

gestual
script,
typannot,

Coding movement in Sign Languages: the **typannot** approach

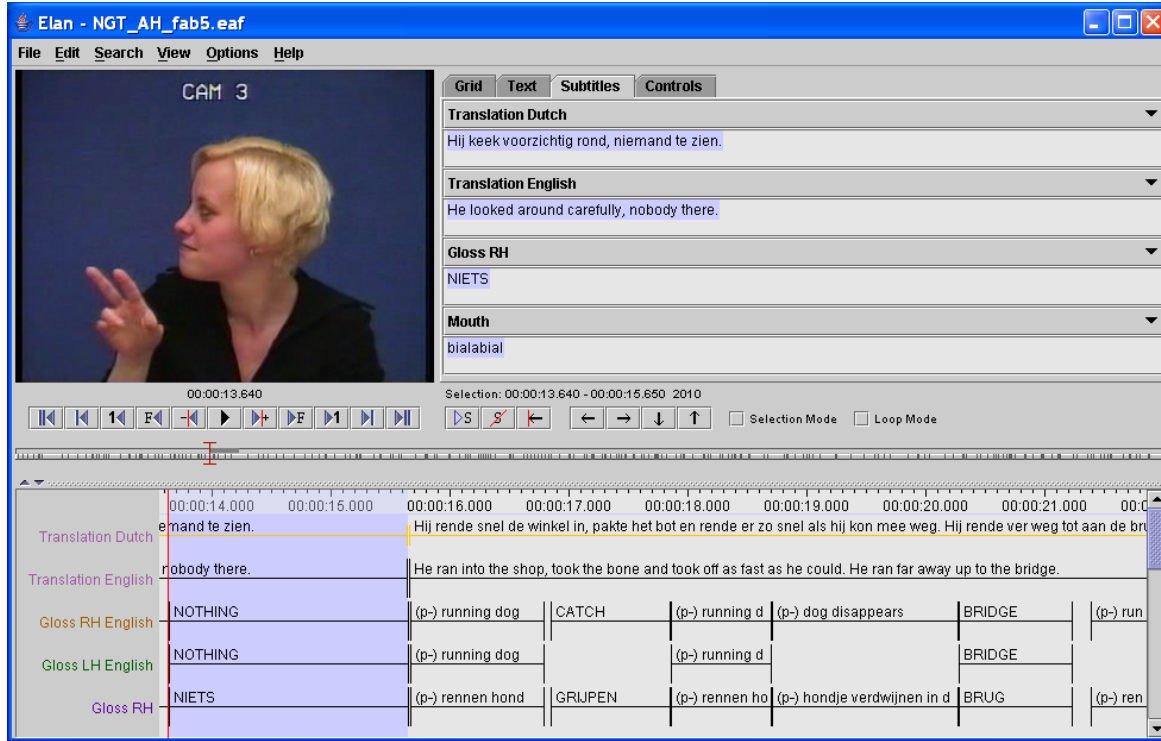
Claudia S. Bianchini¹, Lea Chevrefils², Claire Danet³, Patrick Doan⁴,
Morgane Rebulard⁴, Adrien Contesse⁴, Dominique Boutet²

with the collaboration of:
Jean-François Dauphin and Mathieu Réguer

1
Université de Poitiers



Sign Language transcription systems



ELAN tool

*MOT: t@ag(*2) w@ag ^opr'WHQ SEE
 WHAT(1h) ^ ?
 *CHI: MOUSE(*N) .
 *MOT: t@ag g@ag(nh): \- ^opr'WHQ
 WHAT(1h) ^\?

BTS coding

B_aB_a^{z~} ʷʷʷ^á 3⁺ [] VC⁺VC^x^{*}
 B̄_a √B_λ^ʷ G⁺ B_λ[!]B_λ[÷] D Á^{ox}

Stokoe Notation



Si5s



SignWriting



HamNoSys



typannot,

Five criteria for TranSys



typannot,

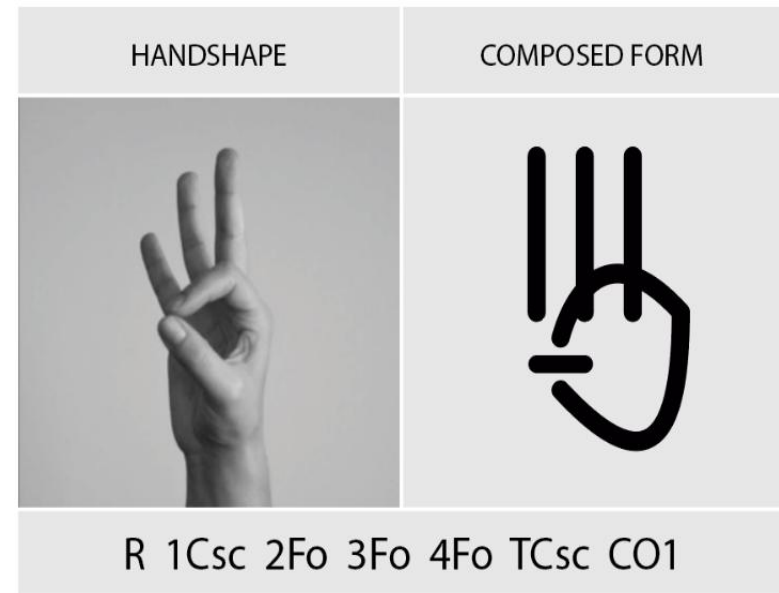
Five criteria for TranSys








	Read-ability		Writ-ability		Search-ability	Generi-city	Modula- rity
	Human	Digital	Human	Digital	Digital		
Sign Writing 1975-2018	++	-	+	-	-	--	--
HamNoSys 1990-2018	-	++	-	++	++	--	-
Typannot 2013-2018	+	++	+	++	++	++	++

typannot,

Typannot

- 3 levels of representation
 - Graphematic formula
 - Generic form and formula
 - Composed form
- Represent
 - HandShapes
 - HandShapes (HS)
 - Orientation (Or)
 - Movement
 - Initial Location (LOCini)
 - Movement deployment (MOV)
 - Facial expressions
 - Mouth Action (Mouth)
 - Whole Face (Face)



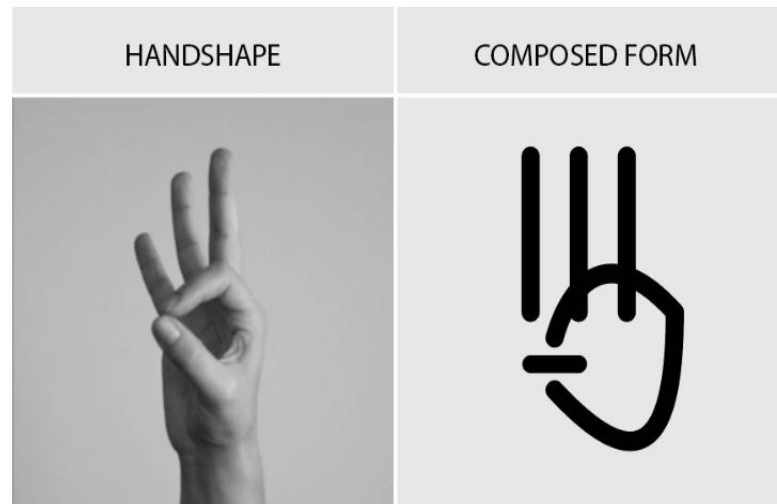
GRAPHEMATIC FORMULA	GENERIC FORM
R - right	
1Csc - index curved semi closed	
2Fo - middle flat open	
3Fo - ring flat open	
4Fo - pinky flat open	
TCsc - thumb curved semi closed	
CO1 - contact index	

typ an

Graphematic formula



Hand	L left	R right			
Finger	1 index	2 middle	3 ring	4 pinky	T thumb
Shape	F flat	C curved	B bent		
Angle	o open	sc semi-closed	c closed		
Fingers event	G grouped	X crossed	K stacked	Re reverse	
Thumb event	CO contact	OP opposed	NOP nonopposed		



R 1Csc 2Fo 3Fo 4Fo TCsc CO1

GRAPHEMATIC FORMULA	GENERIC FORM
R - right	
1Csc - index curved semi closed	
2Fo - middle flat open	
3Fo - ring flat open	
4Fo - pinky flat open	
TCsc - thumb curved semi closed	
CO1 - contact index	

typ an

Generic form & formula

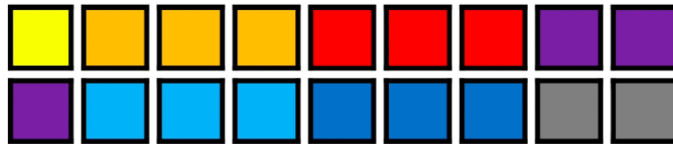


Hand	left	right			
Finger	index	middle	ring	pinky	thumb
Shape	flat	curved	bent		
Angle	open	semi-closed	closed		
Fingers event	grouped	crossed	stacked	reverse	
Thumb event	contact	opposed	non opposed		

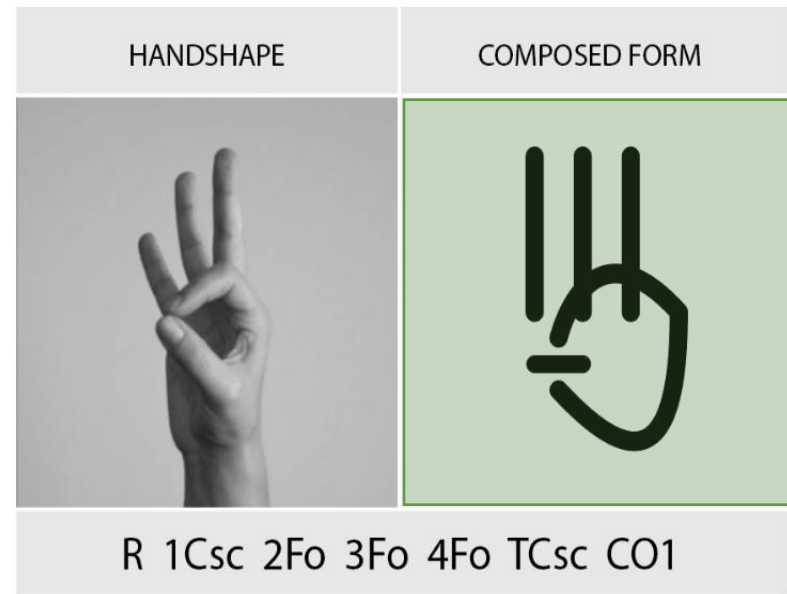
HANDSHAPE	COMPOSED FORM
R 1Csc 2Fo 3Fo 4Fo TCsc CO1	



















GRAPHEMATIC FORMULA	GENERIC FORM
R - right	
1Csc - index curved semi closed	
2Fo - middle flat open	
3Fo - ring flat open	
4Fo - pinky flat open	
TCsc - thumb curved semi closed	
CO1 - contact index	

Composed form



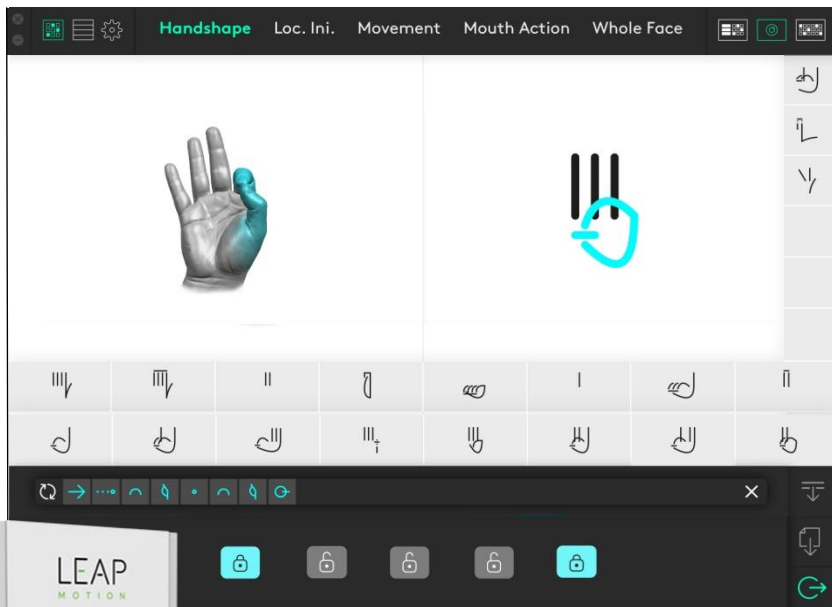
typ an



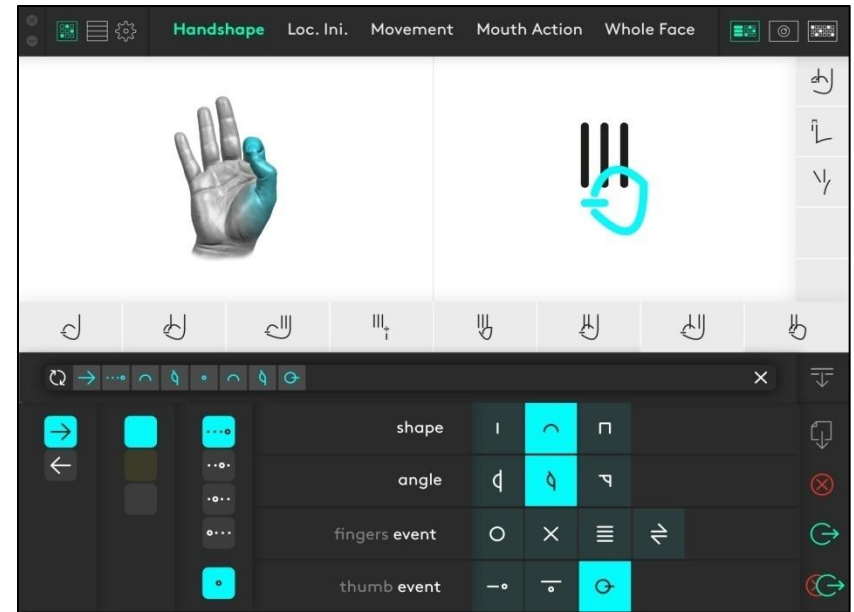
GRAPHEMATIC FORMULA	GENERIC FORM
R - right	
1Csc - index curved semi closed	  
2Fo - middle flat open	  
3Fo - ring flat open	  
4Fo - pinky flat open	  
TCsc - thumb curved semi closed	  
CO1 - contact index	 

Typannot keyboard (work in progress)

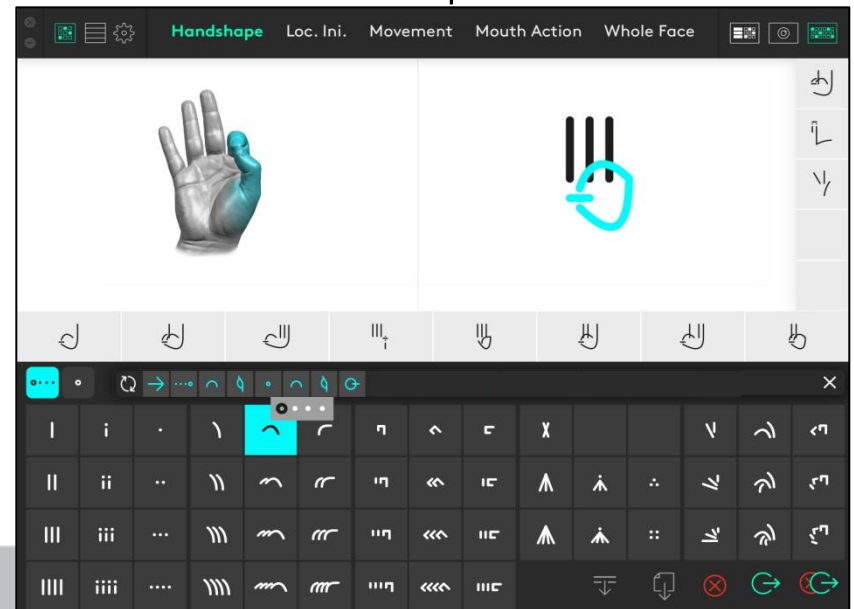
Gestual UI



Generic UI



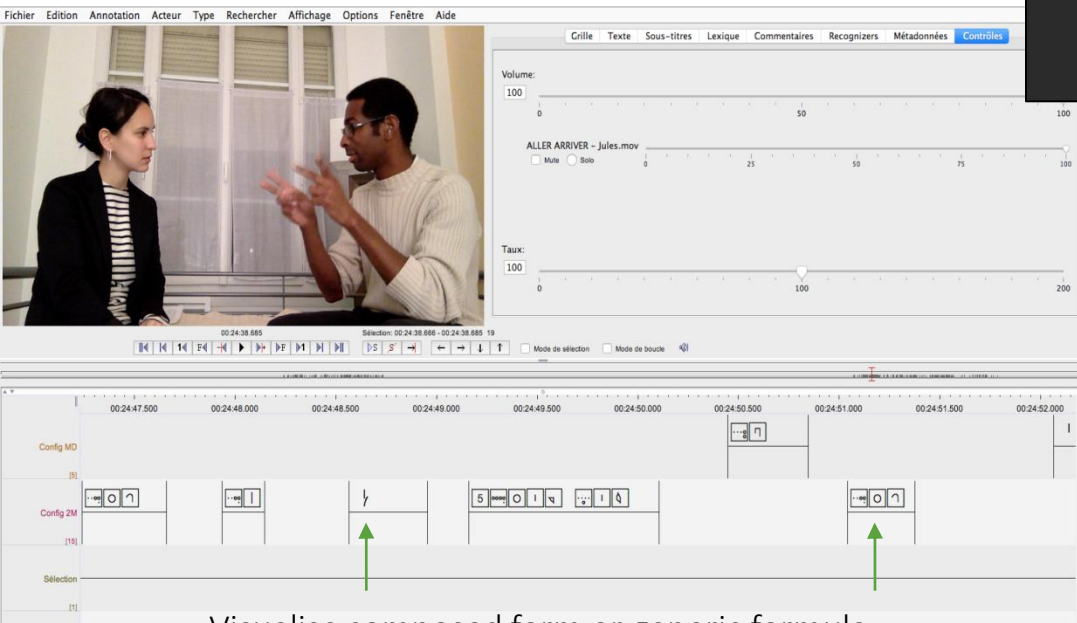
Semi-composed UI



typannot

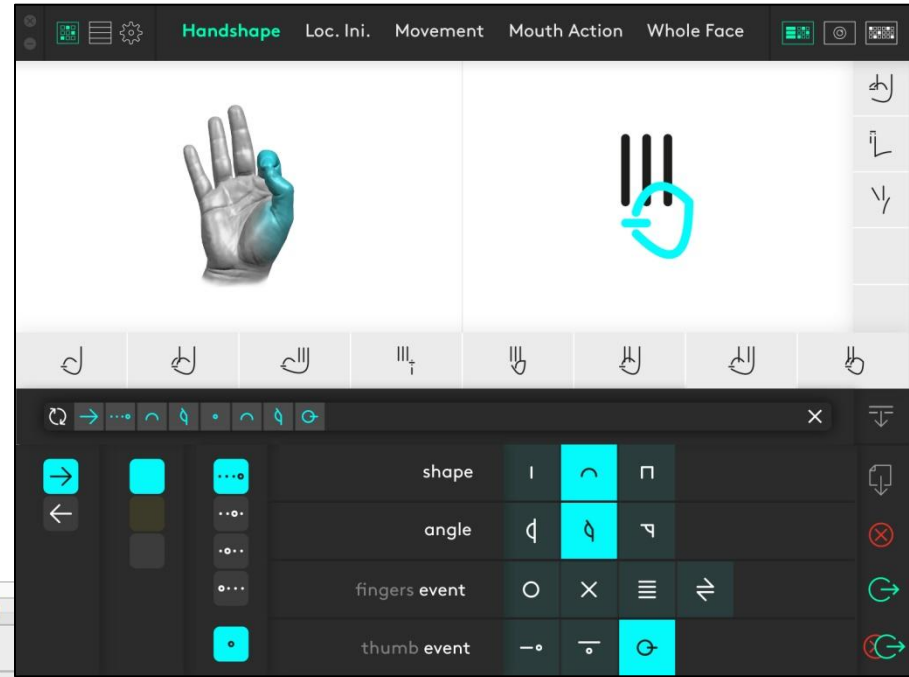
Generic UI

ELAN tool



Visualise composed form or generic formula

Typannot keyboard



Export complete generic formula



typannot,

Movement

- To annotate we need standardization and simplicity
 - But how can movement be standardized and simple, as it change continuously?

Extract of «Lla fiaccola», Lorenzo Laudo. Poetry in Italian Sign Language



typ annot,

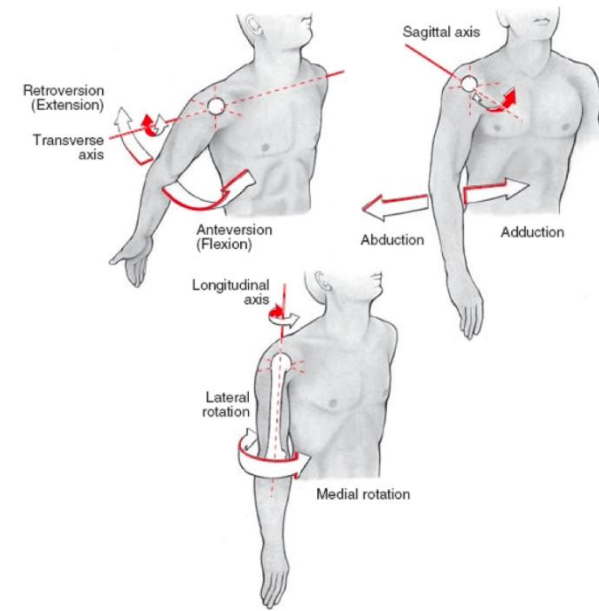
Movement = (prep) + LOCini + MOV



[EAGLE]
French SL

typannot,

LOCini (Initial Location)



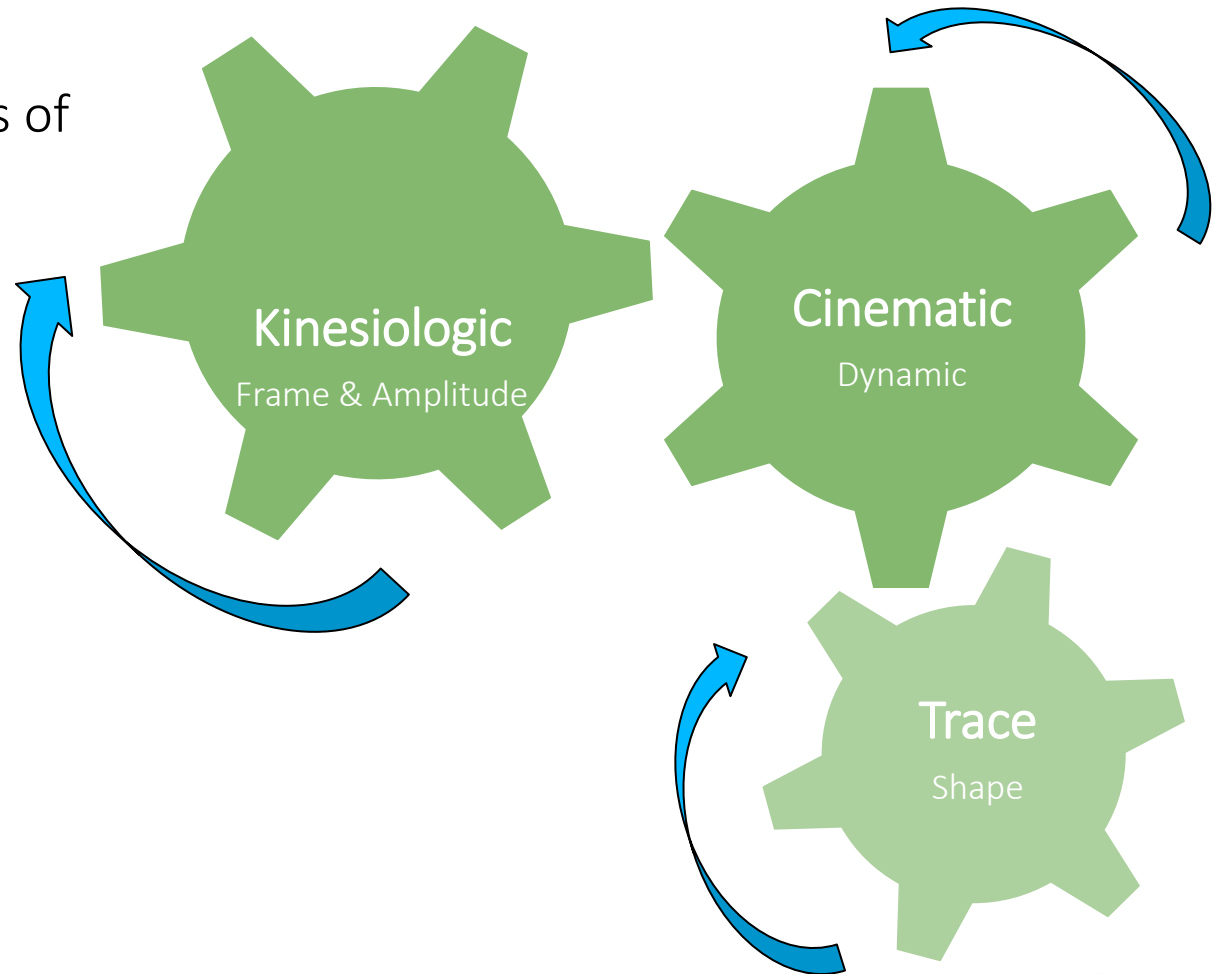
- LOCini: the stable position before MOV
 - The key for a simple description of MOV itself
- Our description keywords:
 - Intrinsic Frame of Reference (iFoR)

		Segment involved		
Movement type	Degree of Freedom	Arm	Forearm	Hand
Joint	Flex-Ext	5 grades	5 grades	5 grades
displacement	Abd-Add	5 grades		3 grades
Bone rotation	Rint-Rext		5 grades	5 grades

NB: bone rotation (Prono/Supi and Rint/Rext) are visible on the following segment

MOV (Movement)

- 3 conceptual levels of description



Comparaison of 2 signs of French SL



typ annot,

[THANK YOU] in French SL






LOCini	Arm		Forearm		Hand		
	Abd-Add	Flex-Ext	Flex-Ext	Rint-Rext	Rint-Rext	Flex-Ext	Abd-Add
1	0	0	-2	-2	+1	0	+1
2	0	0	-2	0	+1	-1	+1

MOV	Frame	Amplitude	Dynamic	Shape
1	Forearm to hand	ArmRExt1 ForearmExt	One hand No iteration	Line Pointing
2	Arm	ArmExt	One hand No iteration	Line Pointing

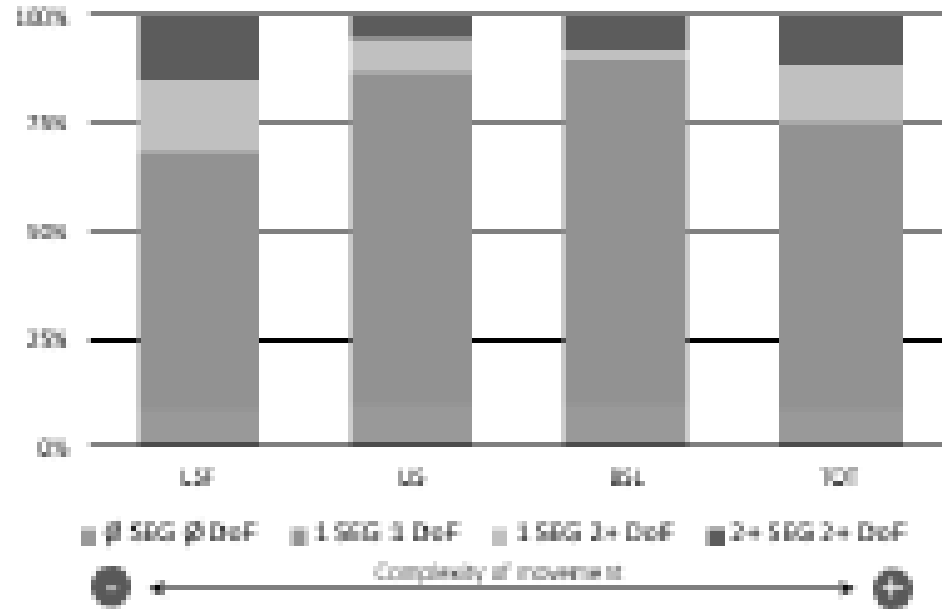
How Typannot generate new knowledge

- Transcription of 6 short extracts using Typannot generic form for MOV

SL		Title	Duration (sec)	MOVs (count)
French		Corpus LS-Colin (cuisine_1, cuisine_2, cheval, oiseau)	263	393
Italian		Pinocchio in LIS	113	150
British		Holiday in Lanzarote	50	91
		TOT	7 min 6 sec	634 MOV

Test 1

- Hypothesis A: MOV has a simple motor scheme aimed at minimizing motor control during MOV
- Test: MOVs ranked on the basis of the number of MOV-deploying SEGs and within each SEG the number of DoF at the MOV origin
- Results: Significant predominance of MOVs “1 SEG 1 DoF”
- Hypothesis validated! Despite the apparent complexity of MOVs, most of them are governed by a simple motor scheme

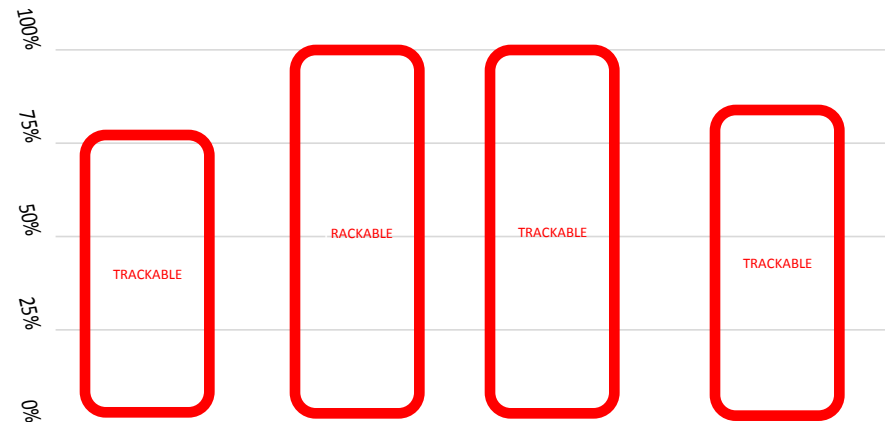


Test 2

- Hypothesis A: MOV has a simple motor scheme aimed at minimizing motor control during MOV

Collateral hypothesis: Using a iFoR common to IMU MoCap device and Typannot drastically reduces MOV transcription times

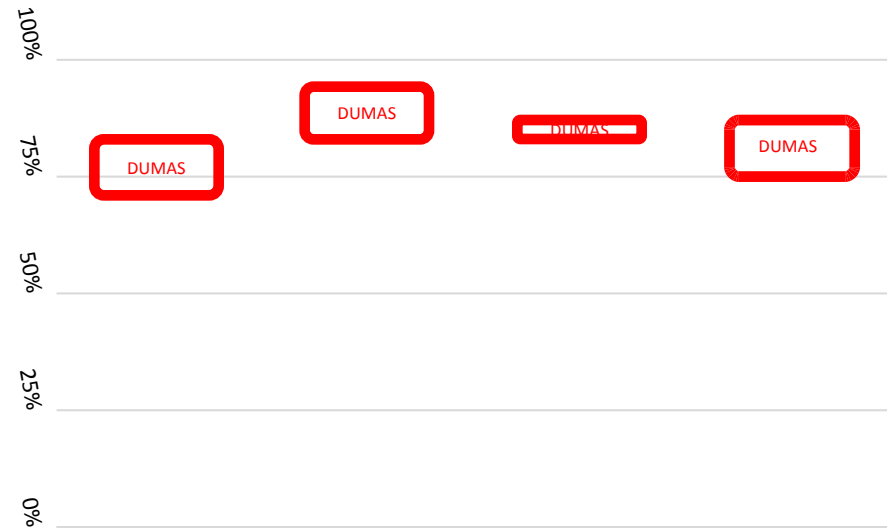
- Test: MOVs classified on their potentiality for being tracked by a MoCap system
- Results: For more than 70% of the signs it is possible to determine the MOV origin, irrespective of MOV performed
- Hypothesis validated! IMU and Typannot share an iFoR based system: conversion between IMU data and Typannot is easy and allows to transcribe faster with Typannot than with non-iFoR TranSys



typannot



Test 3



- Hypothesis B: The inertial tendency towards a FLOWProx→Dist of MOV, established by Dumas *et al.* (2012) for MOV in general, is predominant also in SLs
- Test: MOVs were classified based on their flow direction (Prox→Dist or Dist→Pro)
- Results: FLOWDist→Prox is significantly predominant in SLs
- Hypothesis NOT validated! Dumas hypothesis doesn't apply to SL's MOV. A classical approach based on non-iFoR and trajectories would not have made it possible to unfold this phenomenon

Raphael Dumas, Thomas Robert, Vincent Pomeroy and Laurence Cheze (2012). Joint and segment coordinate systems revisited. *Computer Methods in Biomechanics and Biomedical Engineering*, 15(suppl.1): 183-185.

Conclusions

- Typannot is an innovative TranSys for Sign Languages
- Movement is analyzed as LOCini + MOV, in an iFoR and with full attention to every SEG involved in the movement
 - LOCini is the key to have easier (and faster) MOV transcription
- Using an iFoR, shared with an IMU MoCap device, allows to:
 - Understand SLs in a new light that emphasizes features of the SLs which remained hidden with the previous TranSys
 - Do faster transcriptions

typannot,

Thank you!

Any questions?

Contact: chiadu14@gmail.com

typannot,

01

Good morning,
my name is Claudia Savina Bianchini and I'll present Typannot, a system for the graphical representation of sign languages.

It was created by the GestualScript team, formed by linguists, designers and computer scientists.

02

Since linguistics exists, nobody has ever been able to analyze a language without having a system of exact representation of the linguistic signal. For the vocal languages, we use linear phonographic systems, like adaptations of our alphabet.

The problem is that Sign Languages are multilinear and not phonic, so it is impossible to represent them with solutions developed for vocal languages.

Moreover, Sign Languages have no written tradition, so they cannot offer a valid alternative for their representation.

Some Sign Language researcher decided to bypass the problem, assuming that the use of an electronic annotation tool like ELAN, that time-align videos and labels-systems like BTS coding, will give enough information about the linguistic signal.

I swear I'm not one of them!

Others, however, have tried to develop Transcriptions systems that faith-fully represent the linguistic signal and allow accurate analysis of the functioning of the language.

Many systems were developed, with different purposes and results: SignWriting, S-AI-Five-Ess (Si5S), HamNoSys, Stokoe Notation, and many more...

03

To be used in electronic corpora, a transcription system should meet five criteria:

READ-ABILITY and **WRIT-ABILITY**: A transcription system should be readable and writable by both the human transcriber and the annotation tool.

GENERI-CITY and **MODULAR-ITY** A transcription system shall allow a detailed and structured representation of languages, and, it shall propose an integration of these minimal components within larger formal structures, allowing synthetic representations.

SEARCH-ABILITY, It should also allow executing a precise search of the forms, both on the global form and on its micro-characteristics,

04

Of the existing Transcription Systems, the prevailing two are SignWriting et HamNoSys.

SIGNWRITING was born for educational purpose. He is very user-friendly in writing and reading, but it is almost impossible to query a SignWriting transcription.

HAMNOSYS was born as a linguistic research tool. Authors want to foster searchability, So they decide to be very computer-friendly and less human-friendly.

SignWriting and HamNoSys do not ensure modularity and genericity.

Then, there is Typannot, our Transcription System, which has been conceived with the intent of satisfying all these 5 criteria.

typannot,

05

Typannot is based on 3 levels of representation: the graphematic formula, the generic form and the composed form.

I'll go into the details in a minute using the handshape as an example, because it is the easiest to explain and to understand; but the same process applies to all other components too.

In fact, Typannot allows representing both the manual components, such as HandShape and Movement, and also the non-manual components, such as Mouth Action and Facial Expression.

06

The graphematic formula is an ordered list of all the features used to describe the HandShape.

We find which hand is involved, which fingers assume which form and with what angle, what is the relationship between the fingers and between the fingers and the thumb.

The graphematic formula ensures searchability and genericity.

07

Each character identified in the graphematic formula has been translated with a glyph, a symbol; and these symbols have been inserted into a formula with a rigid syntax. That allows the detailed description of any HandShape that can come to mind.

Using glyphs, instead of the alphanumeric codes, allows to uncouple from the vocal language and to improve the writability, as well as the system memorization.

We plan to have our generic characters included in Unicode. Unicode has already accepted SignWriting and its thousands of glyphs (over two hundred fifty (250) glyphs only for handshapes "planned" by SignWriting);

We only ask for twenty (20) positions in order to codify every handshapes that can come to mind.

08

The third level of representation is the composed form. It is a glyph that allows representing in a synthetic and iconic way all the features of the HandShape.

The composed form is readable, writable and composed of modules that allow you to identify, with certainty, the position of each individual finger.

See here, as an example, how we build our configuration, module by module.

We are very advanced in the development of an OpenType font that, thanks to a ligature system, allows the generic formula to "past" and transform itself into the composed glyph. And, since it is a "typographic ligature", we can look for both the whole character and any generic glyph within it,

as in "capital A with accent (Á)" we can look for both the "A" and his features "capital" and/or "accented".

typannot,

09

A key feature of Typannot is that, in addition to the representation system, we have also developed a tool that allows to fully use the potential Typannot.

The tool is a virtual keyboard, designed primarily to export annotation strings to ELAN, but which allows typing with Typannot on any software that supports OpenType fonts.

Our keyboard is made of 3 interfaces, depending on the level of automation and representation used.

The generic and modular interfaces are designed for a "manual" transcription using the generics form or the modules of the composed form.

The gestual interface is designed for automatic transcription: by connecting a Motion Capture device to your computer, you can reproduce the parameter that you want to transcribe and he will be recognized automatically and transcribed with Typannot.

For HandShape, we choose the Leap Motion device

10

Here I show you the generic interface for handshapes: it starts by default with a "grey" hand; then, by selecting the different feature of each finger, we compose the glyph.

His formula appears in a string as it is composed.

For sake of simplicity, I chose to show you only the generic characters of the fingers that are "active".

As I'm composing, an avatar allows verifying in real time if the result is the expected one. This also facilitates the learning of the system.

Once the composition is finished, I export to ELAN the complete generic formula, which contains both the fingers that I modified and those that remained in the default position.

Thanks to the OpenType font, We will be able to display on ELAN both the generics formula and the composed glyph... and we will be able to search for both an entire glyph and each of its feature, what-ever the chosen view.

11

But this is a conference on movement! So let's speak about movement! Now that I've explained how Typannot works, let's talk about how we write down this complex parameter.

To annotate, linguists need standardization and simplicity... but how can we get standardization and simplicity with a parameter characterized by constant changes?

This difficulty has led many sign language linguists to limit themselves to the handshapes and to neglect the movements, often "justifying" their choice by defining movements as a less-linguistic component.

Instead, those who have decided to devote themselves to the movement have all done it by looking exclusively at the hands and the track left by the hand trajectory.

Even with modern Motion Capture systems, in the end, they only look at the hands in a Relative Frame of Reference.

typannot,

12

Our idea to simplify the movement is to NOT look at the hands only, and to divide the movement in 3 moments:

- a preparatory phase, very complex but that does not provide any useful information, and there-fore it doesn't require annotation;
- an Initial Localisation, LOCini, a stable position that is reached by the signer just before developing the sign;
- a Movement, the deployment of the movement itself.

In our opinion, the movement is like a spring: it is charged during the preparatory phase, when the motor control is at its maximum; it reaches a moment of maximum tension on the instant of the LOCini; and then it releases all its energy into movement deployment, where the motor control is just the minimum necessary.

We believe that it is sufficient to note LOCini and movement in order to have an accurate but simple description of the whole movement.

13

LOCini is the stable position before the deployment of the movement and is the key to a simple description of the movement.

Typannot describes the tilt of each individual segment of the upper limb along the axes of displacement of the segments, that we call Degree of Freedom: flexion/extension, abduction/adduction, internal/external rotation (a.k.a. pronation/supination in the hand).

This displacement is not expressed in angular degrees but in grades, a fraction of the maximum angle that separates the two extreme poles of the Degree of Freedom: this maximum angle depends on the position of the previous segment.

For this reason, we use an intrinsic Frame of Reference, in which each segment is the Frame of Reference of the next segment.

To describe the LOCini, it is necessary to look at the grades of 7 Degree of Freedom: it seems very complex! but in fact it is a parsimonious approach, which does allow large savings in the description of Movement deployment.

14

It is now time to talk about the description of the movement deployment. We have identified 3 conceptual levels of description.

- The first is kinesiological: we describe which segment is involved and the amplitude of displacement with respect to LOCini. Again, it is not a question of angular degrees but of grades;
- the second level is kinematic: we describe the movement dynamics, such as symmetry or iteration;
- finally, the third is the trace: we describe the general form of the movement and if it is a pointing. We define a movement as pointing if it is directed towards an external pole of attraction. In fact in sign languages the "referents" you refers to will be positioned in space and if the movement point in the direction of one of those referents, the position of the latter will influence the movement itself... therefore, it is an important element to know.

15

Very quickly, I'll show you an example of transcription.

These signs appear as very different:

there is no correspondence between the two orientations of the hand, nor between the directions or the amplitudes of the movements.

The only reason to compare them is because they were both labeled [THANK YOU] in LSF.

typannot,

16

However, looking at the transcription with Typannot, we can observe that they are very similar signs.

LOCini is quite the same, if not is just for a pair of grades on two Degree of Freedom.

Also the proper MOVement is more similar than it appears:

We always have a movement of extension, even if it applies to fore-arm in one case, and to arm in the other case.

Finding these similarities is possible only analyzing the movement in an intrinsic Frame of references and considering all the segments.

If we had limited ourself to the hand trajectories, the label [THANKS] would have been the only link between these two signs.

17

Before concluding, I'd like to show you an example of how Typannot, with its intrinsic Frame of reference, does permit to deepen the knowledge on Sign Language functioning.

These are only preliminary data, but they seem promising.

We have transcribed 6 fragments of short stories, narrated in 3 different Sign Languages, Italian, French and British, for a total of 7 minutes.

It may not seem that much, but corpus annotation can take up to four hundred (400) minutes of work per minute of video, so 6-7 minutes are considered, in my field, a valid exploratory corpus.

18

Our first hypothesis is that movements have simple motor schemes, in order to minimize the motor control necessary for their execution.

We have ordered the movements based on the number of Degree of Freedom being activated on each segment

We found a significant dominance of Movements in which only one single Degree of Freedom is involved.

This result validates our hypothesis on the presence of simple motor schemes.

19

The second experiment, tests again the hypothesis of the motor scheme;

Collaterally, we also assume that finding a Motion Capture device sharing with Typannot the use of an intrinsic Frame of Reference will speed up the transcription: for this reason, we have tested Perception Neuron, a Motion Capture device with an IMU, an inertial measurement unit.

We ordered Movements on the basis of their aptitude to be tracked with an IMU:

for that, they must be very simple, like involve one single Degree of Freedom, or like have a simple shape like a circle.

We noted that over seventy percent (70%) of Movement we found are simple and there-fore also trackable.

This again validates our first hypothesis and gives also hope for speeding-up the transcription work using a MoCap.

typannot,

20

A last experiment tests a Dumas' theory. He found a general inertial tendency that favors the proximal-distal flow versus the distal-proximal flow.

We think that this trend should be present in sign language too.

Therefore, we ordered Movements on the basis of the direction of movement propagation between the segments, namely distal-proximal flow, proximal-distal flow or else, like static, or without a flow, or not classifiable.

We realized that, in Sign Language, more than fifty-five percent (55%) of Movements follows a distal-proximal flow... and almost thirty-five percent (35%) are included in "others": there-fore, just ten percent (10%) of movements are proximal-distal.

So, our data contradict Dumas' findings, which probably apply to the movement in general, but do not seems to be reflected in Sign Languages.

And the next step will be to try to understand why.

21

In all the tests we made, IF we had observed movements in a Relative Frame of Reference instead of an intrinsic Frame of references,

we could not have noticed the phenomena that we discovered thanks to Typannot.

In conclusion, Typannot is an innovative system that analyzes movement as a complex LOCini followed by a simple MOVEMENT deployment.

This approach allows to transcribe any Sign Language more quickly and reliably, and to highlight phenomena that are hidden by the traditional Transcription systems, based on the trajectory of the hands alone.

22

Thank you so much for listening!

typannot,