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Temporarily out of sync: Momentary temporal independence of a solo voice as expressive device

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Summary
The solo part in music performance usually synchronizes well with the rhythmic-metrical context of the accompaniment, that is, the onsets of that part occur within certain temporal limits relative to the onsets of the accompaniment. This applies to a range of musical styles (e.g., classical music or Jazz) and ensemble configurations (from an orchestra to small ensembles or even piano solo). However, deviation from this synchrony may exceptionally be used as expressive device. This paper strives to explore those situations of temporal independence in various musical styles and ensemble sizes. In classical piano music of the Romantic period, this device is described as "tempo rubato in the earlier meaning" (Hudson 1994), referring to the temporal freedom of the melody hand relative to the accompaniment (e.g., in a Chopin Nocturne). For example, in Jazz performance, this effect may correspond to a significant delay of the (right-hand) solo relative to the beat for almost an entire chorus that is brought back in time at the beginning of the next chorus (as found e.g., in recordings of the Erroll Garner Trio). This paper reports on exemplary quantitative analyses of those situations of temporal independence and demonstrate its expressive effects through complex data visualization.

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1. Introduction

1.1. Background

Musicians possess a long-trained and well established ability to synchronize well with other musicians in the presence of in part large and continuous changes in tempo, dynamics or the like. Thus, they usually manage to produce tone onsets within relatively small temporal limits that give rise to a perceptual quality of togetherness. The same is true for musicians that produce multiple voices on their own (e.g., pianists). They have control over the onsets of all voices at the same time.

This synchronization ability is on one side limited by production properties; that is, certain motor variability that is inherent in any human movement creates temporal variation in synchrony [1]. Even though musicians try to minimize this motor variability through constant and deliberate practice, there are perceptual limits to this just as well. Certain asynchronies between onsets simply do not matter under certain thresholds and thus, musicians may not care to refine their motor performances beyond those limits.

In real musical contexts, the perceptual limits of two (equally loud) tone onsets to be heard as synchronous are around 30 ms, in both artificial (sawtooth) and natural piano sounds [3]. When the two tones have different loudness levels, two tones are heard as simultaneous when they are as much as 55 ms apart, when the louder tone comes first, but not, when the louder comes second. This asymmetry might be explained by temporal masking (second onset not heard and assumed to present, continuity effect) and is closely related to the "melody lead" phenomenon in piano performance [4]. The melody lead phenomenon is exclusive to piano performance and describes the emphasized voice (the melody) to be both louder and earlier (around 30 ms) than the other voices. It has been shown that the temporal anticipation can be attributed to the dynamic differences of the voice through the travel differences of the piano action [4]. In other keyboard instruments that do not show dynamic differentiation possibilities (harpsichord, organ), no such effect could be documented [5].

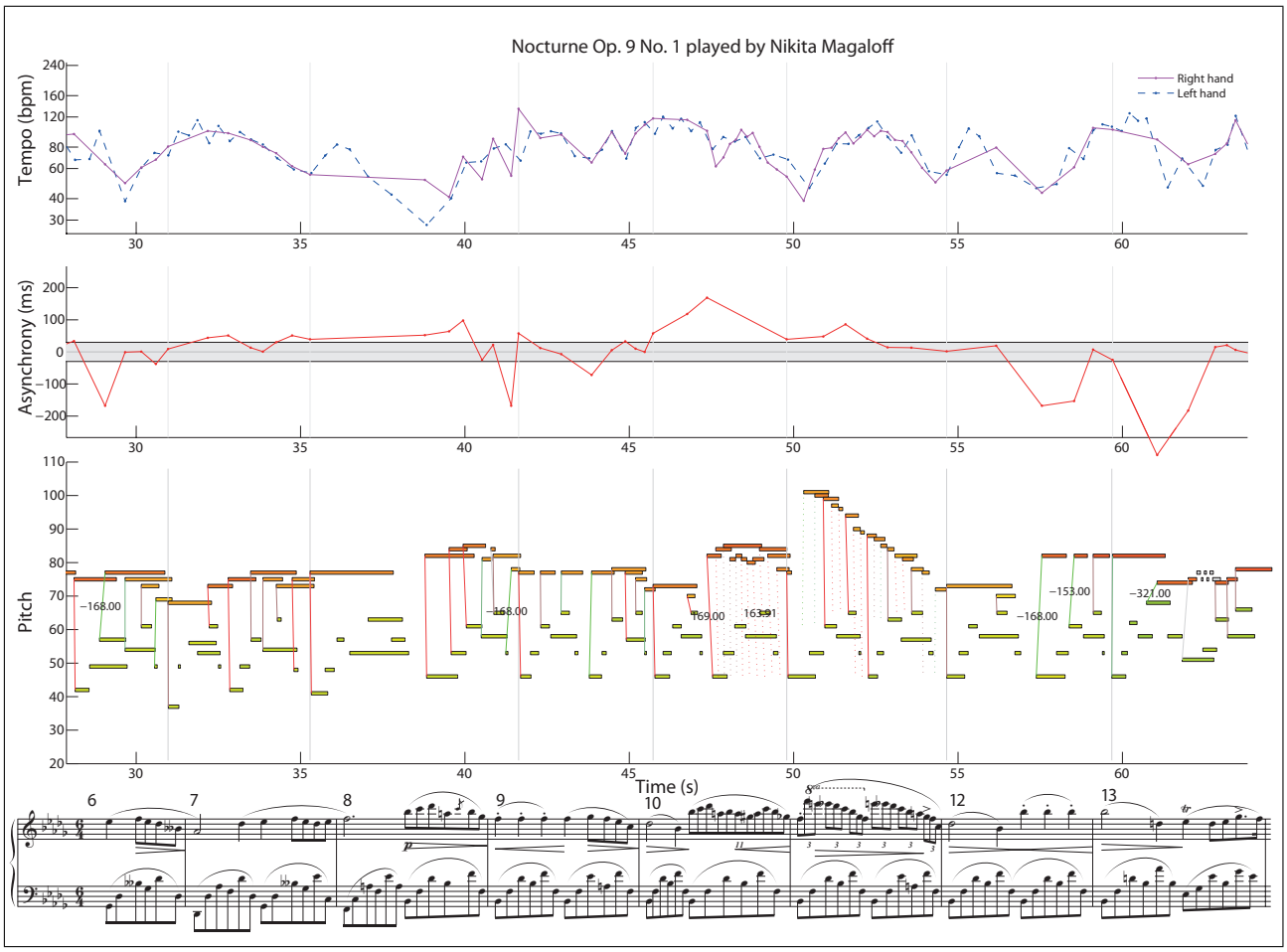

Figure 1. Chopin Nocturne Op. 9 No. 1, bars 6–13: excerpt of Magaloff's performance showing an example of "Tempo rubato in the earlier meaning."[2] The upper panel shows the tempo profile for each hand separately; the middle panel depicts the between-hand asynchrony profile (positive asynchronies denote an early right hand); the lower panel shows an extended and annotated piano-roll representation. Red vertical lines denote an early right-hand tone, green vertical lines a delayed right-hand tone.

In performance analyses of small ensembles playing classical style musics, asynchronies of 30–40 ms have been reported, irrespective of the specific instruments involved [6]. In Jazz performance, systematic asynchronies within the rhythm section are usually below 30 ms [7] even though different studies suggest that systematic asynchronizations within those limits influence the perception of swing or groove considerably [8]. However, a perceptual study that explicitly focussed on those systematic shifts of up to 30 ms could not find any significant effects [9] (also due to the severe methodological flaws in that study). In a study investigating improvisation freedom in early Jazz performances, Benadon decided to consider temporal effects only, when they are larger than 50 ms and thus can be clearly perceived [10]. In sum, it seems that asynchronies within +/–30 ms cannot (or only rarely) be heard and thus are likely to be unconscious; asynchronies above 50–60 ms start to appear very prominently even to untrained listeners.

1.2. Goals

In this paper, I am focussing on asynchronicities of 50 ms and well above which can be considered as clearly perceivable and as potentially intentional expressive effects. First, I will describe an effect that has historic roots in vocal music of the Baroque time: "Tempo rubato in its earlier meaning" [2] and report on a study that examined this form of tempo rubato in Chopin performances by a renowned pianist [11]. In the second part of this paper, I document the same kind of tempo rubato also in fast Jazz performance and describe an example by the Erroll Garner Trio in which this form of tempo rubato is clearly present.

2. Tempo rubato in Chopin performed by Nikita Magaloff

The term "tempo rubato" usually refers to the expressive timing of a music performance and describe the slowing and speeding up of the musical time. However, the original meaning of this term is closer to the

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italian meaning of the word "rubare" (stealing) and refers to a melody voice that deviates in time from the accompaniment only to come back to synchrony again (or in the image of rubare, give back, what has been stolen before). Richard Hudson calls the latter of the two terminological flavors "tempo rubato in the earlier meaning" and the former "tempo rubato in the later meaning" [2].

The earlier tempo rubato is widely know in music of the 18. Century. For example, Wolfgang Amadeus Mozart writes about it in a letter to his father Leopold: *"Das Tempo rubato in einem Adagio, daß die lincke hand nichts darum weiß* [was die rechte tut], *können sie gar nicht begreifen."* [12, p. 215] (*"They cannot realize here (in Augsburg) that a tempo rubato means that the left hand does not know anything about what right hand is doing."* translation by the author) Particularly Chopin has been known to adhere to this type of tempo rubato. He frequently talks about it to his pupils. One of them, Georges Mathias, says around 1838:

> *Chopin* [...] *often required simultaneously that the left hand, playing the accompaniment, should maintain strict time, while the melodic line should enjoy freedom of expression with fluctuations of speed. This is quite feasible: you can be early, you can be late, the two hands are not in phase* [en valeur]*; then you make a compensation which reestablishes the ensemble.* [2, p. 193]

Nikita Magaloff performed the entire solo works by Frédéric Chopin in spring 1989 through a series of six recitals in public in a well-known Viennese concert hall, following an increasing opus numbering from 1 (Rondo) through 64 (three Waltzes). For this concert series, he used a Bösendorfer computer-monitored piano that recorded the over 330.000 performed notes or 10 hours of continuous music precisely and stored them on a personal computer. These enormous data corpus has been prepared and analyzed by the Gerhard Widmer group in Linz through an intensive research project [13].

In the following, I briefly sketch research that assessed occurrences of (the earlier) tempo rubato in Magaloff's Chopin performances. A more detailed account of this research has been reported elsewhere [11]. The goal was to automatically identify regions of early tempo rubato quantitatively in the Magaloff corpus. First, between-hand asynchrony was computed from the performance data such that positive values corresponded to an early right hand, while negative values mean an early left hand. The entire corpus contained more than 63.000 such asynchronies. Subsequently, an out-of-sync region was defined as a series of consecutive asynchronies each of which larger than 30 ms and only when that series contained more elements than occur per second in that piece on average (for more details, see [11]). On average, each of the over 150 pieces contained 1.8 such out-of-sync regions; Waltzes, Preludes and Etudes contained almost none, while Nocturnes contained over 5 (on average). This suggests that particularly this melodic genre within Chopin's music seems to leave most room for independent temporal shaping of melody and accompaniment.

To illustrate such an out-of-sync region, an excerpt (bars 6–13) of Magaloff's performance of Nocturne Op. 9, No. 1 is shown in Fig. 1. It can be seen that the melody floats behind and before the accompaniment over the course of the 5 bars shown. Asynchronies are often far beyond the sketched +/–30 ms range (grey area in the middle panel). For example, in the second half of bar 8, Magloff's melody starts the phrase early, already the last note is late (possibly due to a dotting of the 1/8 note); the following four quarter notes are again starting too early, but the last is already late. In bar 10, the melody is greatly ahead already before the 11-tuplet begins and over the course of the triplets the earlyness is changed to good synchrony. The next phrase (second half of bar 12) starts contrary to the first very late.

As can be seen in this example, Magaloff apparently uses the earlier form of tempo rubato in his Chopin performances; more detailed analyses are reported elsewhere [11]. Even though this effect is originating from performance traditions of the Baroque era [2], I want to demonstrate in the following that such an effect can occur also in a completely different musical genre such as Jazz performance.

3. Erroll Garner "Red Top"

The example discussed in this section stems from the 1955 live recording of the Erroll Garner Trio "Concert by the sea" (Columbia records). The musicians involved were Eddie Calhoun on bass and Denzil Best on the drums. It is an excerpt of track 6 "Red Top" (by Lionel Hampton and Ben Kynard). Throughout this example, Erroll Garner marks the beat with left-hand block chords together with the rhythm section, while his right hand is devoted to melody and improvised solo passages and, as I will demonstrate, in part out of sync with the beat. In this excerpt, Garner quotes two other songs: in the very beginning of the 5th chorus, he plays "Now's the time" by Charlie Parker and later he quotes the nursery rhyme "Pop goes the weasel" (bars 6–8 of 6th chorus, see notation in Fig. 2)

The digitized sound files (44.1kHz, 16-bit) were analyzed using the (freely available) beattracking software *BeatRoot* by Simon Dixon [14] in two steps. First, the onsets of the quarter-note beats were semi-automatically determined by BeatRoot. In a second round, the right-hand solo was analyzed by placing markers on the onsets of each performed note of the solo. Where BeatRoot already detected a correct onset, it was kept; missing onsets were added manually, always aiming for a perceptual onset (closer to the

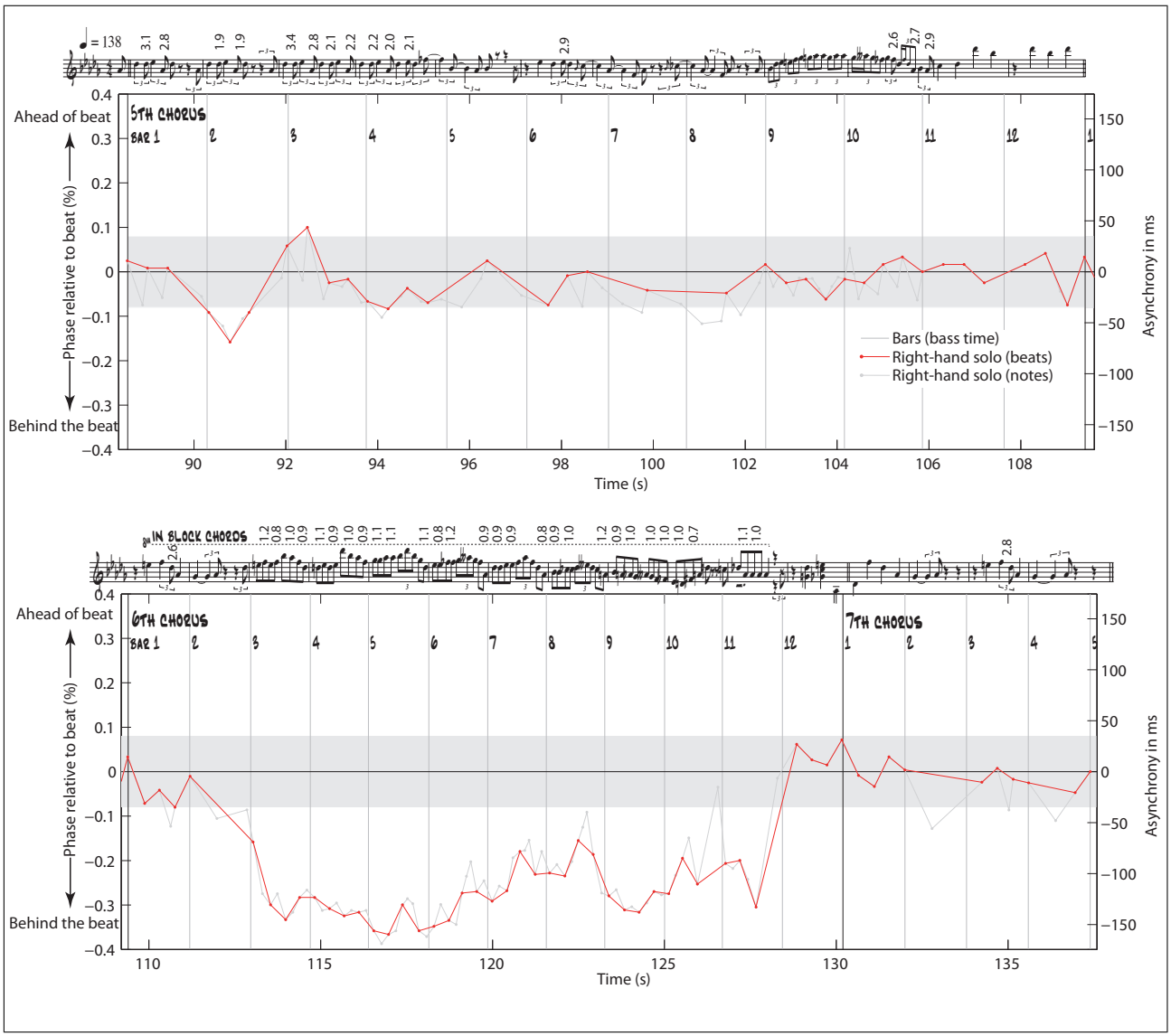

Figure 2. Excerpt of "Red Top" (Track 6) of the 1955 recording "Concert by the Sea". Synchronicity of Erroll Garner's right-hand solo relative to the beat as played by the bass, drums and Garner's left-hand chords in terms of relative phase (in percent, left ordinate) and asynchrony (in milliseconds, right ordinate). The red line indicates asynchronies at the beat level (quarter note); the grey line estimated asynchronies calculated from the transcribed rhythm. The vertical grey lines indicate the bar beginnings as played by the rhythm section. The right-hand solo was transcribed and type-set by the author.

maximum) rather than a physical one. The beat and melody onsets were carefully inspected by click auralization during repeated playback of the passage.

The asynchronies of the right-hand were computed relative to a rhythmic transcription of the solo passage by the author (see notation in Fig. 2), both on a note-by-note level (grey lines) and on beat level (red lines). The asynchronies are presented in Fig. 2 both as a percentage of the average beat interval (434 ms or 138 bpm for the quarter note) or in milliseconds (right ordinate).

It can be seen that in chorus 5, Garner is generally well in synchrony with the beat (the two phrases in bar 2 and 3 being small exceptions). However, in chorus 6 (lower panel of Fig. 2), where he changed to block chords in the right hand (bar 1), he starts out very soon into an out-of-sync passage of about 9 bars (bars 3–11) being constantly behind the beat as much as a third of a beat or 150 ms. He uses the following rest (end of bar 11) to place the left-hand chord on the anticipated one of bar 12 already in time (that is, syncopated to the first beat), only to stay completely in sync in the following bars (beginning of chorus 7).

The careful reader will notice that the transcription uses 2:1 triplet notation in the 5th chorus, but straight eight notes in the 6th chorus for the beat subdivision. This is done by ear; however to back this subjective judgement, swing ratios (the ratio of the long to short interval subdivision within a beat) were computed from the measurements and given in Fig. 2

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above the notation. In chorus 5, the swing ratio is mostly between 2 and 3 (over-dotting the ternary beat sub-division), while in the 6th chorus during the hold-back phase, it is more around 1 pointing to a binary beat subdivision.

Except for bar 3 in chorus 5, Garner is always tends more towards delaying his right hand than anticipating it. With the present, exemplary data it is unclear whether this asymmetry is typical for Jazz improvisation. Future research might shed light on this question.

4. Discussion

In this paper, I demonstrated an expressive device described already in the Baroque era: "tempo rubato in the earlier meaning" [2] where one voice goes temporarily out of synchrony with the accompaniment only to come back together soon again. This effect was exemplified in two different styles of music: in an interpretation of Chopin's entire works by the renowned pianist Nikita Magaloff and in a Jazz performance by Erroll Garner. Even though this research is preliminary as it stands, it provides a first insight to such an exciting expressive behavior that operates at asynchronicities clearly beyond the 30-ms thresholds for perceiving asynchronous onsets. A number of questions remain unanswered in this context such as how musicians manage to maintain timing control of the two hands independently (e.g., by employing two different internal time keepers, see [15]), or whether it is easier to lag behind the beat than to lead in a context with a steady tactus. However, these and other questions remain to be investigated in future research.

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