

A conceptual approach in sign language classification for concepts network

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Abstract

Most websites presupposes a conceptual equivalence between a written word and a sign. In such tools, signs, which don't have strict written equivalent lexicons, can't be found. The collaborative website OCELLES project LSF/French tries to give the opportunity to obtain several signs for a unique concept, with the possibility of uploading a sign without being constrained by written language. Although word checking in a written text is quite easy, it is not the case for sign checking in a video.

Today studies are carried out in the field of gesture recognition, but all the sign language linguistic parameters cannot be considered as such. Indeed, they have to be used simultaneously during communication interactions.

Our approach Based upon the semiological Cuxac model (Cuxac, 2000) and Thom morphogenesis theory (Thom, 1973), could help to find a sign in a sign dictionary without using written language.

Keywords: sign language, LSF, morphogenesis, catastrophe theory, OCELLES

1. Representation of lexicalized and iconic sign on internet websites.

According to Cuxac (2000), two discursive enunciation strategies co-exist in sign language, using visual-gestual channel, you can choose to communicate either by showing or not. It means you can "let people see" your experience with a visually sequence of signs, or you can use lexicalized signs which don't bear any resemblance with the experience you describe.

Today, most websites propose only lexicalized signs and overlook all iconic signs which are the most used ones, depending on speech type studies (Sallandre, 2001). This approach comes from methodology choices. The conception of these websites presupposes a conceptual equivalence between a written word and a sign. Users are invited to upload a lexicalized sign from a chosen written word. In such similarity based tools, signs which don't have strict written equivalent lexicons or iconic signs can't be found.

The collaborative website OCELLES project LSF/French tries to give the opportunity for sign users to obtain several signs for a unique concept, so that they can use them as signifiers, without being limited in their choice (they could chose lexicalized or iconic signs). (Moreau & Mascaret, 2010).

2. Signs access on website

It seems that, with the possibility of uploading a sign without being constrained by written language, problems could be solved. But which sign access are deaf people provided with when looking for a sign, in a conceptual network like OCELLES, when they have no idea what the equivalent written word is? Although word checking in a written text is quite easy, it is not the case for sign checking in a video.

How can a specific sign in a video be found? Today

studies are carried out in the field of gesture recognition (Dreuw & Ney, 2008; Lefebvre-Albaret & Dalle, 2010) but all the linguistic parameters cannot be taken into consideration, for instance specific parameters of sign languages (handshape, movement, place (Stokoe, Casterline, & C –Cronenberg, 1965), orientation (Friedman, 1977; Liddell, 1980; Moody, 1980; Yau, 1992), but also symmetry (Filhol, Braffort, & Bolot, 2007), ...). These linguistic parameters cannot be considered as such. Indeed, even if a human mind can discern one from the other, as isolated significant elements, they have to be used simultaneously during communication interactions. Contrary to vocal languages, realizing a signifying form in a sign language cannot be made through a succession of distinct realizations of isolated and non-signifying elements. Minimal realization structures in sign language may be ranged on a growing complexity scale, starting from the formal transfer (infra-conceptual level) and going up to the double transfer (level where several actors, location parameters and utterances can be combined) (Cuxac, 2000). These various structures use the same linguistic parameters during the same realization laps of time. (Moreau & Mascaret, 2010)

If we consider these elements, we can observe that few websites propose thematic approaches making it possible to find a sign through labels including animated signs. In most of existing tools, deaf users have to master written language which often isn't their natural language. Deaf people can't find a sign directly in a document the same way vocal speakers can find a word in a text or in a dictionary.

3. Theoretical and conceptual framework

3.1 Hypothesis

The approach which has currently been chosen, is both

theoretical and general, it could help find a sign in a sign dictionary or sign ontology without using written language. Based upon the semiological Cuxac model (Cuxac, 2000) and Thom morphogenesis theory (Thom, 1973), we consider a sign as a constellation of pregnant (stable and perpetual) parameters. A sign is a dynamic form i.e. a set of space discontinuities which changes in time.

3.2 Space and internal dynamics

According to Petitot¹, in the “catastrophe theory”, a substratum has a spatial extension, in which each point has a local physic. This local process was called internal dynamic by Thom (1973). Therefore, each point has an internal dynamic. Spatial extension of substratum works as a coupling mode between internal dynamics, what Thom calls space control. Position in control space creates interactions between local dynamics and others which are nearby. These interactions propagate spatially and the coupling exists thanks to characteristic substratum mechanisms. Space becomes mainly a coupling factor, which connects internal dynamics. Space isn't a container, but an interaction principle between internal dynamics.

When we move spatially, internal dynamics, which result from couplings, are transformed and deformed. But, for one point, these internal dynamics define the local state of substratum. So, when some critical values are crossed while moving, the internal dynamic modifies internal states of the system.

Some domains are logically found within some internal states which predominate each time. Each domain is delimited by boundaries. So, domains with boundaries define the concept of form. Each form means that substratum space is broken.

Dynamic can be defined as a process which minimizes energy level. At a given point, internal dynamic is described by a function of potential. The internal states are the minima of this function. This principle is an optimization principle. Thom calls this first category: elementary catastrophe (Thom, 1973).

The second category is called generalized catastrophe. This approach corresponds to complex situations including many sorts of dynamics. The theorem shows that in each dynamic, there has to be some dissipation or gradient decrease, in the shape of a depression, the minima of which is called system attractor.

3.3 Isomorphism

According to the Gestalt theory, we postulate an isomorphism between the world and the way the person perceives it.

This dynamic and topological representation must obviously be understood in a broad sense: abstract and complex. If we perceive a handshake it doesn't mean that this handshake will physically take shape in our brain. It

is not a strict coding of our sensations, particularly concerning our perception of space and time.

“Thom claims that the principle organizing the combination of meaning-carrying units in language corresponds to the principle underpinning the configuration of phenomenal parts into intelligible wholes in perception. The rationale of this claim is biological: it seems sensible to suggest, as Thom says (Thom, 1980 b p. 180), that language has evolved from the necessity of (or the advantage inherent in) conveying to others the significant changes (i.e. the catastrophes) in the environment. This entails—as Thom with no further argument asserts—that the syntactic structure “naturally” reflects the dynamic structure of the external catastrophe.” (Bundgaard & Stjernfelt, 2010)

4. Application in the sign language

4.1 Process of a sign formulation

The sign achievement process is considered as an optimization process. A sign looks acceptable to a sign language speaker, if it complies with signing constraints. A sign is considered as acceptable when meeting with meaningful linguistic units interactions.

4.2 Space of the sign and conceptual space

We consider two isomorphic spaces: a sign space and a conceptual space.

During sign procedure, its form changes into a potential gradient, under the influence of internal variables, resulting both from internal constraints and the period of achievement. Every minima of this space corresponds to a system attractor.

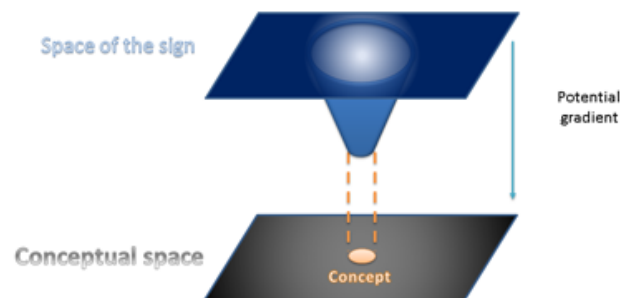


Figure 1: Space of the sign and conceptual space

The sign space is the sum of morphemic subspaces. Each subspace is evidence of a morpheme and characteristic of its internal states.

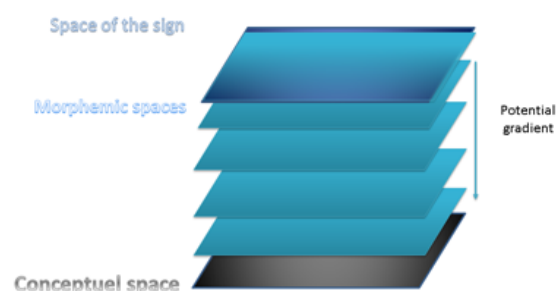


Figure 2: Morphemic subspaces

¹

http://www.archivesaudiovisuelles.fr/FR/_video.asp?format=68&id=117&ress=477&video=81606

4.3 General Principle

In these conditions:

- A sign is defined by the same generative potential, which found the mutual determination of agents, by extension the parameters and the morphemes. The potential is the source of the structure,
- The number of linguistic parameters characterizing a sign isn't a priori defined,
- There is an initial equiprobability of linguistic parameters,
- The possible perceptual stability of one or several linguistic parameters can evolve during the realization,
- An attractor results from a morpheme, which could use several linguistic parameters,
- The spaces of the signs and the conceptual spaces are countless and can overlap.



Figure 4: [LOUIS XV] (extract of sign [TABLE LOUIS XV])

4.3 Illustration

This approach based upon the perception-conception character of sign language helps consider lexicalized signs and also high iconicity structures. It helps make the distinction between each lexicalized sign together with a couple of high iconicity structures, which are close to one other.

From the structure of high iconicity in which the form [TABLE LOUIS XV] for example, is reinvested during a transfer, we can emphasize:

- some morphemic subspaces in which the lexicalized sign [TABLE] displays appears in the first instance,



Figure 3: [TABLE] (extract of sign [TABLE LOUIS XV])²

- some morphemic subspaces in which the proforms (Cuxac, 2003), specify the distinctive form of the table appropriate to the style [LOUIS XV].

² On the picture : Moez a French Sign Language native speaker

The conceptual space [TABLE LOUIS XV] is a conceptual subspace of [TABLE].



Figure 5: Table of style Louis XV³

This process can be illustrated by the plans below. Attractors change during period of sign realization. Agents are symbolized by red balls.

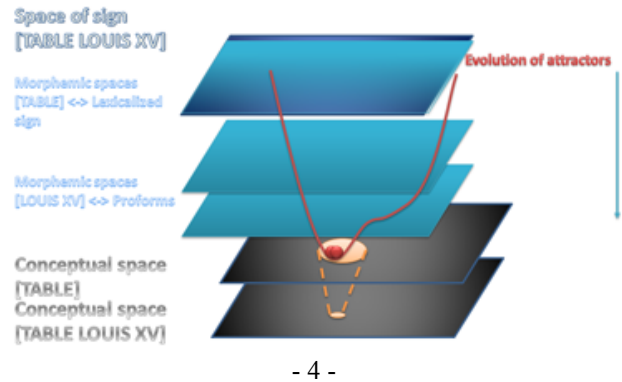
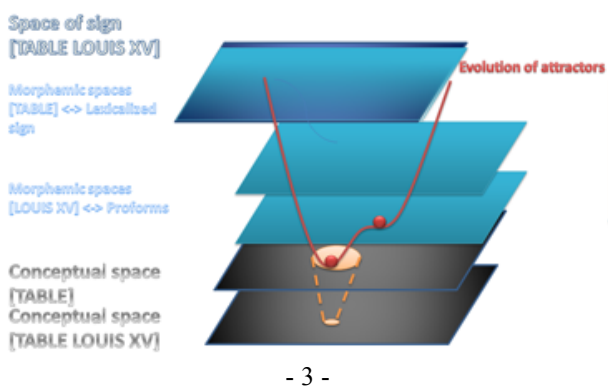
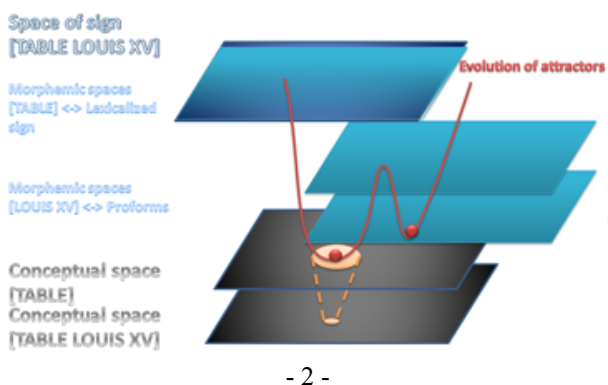
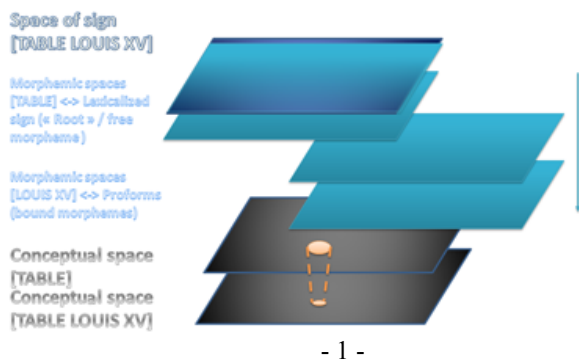


Figure 6: Example of evolution of realization of a structure of high iconicity [TABLE LOUIS XV]

When we approach the bottom of the basin of attraction (the minima of the attractor or "chreode" (Thom, 1973)), which corresponds to the exact meaning of the concept, parameters which are not the most pregnant one contribute to the exact determination of the concept, and they can modify the surface of the basin.

The iconic signs send back to conceptual subspace of a greater granularity than the conceptual space of the lexicalized signs.

The use of the perceptual stability of the morphemes of "secondary" morphemic spaces allow the distinction between two structures of high iconicity, close to each other.

For example, [TABLE LOUIS XV] and [TABLE HENRI II] have the same first morphemic space, which comes from lexicalized sign [TABLE]. Their "secondary" morphemic spaces relative to the legs of the table, for example, allows to distinguish them.



Figure 7: Table style Henri II⁴

The differences between these two signs particularly concern the use of given proforms which specify the distinctive shape of the leg of each table.



Figure 8: Spaces of signs [TABLE LOUIS XV] & [TABLE HENRI II] and conceptual spaces

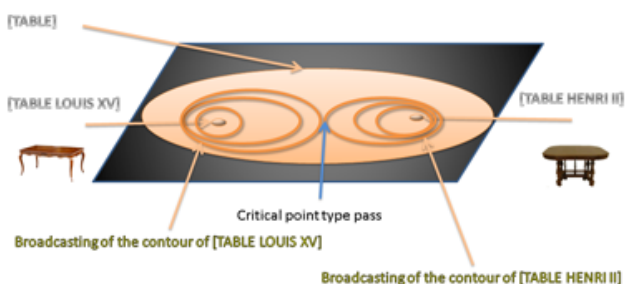
³

<http://www.mariealbertfurniture.com/images/items/Table/03019th1.jpg>

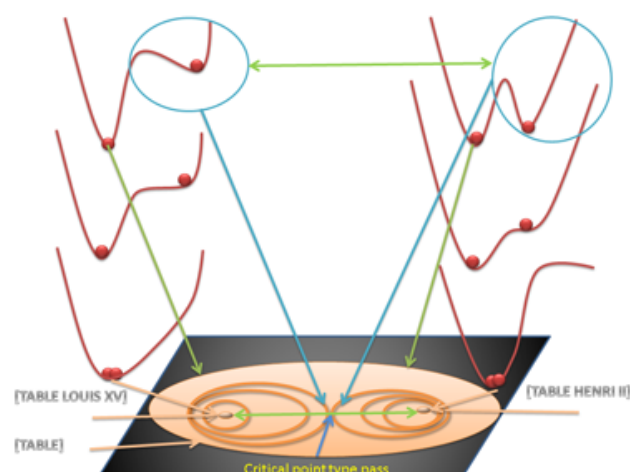
⁴ <http://www.french-warehouse.com/Images/Table.jpg>

According to the idea introduced by (Blum, 1973; Psotka, 1978; Koenderink, 1984; Koenderink & VAN DOORN, 1986) spreading boundaries on which the process of genesis of a relational shape bases on, is transmitted as a front of wave (Petitot, 1991).

The transition between two signs is characterized in the abstract space by specific type of pass: transition between two lines level tangent. These characteristic points could be used to identify the position (Petitot, 1991) and the determination of the relative distance between close concepts.



- 1 -



- 2 -

Figure 9: Proximity of concepts [TABLE LOUIS XV] and [TABLE HENRI II]

5. Perspectives for sign access on website

Perspectives of this theoretical and general work could be used in the future as a way of accessing a sign in bilingual or monolingual (sign language) dictionaries or ontology, like OCELLES project.

From perception of sign speakers, perspectives of this theoretical and general work could be used in the future as a way of accessing a sign in bilingual or monolingual (sign language) dictionaries or ontology, like OCELLES project. Every user will be able, for example, to give his perceptive point of view about every sign by proposing a morphemic cutting and weighting way based on every linguistic parameter (by proposing eventually new ones). If the sign access is unsuccessful, users will always be able to use isomorphism between sign and conceptual spaces.

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