

# A Notation System for Tango

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## Abstract

There are several notation systems that allow to describe the movements of a dancing person. This article discusses the notation of figures of a dancing *couple*, and we are interested in the situation where the partners do not dance with a prepared partner, but where one partner improvises and *leads* the other partner, as this is the case for instance in Tango or Salsa. We propose a notation that is based on the information communicated between the partners, and demonstrate this approach with a concrete notation system for Tango. In this notation we do not specify absolute positions, and thereby avoid the annotation of redundant or inessential information. Compared to the well-known Labanotation or the Benesh system, or other systems particularly designed for Tango, it allows a more compact representation of complex movements. Finally we show how the notation of the following partner can in many cases be deduced from the notation of the leading partner.

## 1 Introduction

What do we mean if we say that a movement in Tango is *lead*? It is a common observation in Tango (as well as e.g. in Salsa) that there are some few principles that are used to communicate complex sequences of steps between leading and following partner. This allows that two persons that never danced together before dance figures they never danced before. The fundamental elements of this communication between the partners in Tango are essentially independent of the various Tango schools and styles.

It is extremely complex to describe human motion in space. Benesh wrote in *“Birth of a Language”* [1]: *“Designing a practical notation is perhaps like designing a piece of equipment that will do the work of a steam hammer but must pass through a key-hole.”* Benesh sought a universal notation for all human movements. The result is the *Benesh Movement Notation (BMN)*, see e.g. [4]. An older approach is the Labanotation [3].

If we want to describe sequences of steps in Tango, we do not have to use the full power of BMN, but we can exploit the fact that there already *is* the ‘language of Tango’ that is shared by the Tangoeros all over the world. Several concepts of this language are reflected in the lessons of many Tango teachers. But many details about the precise posture of the dancers are either invariant throughout Tango, or are implicitly understood from the context, or depend on the various

schools and styles in Tango, and do not have to be communicated between the partners. I propose to use the information that is exchanged between the partners as the fundamental elements to annotate figures and choreographies.

For music there already exists a well-established notation system. Music scores have many applications. Most importantly, they are a tool for communication, and scores are used to exchange information between composers, conductor, and musicians. The notation system for music is also a device for composition on an abstract level. It should be emphasized that this system does not *define* how music can look like. However, its usefulness is undisputed. This is even so despite the fact that it requires certain practice to use it fluently. For a beginner, it can be hard to grasp a melody from its notation only.

This text does not try to define or to formalize Tango, which is impossible. It is also not a text on how to learn Tango. I rather want to suggest a simple notation that dancers might use to structure the zoo of figures they learn, to discuss figures in the same terms with other dancers, and to satisfy their curiosity about the system behind the things that they usually manage intuitively.

**The Rôle of Abstraction.** A movement of the legs might induce at some point the movement of the whole body. More specifically, if for example a person has the weight on the left leg, moves the right leg to the front, and ends in a position where the weight is on the right leg, we know that the person moved to the front. The precise time point from when to when the center of the body moves is not spelled out in detail. This would be a difficult task, since it very much depends on various factors, musicality, speed, next movements, size of the movements etc. For our system it is only relevant, that the weight of the body moved from above the supporting leg in the previous state to the position above the other leg.

Notation of movements has to make many abstractions. For instance, we do not want to specify absolute time points in the notation of a Tango figure – this would often not make sense, since at each stage the speed could be doubled or halved or varied otherwise, according to the musicality of the dancing couple. Unlike several notation systems in the literature, we also do not specify absolute positions – the size of the movements, the angles of rotations all very much depend again on the music, the physics of the dancers, the situation in the salon etc. I think that this strong abstraction is necessary. Benesh writes in “*Birth of a Language*” [1]: “*The essential need for simplicity cannot be over emphasized. Simplicity does not necessarily mean omitting and reducing the value of things, it means the embracing of everything necessary into a simple unified theory or concept*”. However, we should not expect too much: many figures that feel simple and look natural are indeed very complex, and are only mastered by a large amount of practice. Any notation system must trade off between universality and simplicity.

**Personal Pronouns.** I frequently use the pronoun ‘we’, which is meant in the sense of ‘the reader and I’. I would also like to make use of the richness

of the English language, which supports the concept of grammatical gender<sup>1</sup>, and from now on we let the leading person be *male* and the following person be *female* to conveniently distinguish them in text.

**Outline.** This article is organized as follows. We start with a general discussion of principles for notation systems for dances with leading and following partner. Section 3 introduces popular concepts in Tango that will be useful to introduce our notation. In Section 4 we describe the alphabet of our notation, in Section 5 we show how to combine the symbols to sequences that denote Tango figures. We illustrate the notation with rotations, which are notoriously difficult to annotate. Section 7 shows an application of the notation: we show several ways how the notation of figures can be transformed to obtain new figures. In Section 8 we discuss how it is often possible to predict the notation of the following person from the notation of the leading person. We close with a demonstration of the potential of the new notation system, and annotate parts of a choreography of Juan Carlos Copes in the film *Tango* directed by Carlos Saura [5].

## 2 Notation Design Principles

In this section we develop principles for the design of notation systems for dances with a leading and a following partner. The leading partner wants to dance a certain figure with his partner, but the following partner does not know which figure. *Leading* is the non-verbal communication of this intention to the following partner. Dances like Tango and Salsa have some few principles for leading. In these dances, most choreographies can be lead, sometimes even if they contain figures that the following partner never danced before.

This communication bears extra complexity for notation systems; it is extremely complex to keep track of all the involved elements that constitute successful leading. For example, to lead the partner into a certain step, we often need slight counter movements before we can actually perform the main movement that indicates the step. Another difficulty is that the precise movements of the leading person heavily depend on the response of the partner. We believe that any notation system that is based on precise descriptions how two bodies move has fundamental problems with the annotation of leading and following.

On the other hand, the mentioned non-verbal languages in Tango or Salsa turn out to be an advantage for the design of notation systems. Before we discuss how the new requirements might influence the design of a notation, we review the most systematically designed universal notation system, which is the Benesh Movement Notation (BMN). It is based on descriptions of absolute positions of the bodies of the dancers, and consequently we believe that for our purposes the BMN works on the wrong level of abstraction and is impractical.

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<sup>1</sup>I often got the response from readers that every human language has a grammatical gender. This is not true; for instance Turkish and Korean do not have one.

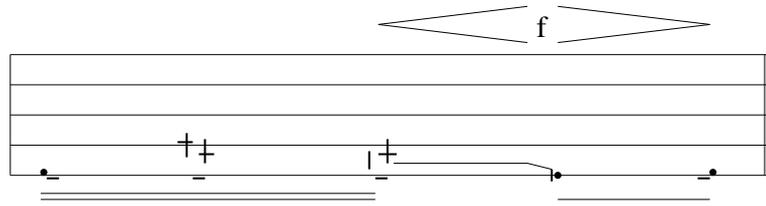
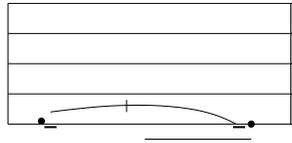


Figure 1: Benesh Movement Notation for a frequent sequence in a choreography of *Five Tangos* by van Manen - it denotes a single forward step of a single person. In the notation for this choreography of the one-act play a short-cut for this step was used, which can be found below.



**The Benesh Movement Notation.** The Benesh Movement Notation is written within the so-called *stave*, which is a five-lined matrix for the human body. It is suited for the notation of running, rolling, falling, dancing, walking or any other form of movement. BMN was used for the notation of a Tango choreography by van Manen; a single forward step is analyzed as shown in Figure 1. Tango dancers might have the impression that this is quite a lot to write for a single step for a single person. Indeed, already in the BMN of this choreography certain short-cuts were introduced. For instance the notation in the second part of Figure 1 replaced the notation in Figure 1. But we believe that the notation is still too explicit for such a fundamental and frequently used element in Tango.

The design of the BMN is based on two principles, called *axioms* in [1].

1. The notation system should be *visual*.
2. The notation should take the perspective of a third person watching the dancer. This person has a two-dimensional reception of the three-dimensional dancer in the space, and this justifies the usage of the stave.

A notation is *visual* if it exploits symmetries in space. For example, if we introduce  $\rightarrow$  as the symbol for a certain movement to the front, then the corresponding backwards movement is naturally denoted by  $\leftarrow$ .

For the notation of dances with leading and following we still believe in the first principle. However, we would not require to use a stave. The reason for this difference to Benesh's design decisions is that for our purposes Benesh's second principle is not met. For a dancing couple in Tango, the point of reference is the partner, and not potential spectators.

We now want to formulate two additional design principles. Because of the importance of the connection between the music and the dance, we would like to have the possibility to write a choreography in our language directly below the corresponding score of the music, as this is the case in BMN. Notation that is compatible with music scores seems impossible for other systems that have been proposed for Tango, e.g. for the descriptions of the figures in Castro's system [2]. As in many other descriptions for social dance, they are based on a picture for the sequence of steps of the partners. The paper represents the dance floor, and the feet of the partners are shown, decorated with numbers according to the order in which the steps are made. Since these pictures represent *absolute* positions in space, we might have problems to fit the pictures for a sequence of rotations of the couple sequentially below the lines of music.

The last principle we want to formulate is devoted to leading and following. If a figure is lead, then the movements of the following person are to some extent determined by the leading partner. We would like to have a system where the notation for the following person can in such cases be deduced from the notation of the leading person. One of the main underlying ideas of how this is done in Tango (and Salsa) is that the following person always dances what is *natural* or *convenient*. The leading person on the other hand tries to create situations where there is a unique *most convenient* way for the following person. It is for Tango dancers clear that the leg carrying the weight can impossibly move without changing the weight to the other leg, and therefore we use the other leg to move. The movement of the leading upper body determines the direction of this step of the following partner. We will treat this in detail in Section 8.

We summarize the four mentioned language design principles.

1. The notation should be *visual*.
2. The notation should describe the state and movements of a dancer relative to the partner.
3. It should be possible to sequentially write down the notation, according to the linear order of the movements given by time. Thus it should be possible to write the notation together with the score of an associated piece of music.
4. It should be possible to predict the notation for the following partner from the notation for the previous state of the following partner, and from the notation for the leading partner.

### 3 Preliminaries

In Tango, most of the time a dancer carries the weight on *one* leg, which is also called the *supporting* leg. The *free* or *non-supporting* leg that does not carry the weight can move. The diagram in Figure 2 shows the typical positions of the free leg of a person standing on its left leg in the hatched area. The person is oriented to the right, i.e., it faces the right side; accordingly, Position 2 in

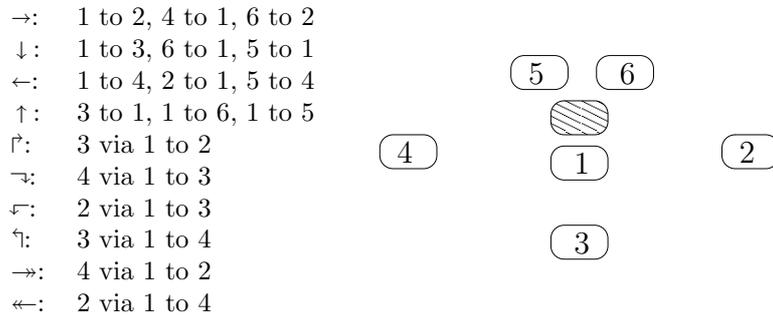


Figure 2: Schema for the various positions of the right leg of a dancer, standing on his left leg in the hatched area, and oriented to the right side. The arrows denote the changes between these positions.

Figure 2 corresponds to a *front* step of the person. We chose this orientation of the illustration because it will fit the direction in which we read our notation. The precise placement of the feet within or close to the encircled areas is not specified. They also might be oriented in various ways. We do not keep track of this information in our core language, since the position of the feet can most of the time be deduced from the context.

It is typical for Tango that when we change from some position of the free leg to another, we usually first return to Position 1 (again, see Figure 2). It is also one of the special elements of Tango that sometimes there is no movement at all, but the dancers rest in the music.

When do we call a sequence of movements a *figure*? I adopt the convention that a figure is a sequence of steps or other movements that 'belong together' for certain reasons. Such reasons might be of historic, dynamic, melodic or rhythmic nature. It might be possible to divide a figure into smaller constituting parts; however, they still form a certain entity, for instance because they are particularly convenient to dance in combination. The sequence might also be grouped together and form an entity because of didactic reasons. It might be best to teach the whole sequence, instead of teaching its parts. The most famous figure of Tango is the so-called '*base*'. We will use the base to illustrate the notation in Section 5.

There are several aspects of Tango that might vary a lot, depending on dancer, couple, and style: How much do you bend the knee of the leg carrying the weight, how much the other knee? How do the partners hold each other at hands and arms? Are the upper bodies touching at the front, more at the right side, or not at all? How much do you use vertical movements and impulse for leading? How close are the feet and the knees in position one? How do you step forward with your feet (hills first, hills last, the whole foot)? Such questions are taught differently in different schools; we try to be as basic as possible and try not to specify such matters of style.

**A Notation System for Tango.** In the notation system presented here we keep track of the states, the movements, and the communication of the dancers with respect to the following categories:

1. *Weight* – The dancing person might stand on the left or on the right leg.
2. *Orientation of the upper body* – In Tango one usually starts a dance standing in front of each other. But quite often while dancing your partner is more to your right or more to your left side, and you have your upper body turned towards him.
3. *Impulses of the upper body* – Such an impulse of the leading person might for instance indicate a rotation to the following person. It might also cause that the upper bodies open to the left or to the right side.
4. *Relative state of the legs* – This is the determining factor to describe the state of the lower body in Tango. It can be either *open* or *crossed*. The usefulness of this concept has also been recognized for teaching Tango. This concept is explained in detail below.
5. *Movement of legs* – The movements of the *free* leg of the dancing person, i.e., the leg that does not carry the weight.

Our notation system describes all states and movements during a dance with respect to these categories, we obtain a notation system that can be used to annotate Tango figures; the details of this system will be introduced in Sections 4 and 5.

## 4 The Alphabet

The alphabet of the notation system consists of symbols for the notation of the state of the upper body, symbols that denote the state of the legs relative to the partner, and symbols for movements of the legs.

We start with the upper body. The alphabet contains three symbols for the alignment of the shoulders:  $|, \backslash, /$ . The first symbol stands for the state where the upper body is oriented straight towards the walking direction, whereas for then second and third symbol the upper body is turned towards the left or the right, respectively. The second information we denote is whether the leading partner gives some extra spin impulse with the upper body. For instance the symbol  $\lfloor$  denotes the situation where the upper body is directed straight to the partner, but at the same time there was some impulse that caused her upper body to turn to the left. This happens for example at the beginning of the well-known backwards-ocho of the lady – we will come back to that in Section 5. Other symbols denoting such an impulse are for instance  $\lfloor$  and  $\lrcorner$ . The last symbol combines the information that the upper body is oriented to the right or to the left, and at the same time gives some extra impulse.

To describe the relative positions of the legs, we use the two symbols  $o$  and  $x$ , to denote whether the state of the dancer is *open* or *crossed*. The concept



Figure 3: Pablo Villarraza and Dana Jazmin Frigoli: She is in a crossed, he is in an open state.

of the relative state of the legs is defined with respect to the position of the partner. To understand these concepts imagine a line between the centers of the two partners that are facing each other. We say that a person is in the *crossed state* (with respect to his partner) if either the left leg is to the right of this line, or the right leg is to the left of this line. Otherwise the person is in the *open state*. This information forms an important part of the notation since it often influences which steps are possible next. The relative state is also important for the notation of rotations, which will be discussed in Section 6.

Finally there are symbols for leg movements. They are divided into the symbols for half-steps  $\leftarrow, \rightarrow, \uparrow, \downarrow$ , and the symbols for full steps:  $\rightarrow, \leftarrow, \uparrow, \downarrow, \curvearrowright, \curvearrowleft, \curvearrowup, \curvearrowdown$ . These are the possibilities to change between the positions shown in Figure 2. We also have the symbols  $\cdot, -, |, x$  to denote no leg movement. We use the dot ‘ $\cdot$ ’ if the legs are in standard position besides each other, the line ‘ $-$ ’ if the legs are apart in either a side or a front step, respectively, and a cross ‘ $x$ ’ if the leg is in position five or six (in this case the partner is in particular in the crossed state; see Figure 3).

The movements of both partners are specified with the same notation, with a few exceptions for the leading partner. One of these exceptions is the symbol ‘ $\bullet$ ’, which will be explained in the next section. Also the hooks for the impulse of the upper body are only used for the leading partner.

We do not have explicit symbols for embellishments that are typical for Tango – such as the so-called boleo, lapiz, gancho etc. But it will be easy to recognize from the notation in which situations such embellishments are possible. If needed, due to Principle 4 in Section 2, it is possible to notate the decorations along with the base language, for example with the universal Benesh Movement Notation.

## 5 The Notation

For each partner, we annotate the movements by an alternating sequence of a symbol for the upper body, a symbol for the relative state of the legs, and a symbol for the leg movement. The symbol for the relative state is written below or above the symbol for the upper body, depending on whether the weight of the person is on the left or on the right leg. As we read from left to right, we imagine the leading person dancing forward from left to right. Hence, ‘ $\rightarrow$ ’ denotes a forward-step, and the symbol ‘|’ says that the upper body is oriented straight to the front with respect to the walking direction from left to right. We start with the movements of the leading person in the so-called *base* in Tango Argentino.

$$\begin{array}{c} \overset{o}{|} \leftarrow \overset{o}{|} \overset{o}{\uparrow} / \overset{o}{\rightarrow} / \overset{o}{\rightarrow} / \overset{o}{\rightarrow} | \overset{o}{\rightarrow} | \overset{o}{\rightarrow} | \downarrow \overset{o}{|} \\ \underset{o}{\phantom{|}} \underset{o}{\phantom{|}} \underset{x}{\phantom{|}} \underset{o}{\phantom{|}} \underset{o}{\phantom{|}} \end{array} \quad (1)$$

The non-supporting leg of the dancing person makes the next step as indicated by the following symbol for the leg movement. Note that in this figure the weight of the dancing person appears alternatingly at top and at bottom. This is typical for human walking, but not a strict rule: In fact every symbol for a combined movement in Tango can be considered as a short-cut for two simple movements. For example the following notation on the right is the abbreviation for the symbols on the left side.<sup>2</sup>

$$\begin{array}{c} \overset{o}{|} \leftarrow \overset{o}{|} \overset{o}{\uparrow} / \overset{o}{\phantom{|}} \\ \underset{o}{\phantom{|}} \underset{o}{\phantom{|}} \end{array} \quad \begin{array}{c} \overset{o}{|} \leftarrow \overset{o}{\uparrow} / \overset{o}{\phantom{|}} \\ \underset{o}{\phantom{|}} \end{array} \quad (2)$$

It is interesting to write the notation of the following person directly below the notations of the leading person such that movements that happen at the same time are closest together. We call the two sequences also the *tracks* of a notation. We will later see in detail how the notation for the following person often follow from the notation for the leading person. We demonstrate this for the base, and have a look at both tracks:

$$\begin{array}{c} \overset{o}{|} \leftarrow \overset{o}{|} \overset{o}{\uparrow} / \overset{o}{\rightarrow} / \overset{o}{\rightarrow} / \overset{o}{\rightarrow} | \overset{o}{\rightarrow} | \overset{o}{\rightarrow} | \downarrow \overset{o}{|} \\ \underset{o}{\phantom{|}} \underset{o}{\phantom{|}} \underset{x}{\phantom{|}} \underset{o}{\phantom{|}} \underset{o}{\phantom{|}} \end{array} \quad (3)$$

$$\begin{array}{c} \overset{o}{|} \rightarrow \overset{o}{|} \overset{o}{\downarrow} / \overset{o}{\leftarrow} / \overset{o}{\leftarrow} / \overset{o}{\leftarrow} | \overset{o}{\leftarrow} | \overset{o}{\downarrow} | \\ \underset{o}{\phantom{|}} \underset{o}{\phantom{|}} \underset{x}{\phantom{|}} \underset{o}{\phantom{|}} \underset{o}{\phantom{|}} \end{array}$$

<sup>2</sup>The reasons to have these short-hands are manifold. Usually dancers count a combined movement as a single step, although it can be understood as two simple movements of the leg. For example we say that the base has eight steps. In this case simple and combined movements are counted with no difference. Having symbols for combined movements often allows concise descriptions if one partner dances two steps while the other partner dances one.

Using short-hands whenever possible also puts the focus on the more complex parts of figures, where the usage of a short-hand is not possible, for instance in rotations, see Section 6. If the partners are simply walking together, using symbols for combined movements leads to the pattern that the weight always alternates from leg to leg.

State number three of this figure is interesting: The fact that she is on his right front side indicated by / implies that his last side step must have been a little larger than her sidestep. Another interesting part of this sequence is step number five: While walking in three lines, a slight reorientation of his upper body causes her left leg to move back into the new direction, and she thus ends in front of her other leg: her legs are in the crossed state now.

**Anticodico.** In the *base* she has her weight on the left leg if he has it on the right leg, and vice versa. We call this the *parallel system*. If she has her weight on the left leg, and he has it also on his left leg, and if the partners are facing each other, the line between the legs carrying the weight and the line between the other legs cross, and therefore the other system is often called the *crossed system*. To not confuse it with the crossed state of the leg mentioned above, we call the crossed system *anticodico*. Below we find a frequent sequence of steps danced in anticodico.

But first we have to introduce the last symbol  $\bullet$  in the notation for the leading partner. Usually, if he changes his weight, she realizes this at the points of contact of the partners, and changes her weight accordingly. If he wants to prevent this, he can do so by suppressing the signals that would make her change her weight. In other words, he pretends with his upper body to not change his weight, but in fact he does change it <sup>3</sup>. In this case we have to use the symbol ‘ $\bullet$ ’, which we write on that side of the notation of the leading person, where she should then have her supporting leg (from his perspective). The real position of his weight is still specified by the side where we put *o* or *x* in the notations. <sup>4</sup> In the base we do not have such change of weight. We therefore have a look at the so-called *base cruzado*.

$$\begin{array}{cccccccc} \overset{o}{|} \leftarrow \overset{o}{\lrcorner} \overset{o}{|} \uparrow \overset{\bullet}{/} \overset{o}{\rightarrow} \overset{o}{/} \overset{o}{\rightarrow} \overset{o}{|} \rightarrow \overset{o}{|} \rightarrow \overset{o}{\lrcorner} \overset{o}{|} \downarrow \overset{o}{|} & (4) \\ \overset{o}{|} \rightarrow \overset{o}{\lrcorner} \overset{o}{|} \downarrow \overset{o}{/} \overset{x}{\leftarrow} \overset{x}{\leftarrow} \overset{o}{\leftarrow} \overset{o}{\leftarrow} \overset{o}{\leftarrow} \overset{o}{\lrcorner} \overset{o}{|} \uparrow \overset{o}{|} \end{array}$$

In the base cruzado the symbol  $\bullet$  also marks the change between parallel system and crossed system. The crossed system ends three steps later when she is in the crossed state again. The frequent use of both systems and changes between them is one of the fascinating elements of Tango. In the notation we can easily spot the differences: In the crossed system the weight is for both partners on the same leg, whereas in the parallel system both partners have the weight on different legs.

<sup>3</sup>This is in fact a quite frequent pattern in Tango, and one of the ways how the leading person might surprize the following person in subsequent steps.

<sup>4</sup>It might be the case that we have to put the symbol  $\bullet$  at the same side where we already have the symbol ‘*o*’ or ‘*x*’ for the weight. This happens rarely, but is for instance the case if one partner leads her to change the weight from left to right, and back to the left again, while he is always standing on the same leg.

Finally we give an example where a spin impulse of the upper body is an essential part of the figure: The *backwards ocho*. How does the leading person indicate that he wants her to make back steps while he accompanies her with side steps? We start like in the beginning of the base. After step number three he changes the weight to the right leg while turning her counterclockwise on her right leg: this information is given by the symbols  $\begin{matrix} \bullet \\ | \\ o \end{matrix}$ .

$$\begin{matrix} o & o & \bullet & o & o & o & o \\ | \leftarrow | \leftarrow | \uparrow \uparrow \uparrow \uparrow \uparrow \uparrow \downarrow \downarrow \downarrow \downarrow | \\ o & o & o & o & o & o & o \end{matrix} \quad (5)$$

$$\begin{matrix} o & o & x & x & o \\ | \rightarrow | \rightarrow | \downarrow \leftarrow / \leftarrow / \leftarrow \backslash \leftarrow \backslash \leftarrow | \\ o & o & x & x & o \end{matrix}$$

## 6 Examples

This section further illustrates the notation system and discusses famous figures in Tango Argentino. We start with examples from a group of figures known as *rotations*. The notation of rotations of the dancers is one of the greatest challenges for notation systems.

### 6.1 Rotations Around a Common Axis

Most notation systems for Tango are based on a graphical notation of the absolute feet positions, and lines and arrows that indicate movements. For readability, these systems have to describe a complex rotation with several pictures. In contrast, we can *sequentially* specify rotations with the already introduced notation. Even for repeated rotations we do not need several pictures, but still annotate them with the two tracks for the two partners. Here we make essential use of the information we have about the upper bodies. Although a rotation changes the direction of the partners in space, we still read and write from left to right only, since we only keep track of *relative positions* with respect to the partner.

The following is a right-rotation in the parallel mode where both partners walk around a common center. The notation is not symmetric between the partners: She dances the pattern *front-side-back-side*, while he only takes forward steps.

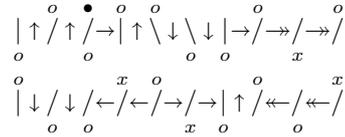
$$\begin{matrix} o & o & o & o \\ | \rightarrow / \uparrow | \rightarrow / \rightarrow [ \rightarrow / \uparrow | \cdot / \cdot | \\ o & o & x & o \end{matrix} \quad (6)$$

$$\begin{matrix} o & o & x & x & o & o \\ | \rightarrow / \rightarrow | \uparrow / \uparrow \backslash \leftarrow \backslash \leftarrow | \uparrow / \uparrow | \\ x & o & x & o \end{matrix}$$

These forward steps are often combined with so-called *sacadas*, i.e., he invades with his leg the space that she just left; this creates the impression that his legs *cut* into her legs – which is what the Spanish name says. See Figure 4

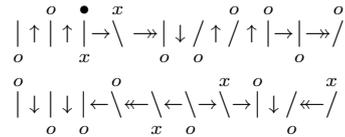


during which the partners usually turn by 360 degrees.



After the first two steps the partners are in the crossed mode as in the base cruzado. The first part of the turn starts with the leading person, who changes on her right side his walking direction towards her, while she is still walking backwards. The next step is the crux of the figure: with respect to the line of their joint movement, he is now on her other side, and leads her from a back step into a front step, while turning her around by 180 degrees. The final turn after the side step, that restores the original walking direction, is lead by another redirection of his upper body.

Again, the reflected version of this figure yields another interesting combination. We do not reflect the ending, such that both the original and the reflected figure end in step 4 of the base cruzado.



## 7 Transformations

In Section 6 we saw how to change a rotation in the parallel system to a rotation in the crossed system, and subsequently how to reflect the figure to obtain a left-rotation. Other transformations between figures are *reversion* between back and front and *inversion* – where we dance a figure from the end to the beginning. Finally we can *swap* the figure which means that he does her steps and vice versa. This does not mean, however, that she has to play the leading part: It is in most cases possible to lead all figures in the presented system in the mentioned transformed ways, even if we combine several transformations. With our notation it is easy to give formal rules how to reflect, reverse, inverse, and swap annotations of many figures. Here, the first two design principles turn out to be useful. For reflection for instance, it suffices to reflect the positions of the weight, to reflect all symbols for side movements, and to reflect all symbols for the upper body from left to right.

Reflecting a figure might be difficult in practice, if the couple got used to an asymmetric position, in particular because usually they hold each other differently on both sides. An obstacle to perform the other transformations in practice is that the leading person should not make too many backward steps, since in the salon there might be another couple behind him.

## 8 Following and Leading

One of the goals in the design of the notation was that the notation for the following partner can often be deduced from the notation for the leading partner. As already mentioned, this is for example not possible in Castro's system. It is not obvious, whether the presented notation achieves this goal.

In this section we demonstrate how the notation of her next movement and state can often be deduced from the notation of her previous movement and state, and from the notation of his previous state and his next movement and state. We will explain how to locally deduce the notation for the following person in several steps. Consider the diagrams in Figure 9, which first show the first non-trivial situation in the backward ocho and the right rotation in Notations 5 and 7, respectively. We would like to find out the symbols that could replace the question marks. We proceed as follows:

1. Using the information of the orientation and impulse of the upper bodies, and the relative positions of the legs, we deduce the relative positions of centers of the partners.
2. With the information about his leg movement, and the information whether the weight changes between his movement, we can figure out the new position of his center.
3. The information about the new position of his center, and the information about the new relative orientation of his upper body determine whether her center, and consequently her legs have to move to some direction.
4. Her new relative position, and the information about the new orientation and impulse of his upper body determine the new orientation of her upper body.
5. If indicated by him (check for the symbol  $\bullet$ ), she changes the leg carrying her weight in the new position.

If we apply this procedure to Figure 9, we obtain the symbols as they were shown in Notation 5 and Notation 7 before.

$$\begin{array}{ccc}
 \begin{array}{c} \bullet \\ \cdot \left[ \uparrow \right] \\ \circ \\ \downarrow / ?? \\ x \end{array} & & \begin{array}{c} \circ \\ \cdot \left[ \rightarrow / \right] \\ \circ \\ x \\ \cdot / ?? \end{array}
 \end{array} \tag{9}$$

## 9 A Part of a Choreography

This section contains the scores for approximately the first 30 seconds of a choreography of Juan Carlos Copes; he dances the choreography in a film called

