

# VisualLIHLA: the visual online tool for lexical alignment

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## ABSTRACT

This paper presents a freely available online lexical alignment tool based on the LIHLA lexical aligner. LIHLA aligns tokens, words and multiword units based on language-independent heuristics (cognates, position, etc.) and automatically built language-dependent resources (bilingual dictionaries). VisualLIHLA allows the online usage, visualization and download of the lexical alignments produced by LIHLA with 84–92% of precision and 76–91% of recall.

## Categories and Subject Descriptors

H.5 [Information Interfaces and Presentation]: User Interfaces—*Natural Language*

## General Terms

Design, Algorithms

## Keywords

Lexical alignment, machine translation, Brazilian Portuguese

## 1. INTRODUCTION

Lexical alignment is an useful previous step for many natural language processing (NLP) applications, such as machine translation [1, 8], bilingual lexicography [6], and word sense disambiguation [4].

The alignment of two (or more) texts is the process of finding translation equivalences between segments (paragraphs, sentences, words, etc.) of one text (the source text) and segments of its translation (the target text). In this paper we are concerned with the lexical alignment, that is, the alignment between tokens (single words, characters, etc.) and sequences of tokens (e.g., multiword units).

Among the several automatic lexical aligners proposed in the literature, the statistical systems are considered to be

the state of the art (e.g., [7] and [8]). Although they provide good results, the statistical aligners are not able to deal properly with the syntactic divergences between languages which bring about some frequent problems such as the non-consecutive phrasal information, long-range dependencies [1] and alignments involving multiword units.

In an attempt to handle some of these problems, many approaches were proposed recently (e.g., [10], [1] and [2, 3]). In this paper we describe a freely available visual online tool developed based on a hybrid lexical aligner: LIHLA [2, 3]. LIHLA tries to find the best alignments between tokens, words and multiword units based on language-independent heuristics and statistical alignments between single words defined in automatically built bilingual probabilistic dictionaries.

This paper is organized as follows: section 2 explains how the LIHLA works. Section 3 describes the visual online tool developed based on LIHLA and section 4 finishes this paper with some concluding remarks and proposals for future work.

## 2. THE LIHLA LEXICAL ALIGNER

The lexical alignment performed by LIHLA is briefly described in this section, for a more detailed description see [2, 3].

To perform the lexical alignment, LIHLA uses the statistical alignments between single words defined in two bilingual dictionaries (source–target and target–source). These dictionaries are automatically built from sentence-aligned parallel texts using NATools.<sup>1</sup> Given two sentence-aligned corpus files, NATools counts the co-occurrences of words in all aligned sentence pairs and builds a sparse matrix of word-to-word probabilities using an iterative expectation-maximization algorithm. Then, the two probabilistic bilingual dictionaries are composed by the elements with the highest probability values in the matrix [9].

Besides the word-by-word correspondences found in the bilingual dictionaries, LIHLA also uses four language-independent heuristics, in the following order:

<sup>1</sup>NATools is a set of tools developed to work with parallel corpora, which is freely available in <http://linguateca.di.uminho.pt/natools/>.

1. **exact matches** – LIHLA prioritizes a target token which is identical to the source token being aligned. This heuristic is very useful, for example, in the alignment of proper names, numbers and special characters.
2. **cognates** – LIHLA tries to look for cognates for a source word using the longest common subsequence ratio (LCSR). The LCSR of two words is the length of their longest common subsequence by the length of the longest word. For example, the LCSR of the Portuguese word *alinhamento* and the Spanish word *alineamiento* is  $\frac{10}{12} \simeq 0.83$  as their longest common subsequence is *a-l-i-n-a-m-e-n-t-o*.
3. **best translation** – LIHLA chooses the best translation for a source word following one of two criteria (an input parameter): the target word with the highest probability according to the *bilingual dictionary* or the one at the best *position* regarding the source word position. By default, LIHLA uses the position criterion.
4. **multiword units** – After finding the best translation for a given source word based on the previous heuristics, LIHLA looks for multiword units for them. To find a source multiword unit LIHLA looks for the words occurring in the neighbourhood of the source word (in the source sentence) that: (1) are possible translations of the target word and (2) are not a possible translation of any other target word in the neighbourhood. A similar process is carried out to find a target multiword unit.

Thus, using the two bilingual dictionaries built by NATools and the heuristics described before, LIHLA tries to find the best lexical alignment in a pair of parallel sentences by means of an iterative process. In the experiments described in [2] and [3], LIHLA has achieved 84–92% of precision and 76–91% of recall for Portuguese–English and Portuguese–Spanish parallel texts, respectively.<sup>2</sup>

### 3. THE VISUALLIHLA TOOL

The VisualLIHLA<sup>3</sup> is a freely available tool developed to allow the online usage, visualization and download of the lexical alignments produced by LIHLA. As shown in Figure 1, to align a pair of texts in VisualLIHLA, the user has to: (1) enter the source and target texts, respectively, in the left and right text boxes; (2) choose the source and target languages and (3) press the “Align” button. The language selection is very important since this information determines which dictionaries LIHLA will use to align the source and target texts.<sup>4</sup>

To improve the alignment performance, the input parallel texts must be sentence aligned, that is, the source sentences

<sup>2</sup>Precision is the number of correct alignments divided by the number of proposed alignments while recall is the number of correct alignments divided by the number of alignments in the reference.

<sup>3</sup><http://www.nilc.icmc.usp.br/nilc/tools/visuallihla/lihla.htm>.

<sup>4</sup>There are 4 language pairs allowed in the current version of VisualLIHLA: Portuguese-Spanish, Portuguese-English, Spanish-Portuguese and English-Portuguese.

and their translations (the target sentences) must occur in parallel lines. For example, the target sentence(s) at the first line in the right text box must be the translation of the source sentence(s) at the first line in the left text box.

During the alignment, a progress window displays the alignment types being produced: omissions (1 : 0, 0 : 1), one-to-one (1 : 1) and many-to-many (1 : 2, 2 : 1, 2 : 2, etc.). Once finished the lexical alignment, the progress window closes and the user is able to view the resulting alignments along with some statistics. To visualize the alignments, it is necessary just pass the mouse over the desired source or target token. By doing this, the selected token and the corresponding (aligned) token(s) in the other text will be highlighted in a different background color as shown in Figure 2 for the 2 : 1 alignment between the two Portuguese words *em conjunto* and the English word *jointly*.

In addition to the visualization of the lexical alignments in the parallel texts, it is possible to see how many alignments of each type were produced and also to select some of them by clicking on the corresponding colored box, as shown in Figure 3. Finally, the user can download the input and aligned (output) texts by clicking on “Save this alignment”.

### 4. CONCLUDING REMARKS AND FUTURE WORK

In this paper we have presented the VisualLIHLA, a freely available online tool for lexical alignment. VisualLIHLA uses the LIHLA [2, 3] lexical aligner to find the best alignments between tokens, words and multiword units.

As future work, we intend to extend the VisualLIHLA to allow the manual edition of the automatic lexical alignments aiming at correcting misalignments or improving the aligner’s performance. We also want to adopt the XML<sup>5</sup> output format and integrate the VisualLIHLA with the VisualTCA [5] —the online visualization tool for sentence alignment.<sup>6</sup>

### 5. ACKNOWLEDGMENTS

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<sup>5</sup>[www.w3.org/XML](http://www.w3.org/XML).

<sup>6</sup><http://www.nilc.icmc.usp.br/nilc/tools/pagina-visualtca/visualtca/tca.htm>.

# VisualLIHLA - Lexical alignment visualization [\(Load example\)](#) [\(Help\)](#)

Paste the source and target texts which you want to align, choose source and target languages below and then click on the button

Source: Portuguese ▾

Target: English ▾

Align

Os defeitos das esferas  
 Em uma descoberta que interessa tanto à medicina quanto à nanotecnologia , Mark Bowick , da Universidade de Siracusa , David Nelson , de Harvard , e Alex Travesset , da Universidade da Iowa , com o apoio da National Science Foundation ( NSF ) , dos Estados Unidos , determinaram como a natureza dispõe partículas elétricas em uma fina camada na superfície de uma esfera .  
 Em uma cobertura plana , já se sabia que a estrutura da rede de partículas se parece com um conjunto de bolas de bilhar acondicionadas a triângulos perfeitos .  
 Entretanto , as superfícies esféricas não comportam arranjos em triângulos perfeitos .  
 O quebra - cabeça começou a ser resolvido quando a equipe mostrou como os cristais esféricos compensam as superfícies curvas desenvolvendo rachaduras ( Science , 14 de março ) .  
 Trabalhando em conjunto com os norte - americanos , equipes alemãs e holandesas desenvolveram um modelo de organização dos cristais esféricos .  
 Essa proposta teórica privilegia o papel dos defeitos na estrutura dos cristais para determinar como as partículas se organizam e se adaptam a eles .  
 Espera - se agora que o desenvolvimento desses estudos beneficie não somente a medicina - localizando , por exemplo , fendas estruturais na superfície dos vírus e bactérias por onde possam agir os medicamentos - mas também a engenharia - possibilitando a criação de novas moléculas .

The faults of the spheres  
 In a discovery that is of interest both to medicine and to nanotechnology , Mark Bowick , from Syracuse University , David Nelson , from Harvard , and Alex Travesset , from the University of Iowa , with the support of the National Science Foundation ( NSF ) , of the United States , have ascertained how nature sets out electrical particles in a fine layer on the surface of a sphere .  
 On a flat covering , it was already known that the structure of the network of particles appears like a set of billiard balls arranged in perfect triangles .  
 Spherical surfaces , though , do not lend themselves to arrangements in perfect triangles .  
 The puzzle began to be solved when the team showed how the spherical crystals compensate for the curved surfaces by developing cracks ( Science , March 14 ) .  
 Working jointly with the Americans , German and Dutch teams developed a model for organizing the spherical crystals .  
 This theoretical proposal gave priority to the role of the faults in the structure of the crystals to ascertain how the particles organize themselves and adapt to them .  
 The expectation is now for the development of these studies to benefit not only medicine - for example , by locating structural cracks on the surface of viruses and bacteria through which medicines can act - but also engineering - making possible the creation of new molecules .

Figure 1: Screenshot of the VisualLIHLA alignment tool

Trabalhando em conjunto com os norte - americanos , equipes alemãs e holandesas desenvolveram um modelo de organização dos cristais esféricos .	Working jointly with the Americans , German and Dutch teams developed a model for organizing the spherical crystals .
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Figure 2: Highlighted alignment between *em conjunto* and *jointly*

Alignment types	Source text	Target text
<input type="checkbox"/> 21 alignments 0:1	Paragraphs: 8	Paragraphs: 8
<input type="checkbox"/> 13 alignments 1:0	Sentences: 8	Sentences: 8
<input type="checkbox"/> 207 alignments 1:1	Tokens: 236	Tokens: 247
<input type="checkbox"/> 7 alignments 1:2	<a href="#">(Align another text)</a>	
<input type="checkbox"/> 3 alignments 2:1	<a href="#">(Save this alignment)</a>	
<input checked="" type="checkbox"/> 1 alignment 3:2 (Click on a color to highlight alignments)		

Figure 3: Lexical alignment result

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