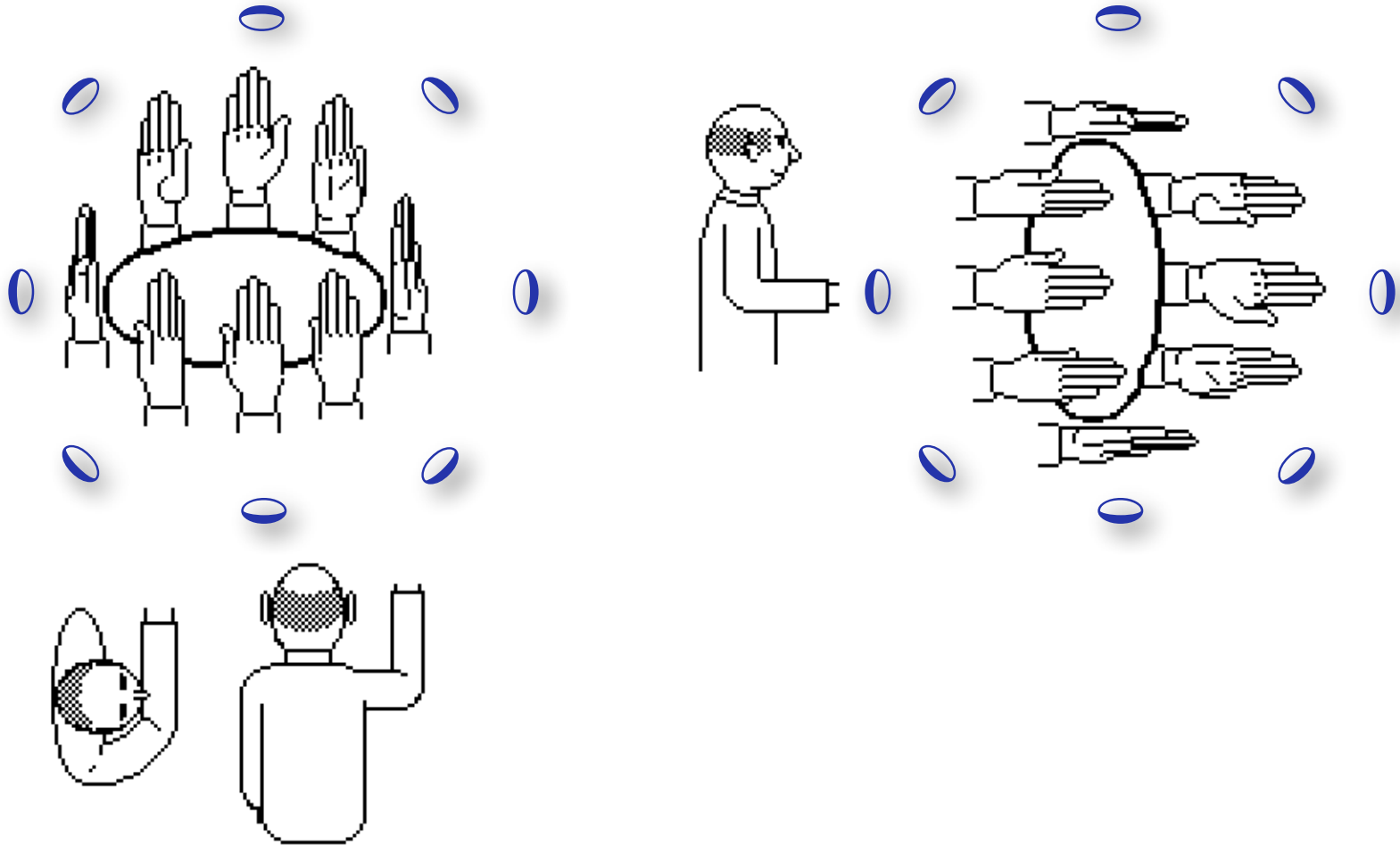


Secondary Directions










| | |
|---|---|
|  | away from the body, up and to the left |
|  | away from the body, up and to the right |
|  | away from the body, down and to the left |
|  | away from the body, down and to the right |
|  | towards the body, up and to the left |
|  | towards the body, up and to the right |
|  | towards the body, down and to the left |
|  | towards the body, down and to the right |



Palm Orientation



Example

| | | |
|---|---|---------------------|
|  |  | Palm up |
| |  | Palm right |
|  |  | Palm up |
| |  | Palm away from body |
|  |  | Palm towards body |
| |  | Palm right |




















































Rule of Thumb for Palm Orientation

- If I can name a direction as downwards, upwards, leftwards or rightwards, then the corresponding symbol is to be used.











































Locations I: Head

| | | left to | left side of | center of | right side | right to |
|---|----------------------------|---|--|---|---|---|
|  | head |  |  |  |  |  |
|  | above the head |  |  |  |  |  |
|  | forehead |  |  |  |  |  |
|  | nose |  |  |  |  |  |
|  | below nose | |  |  |  | |
|  | mouth (see detail page) |  |  |  |  |  |
|  | chin |  |  |  |  |  |
|  | below chin | |  |  |  | |
|  | neck |  |  |  |  | |





































Locations II: Mouth

| | | left to | left side of | center of | right side of | right to |
|---|-----------------------------|---|---|---|---|---|
|  | mouth |  |  |  |  |  |
|  | teeth | |  |  |  | |
|  | upper lips | |  |  |  | |
|  | upper teeth row | |  |  |  | |
|  | upper surface of the tongue | |  |  |  | |
|  | blade of the tongue |  |  |  |  |  |
|  | lower surface of the tongue | |  |  |  | |
|  | lower teeth row | |  |  |  | |
|  | lower lips | |  |  |  | |
































Locations III: Pairy head locations

| | | left to the left | left | between the two | right | right to the right |
|---|----------------|---|---|---|---|---|
|  | eye brows |  |  |  |  |  |
|  | upper eye lids |  |  | |  | |
|  | eyes |  |  |  |  |  |
|  | lower eye lids | |  | |  | |
|  | ears |  |  | |  |  |
|  | earlobes |  |  | |  |  |
|  | cheeks |  |  | |  |  |



Locations IV: Trunk

| | | left to the left | left | between the two | right | right to the right |
|---|-----------------|---|--|-----------------|---|---|
|  | top of shoulder |  |  | |  |  |

| | | left to | left side of | center of | right side | right to |
|---|----------------|---|--|---|---|---|
|  | shoulder line |  |  |  |  |  |
|  | breast line |  |  |  |  |  |
|  | belly line |  |  |  |  |  |
|  | abdominal line |  |  |  |  |  |





















































Locations V: Upper arm (of the opposite side)

| | | front side | back side | right side | left side |
|---|-----------|------------|-----------|------------|-----------|
| ㄱ | upper arm | ㄱ | ㄱ ↺ | ㄱ □ | □ ㄱ |
| ㄴ | elbow | ㄴ | ㄴ ↺ | ㄴ □ | □ ㄴ |









































Locations VI: Lower arm

| | | right and left hand | | right hand | | left hand | |
|---|------------------------------|---|---|---|---|---|---|
| | | handback side | palm side | ulnar side | radial side | ulnar side | radial side |
|  | finger tip |  | | | | | |
|  | fingernail, finger pad |  |  |  |  |  |  |
|  | middle joint of finger (PIP) |  |  |  |  |  |  |
|  | base joint of finger (MCP) |  |  |  |  |  |  |
| | hand (metacarpals) |  |  |  |  |  |  |
|  | ball of thumb |  |  |  |  |  |  |
|  | wrist joint (CMC) |  |  |  |  |  |  |
|  | forearm |  |  |  |  |  |  |



Locations VII: Lower extremities

| | | left side of the left | left | right side of the left | left side of the right | right | right side of the right |
|--|--------------|---|---|--|---|---|---|
|  | thigh |  |  |  |  |  |  |
|  | knee |  |  |  |  |  |  |
|  | shank |  |  |  |  |  |  |
|  | ankle |  |  |  |  |  |  |
|  | foot |  |  |  |  |  |  |
|  | tips of toes | |  | | |  | |



Locations: If you ever need more detailed positions

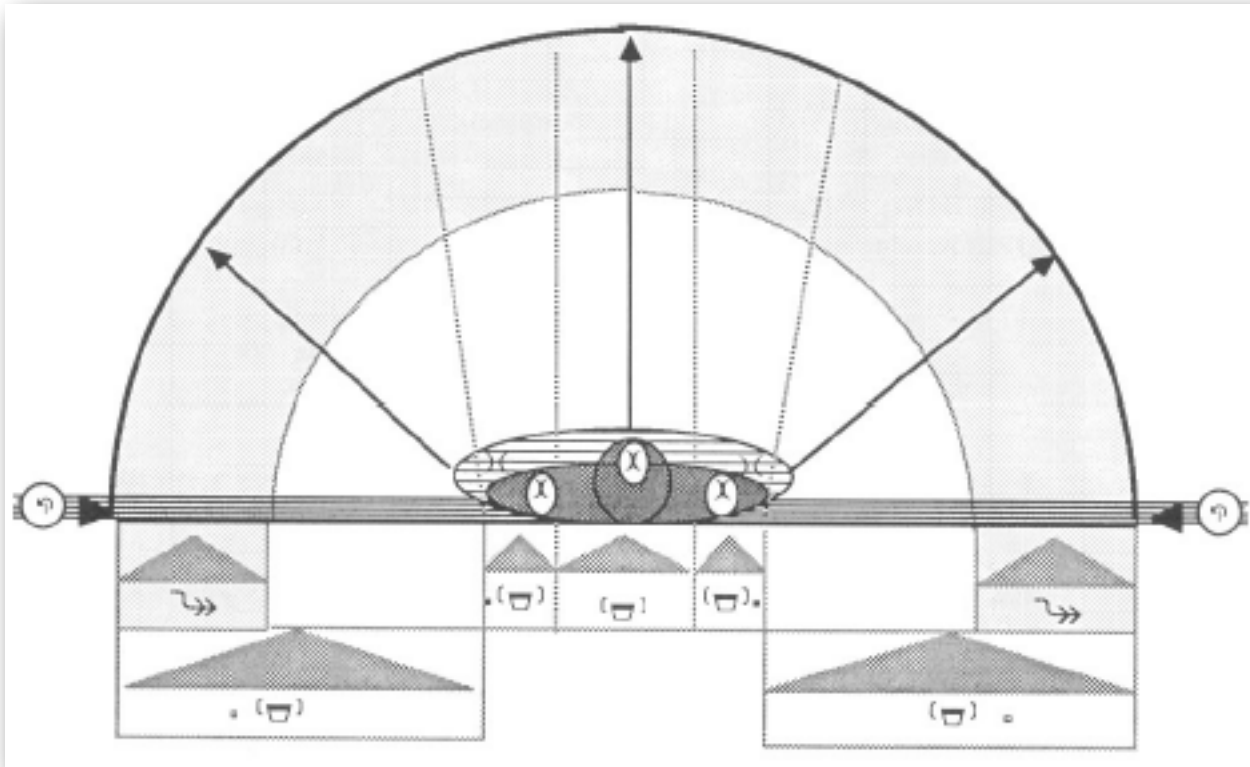
- Combine two neighbouring regions:



- Resulting region slightly overlaps with constituents



Locations: Distance from the Body (notated after the location symbol)



| | |
|----|---------------------------------|
| ↪ | behind the body |
| X | contact with body part |
|)(| close to body part |
| | standard distance |
| ↪ | maximum distance (extended arm) |

- Standard distance depends on size of region, the smaller the region, the closer standard distance is



Movements I
















- Absolute Movements (with target)
 - Direction and Size are redundant



- Relative Movements
 - Direction and Size determine end point of the movement

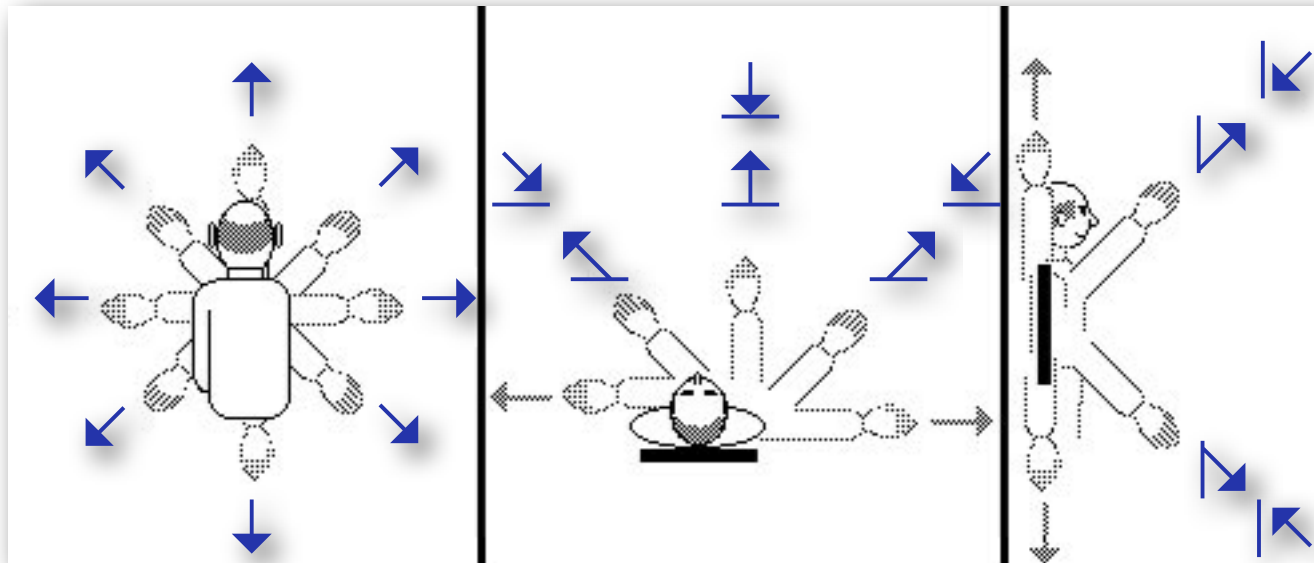


Movements II

- Path Movements (optionally with target)
 - Straight Movements →
 - Curved Movements → 
 - Wavy and Zigzag Line Movements →  
 - Circular Movements and derived forms   
- In-place Movements
 - Replacement of handshape and/or orientation → 
 - Fingerplay 
 - Wrist/forearm movements     
- Nonmanual Movements
 - Head Movements etc.  



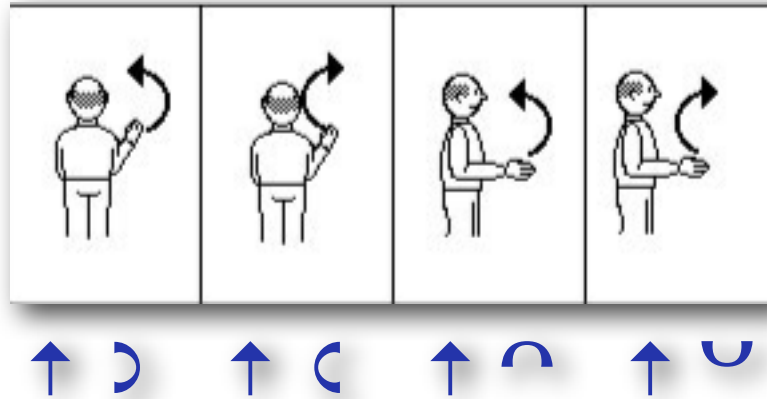
Straight Movements



- Schema identical with that for extended finger direction
- Size specifiers: → small → standard → large










Curved Movements



- Described by the movement arrow connecting start and end point (the chord) plus the direction of the arc
- Size specifiers under the movement arrow determine the length of the movement
- Size specifiers under the arc determine the degree of curvature



Mnemonic: Direction of the Curves

| | | | | |
|---|---|---|---|---|
| |  |  |  |  |
| | rightw. | leftw. | upw. | downw. |
|  | rightw. | leftw. | upw. | downw. |
|  | rightw. | leftw. | away | towards |
|  | away | towards | upw. | downw. |

- If you can name the arc direction as rightwards, leftwards, upwards, downwards, then use the corresponding symbol.
- In the other cases, interpret the symbol as if it had a straight line added.



Wavy and Zigzag Movements

- Described by the movement arrow connecting start and end point (the chord) plus manner and direction of the oscillation
- Size specifiers under the movement arrow determine the length of the movement
- Size specifiers under the oscillation symbol determine the size of the oscillation









- Zigzag line to the right, zags are pointing downwards and upwards, their size increases over time



- Long way line downwards, small bows to the left and right



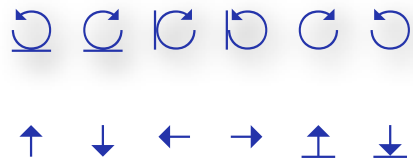
Circular Movements

- Main symbol determines orientation in space and movement direction 
- Size specifier under the circle symbol determines the circle radius 
- Optional specification of a starting point 
- If not whole-numbered turns, specify end point as well:  (a 270° turn)
- Spiral movements: 
- Elliptic shape movements: 



Circular Movement Symbols I

- Same planes model as for straight movement symbols



- The arrows represent the direction of the normal vector to the circle described by the symbol above.



Circular Movement Symbols II








- Here are the symbols for the diagonals:

























- (Once again, the arrows represent the direction of the normal vector to the circle described by the symbol above).
- The circle is drawn from that perspective where it is NOT visible as a circle, but as a back and fro movement.
- The elliptic form of the glyph can be understood by moving the perspective a bit to the right, upwards, or backwards.
- The arrow is positioned on that part of the circle that is closer to the reader.



Elliptic Shape Movements

-  : Elliptic shape (read football) in the plane in front of the signer, the football lying on its side
- Symbols:    
- : The longer axis goes from top to bottom (or body to front in the case of circle symbols in the horizontal plane).

| |   |   |   |
|---|---|---|---|
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |












In-place Movement

- Replacement of handshape and/or orientation



but cf. relative orientation

- Fingerplay in open handshapes  ... 
- Finger crumbling in closed handshapes  ... 
- Wrist and forearm movements
 - wrist nodding, indefinite number of repetitions
 - up-down (WINKEN/WAVE) 
 - left-right (WER/WHO) 
 - Forearm rotation, indefinite number of repetitions
 - turns (SPIEGEL/MIRROR) 
 - Single rotation in wrist joint (RÜHREN/STIR)
 - to the right 
 - to the left 








Handshape Changes:

Rolling Fingers in or out one after the other

| | |
|---|--|
|  | Index finger extends first (2345) |
|  | Thumb extends first (12345) |
|  | Index finger extends first, thumb last (23451) |
|  | Little finger extends first (54321) |
|  | Little finger bends first (54321) |
|  | Thumb bends first (12345) |



Movement Modality

| | | | |
|---|---------|--|------------------------|
|  | fast * |  | stoppage at start 7 |
|  | slow — |  | sudden stop |
|  | tense ✱ | | |

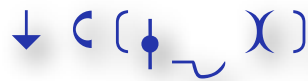


Fast downward movement



Brushing & Bouncing Movement

- Brushing Movement: Contact in the middle of a path



KAUFEN (BUY)

- Bouncing Movement



Movement to the palm and small backwards movement (bounce)



Movement in signing space with sudden stop and small backwards movement (bounce)



Repetitions

- + repeated once
- ++ repeated twice
- ++ repeated a couple of times
- +→ repeated once, 2nd iteration starting where first ended
- ++→ repeated a couple of times, each iteration starting where previous ended
- ← repeated in reversed direction
- ~ hands flip roles in 2nd iteration



Combining Actions

- Sequential Actions

- Action1 Action2

↑ → ↓ ←

(↑ → ↓ ←) +

- Cotemporal Actions

- [Action1 Action2]

[↑ ↻ ++]

- Fusion (fused sequential)

- < Action1 Action2 >

⟨ ← ∪ → ∩ → ∪ ⟩
○




Two-handed Movements

- Two hands in motion: symmetry applies
 - Dominant (right) hand to be described
 - Symmetry operator determines copy to nondominant hand
 - Exceptions can be described if necessary
 - Symmetry operators inventory:



Symmetries

- Palm orientations always laterally equal (i.e. e.g. thumbs pointing to e.o.)
- Extended finger directions: Left and right flipped by  etc., otherwise they remain the same.
- Movements and locations see next slides









Symmetries: Movement

| symbol flips the marked directions: | left/right | up/down | away from / towards body |
|-------------------------------------|------------|---------|--------------------------|
| : | | | |
| .. | ✓ | | |
| ⋮ | | ✓ | |
| ⋮ | ✓ | ✓ | |
| ⋮ | | | ✓ |
| ⋮ | ✓ | | ✓ |
| ⋮ | | ✓ | ✓ |
| ⋮ | ✓ | ✓ | ✓ |



Two-handed Locations

- Same notation as in the one-handed case
 -  Hands side by side (with a certain distance)
 -  Nondom hand on the opposite side of the body
- Hands tied together
 -  Hands side by side contacting each other, without contact to the body
 -  Same as before, but with contact to the body
- Separate notations
 -  Nondom with reference to the body, dom positioned relative to nondom
- Contact specified in more detail
 -  This form also allows one hand on top of the other



Contacts in Hand Configurations

- In addition to)(x the following symbols are available:
 - x Interlocking
 - × Crossing





Exceptions from Symmetry Rules




- can be described by means of [dominant ≠ nondominant]:



Mixed Case: Both hands involved, only one moving

- With symmetry symbol, but movement description like [...]
- No symmetry symbol, but [... ...] for handshape/direction (and optionally location), e.g.



- Permutation of roles of dom/nondom
 - with symmetry symbol: [  ...]
 - without:  instead of symmetry symbol



“Sign Sentences” in HamNoSys

- HamNoSys primarily describes single signs.
- Extension to sentences limited to
 - sequential execution of signs
 - sentence boundary markers
- ≠ sequential execution (fusion, compound)
- , sequential execution
- . sentence boundary, neutral facial expression
- ?! sentence boundary, with some facial expression
- □ place holder for sign-level facial expression



Relative Orientation

- Shorter and more natural notation

- BALL (BALL)



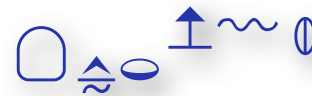
- HAUS (HOUSE)



- KASTEN (BOX)



- WELLEN (WAVES)



Spatial co-reference

- First use of a location can be labelled: 1
- Later reference to that location: ①
- Symbols: 1 2 3 4 5 ① ② ③ ④ ⑤
- Different labels just for convenience, not semantic difference
- Example:




































Left & right vs. ipsi- & contralateral


- Standard HamNoSys describe right-handed signing, all left/right directions are to be mirrored for left-handed signing.
- Exception: Strings marked with ^Я.



Underspecification

-  = {  |  |  |  |  | etc. }
-  relaxed handshape or copy of dominant handshape
-  = {  |  |  }
-  = {  |  |  |  | etc. }
-                 

Nonmanuals in HamNoSys

- For every movement, the hand being the default articulator can be substituted by other body parts:  (a blue trapezoid with an upward arrow) (a blue circle with a double-headed vertical arrow)
- This does not allow, however, the notation of small facial movements:
 - No symbols for opening and closing
 - Not all parts of the face are available as symbols
- Mouth pictures cannot be captured in enough detail with HamNoSys



Instead: Multi-Tier Representation

- HamNoSys as the master tier
- Other tiers are synchronised to the manual part tier:
 - Shoulders
 - Body
 - Head
 - Gaze
 - Facial Expression
 - Eye Brows
 - Eye Lids
 - Nose
 - Mouth
 - Mouth Picture (derived from spoken language)
 - Mouth Gesture

