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Asymmetrical meter in Scandinavian folk music and dance: A case study of Norwegian Telespringar

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ABSTRACT

Certain traditional Norwegian and Swedish dance tunes in triple meter are referred to as being in so-called *asymmetrical meter*—that is, the three beats in the measure are of uneven duration. Norwegian telespringar is recognized for a type of asymmetrical meter featuring a systematic *long–medium–short* duration pattern at beat level. These systematic microtiming patterns are often described in terms of deviations from an underlying isochronous pulse. However, it has been argued that performers' body motion may offer a more perceptually relevant structure of reference than an abstract fixed clock pulse. This study investigates whether the asymmetrical beat patterns previously shown in telespringar music are also represented in the body motion of performers who are playing and dancing. It is reported from two motion capture studies: first, a fiddler playing telespringar on a traditional Hardanger fiddle; second, a couple dancing telespringar. Motion analysis of the fiddler's foot stamping indicates a very regular *long–medium–short* beat pattern. In addition, the fiddler's upper-body swaying and the vertical motion of the body's center of gravity in telespringar dancing are in synchrony with the bar level of the music. The fiddler's foot stamping confirm the *long–medium–short* beat duration hypothesis and support the view that the systematic microtiming features in telespringar are not a matter of deviation from an underlying isochronous pulse. Instead, they actually constitute an essential feature of telespringar.

I. INTRODUCTION

The *pulse* level in music is considered a fundamental temporal structure for rhythm perception (Parncutt, 1994; Danielsen, 2010; London, 2012). Although the underlying pulse can be represented by actual sonic events in the music, it can also exist without the sound, which is the case with, for example, syncopation or a rests in the music, (Snyder, 2001; Sethares, 2007; Honing, 2013). The internal counterpart to this pulse in performers and perceivers, the internal beat, is often described as the level of musical rhythm that we nod our head or tap our feet to (Su and Pöppel, 2012). This underlying pulse is often assumed to consist of isochronous beats. Systematic microtiming features are often conceptualized as deviations from a pulse of isochronous beats. However, it has been pointed out that in many music styles the underlying pulse seems to consist of non-isochronous beats, meaning that systematic microtiming may not be perceived as deviations from underlying isochronous beats, but actually represent the pulse reference of the music (Hopkins, 1966; Kvifte, 2004; Polak, 2010). This seems to be the case with a considerable part of traditional folk music and dance of Sweden and Norway often referred to as being in so-called *asymmetrical meter* – that is, music in triple meter, where the three beats in a measure are of different duration (see e.g., Bakka et al. 1995; Kvifte, 1999). The intimate relationship with the dance is often emphasized in rhythm studies of folk music in asymmetrical meter, and it has been suggested that the rhythmical patterns in the music may be conditioned by a particular way of dancing. In accordance with the view that an underlying perceived pulse, that is, an internal beat, often is explicated through body motion, it has been suggested that performers' body motion should be incorporated in investigations of rhythm structures in music featuring asymmetrical meter (see, e.g., Blom, 1981; Bengtsson, 1987; Kvifte, 2004; Ahlbäck 2003).

A. Telespringar

In this paper we focus on the rhythmical structures in music and motion of traditional Norwegian folk music from the region of Telemark called *telespringar*. *Springar* tunes are considered one of the older types of Norwegian folk music, called *bygdedans* (regional dance) (Bakka et al., 1995). Springar tunes are normally notated in ¾, however, it is pointed out that while ¾ meter normally refers to measures of even beats, this is not the case with springar. In telespringar a systematic *long – medium – short* beat duration pattern seems to be a prominent feature (see, e.g., Groven, 1971; Kvifte 1999).

Telespringar can be played on several musical instruments, e.g. Jew's harp, flutes and accordion, but it is commonly played on the *Hardanger fiddle*. The Hardanger fiddle is slightly smaller than a regular violin, with a shorter neck and a flatter bridge. In addition to the bowed strings, there are four or five sympathetic strings that run under the board (Blom & Kvifte, 1986). Although the style and patterns can differ between fiddlers, foot stamping seems to be an integrated part of telespringar playing, (Kvifte, 1999; Ahlbäck, 2003; Johansson, 2009). In telespringar fiddlers usually stamp their feet on the first and the second beat (Kvifte, 1999).

B. Telespringar dancing

Telespringar dance is a coupled dance that is usually danced in a ring formation. Most variants of the springer consists of a *winding part*, where the dancers turn under each others arms wile moving forward or backwards in the line of dance, an *unfastened part,* where the dancers dance independently along the line of dance, and a *couple turning part*, where the dancers turn around together (Bakka et al., 1995). The dance patterns in folk dance are often described based on the footwork, which foot is carrying the body weight, and the *svikt* pattern. The svikt pattern is the vertical movement of the body caused by bending knees and ankles, combined with hinging on the ball of the foot (ibid.). The Norwegian anthropologist and ethnomusicologist

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Jan-Petter Blom (1981, 1993, 2006) emphasizes that the musical meter in telespringar should be understood in relation to the corresponding dance. Blom illustrates how the svikt pattern in telespringar results in a *patterned libration of the body's center of gravity* (*libration pattern*). The libration pattern in telespringar consists of two down/up motions in each measure, and Blom argues that the first down/up motion corresponds to the duration of the first beat, the next down motion corresponds to the second beat and the following up motion corresponds to the third.

In this paper we wanted to investigate whether the asymmetrical beat pattern in telespringar is present in performers' body motions.

II. METHOD

Three telespringar performers, a fiddler and two dancers, participated in the study. Two separate recordings were carried out: first, a fiddler playing telespringar on Hardanger fiddle; second, a couple dancing telespringar. The recordings were carried out in the fourMs Motion Lab at the Department of Musicology at the University of Oslo. The participants' body motions were recorded at 100 Hz using a nine-camera motion capture system from Qualisys. A total of 27 reflective markers were attached to the fiddler's body (Figure 1a). In order to enable the system to distinguish between the two dancers, the markers were placed slightly different on the dancers' bodies, resulting in 31 reflecting markers to be attached to dancer 1 and 28 reflection markers on dancer 2 (Figure 1b). In addition the performances were video-recorded for reference purposes.

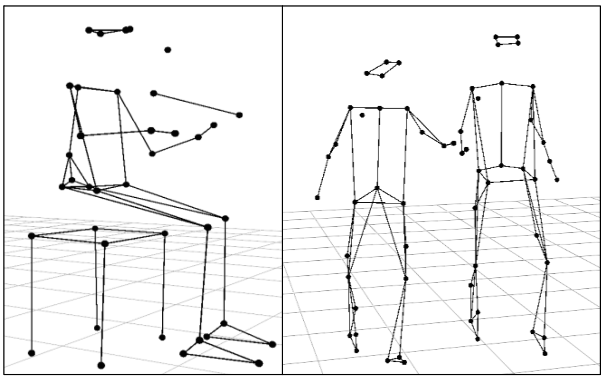

Figure 1. Placement of the markers attached to (a) the fiddler's and (b) the dancers' bodies. The markers were placed slightly different from dancer 1 to dancer 2 in order to distinguish them.

Since the recordings of the fiddler and the dancers did not take place on the same day, the dancers were dancing to the music that had been recorded in the fiddler's session, allowing the dance recording to be perfectly synchronized with the fiddler's session. The music was played back from a custom-built MAX/MSP patch running on a Macintosh computer.

III. AUDIO ANALYSIS

The sound data from the recordings were analysed using the MIR Toolbox for MatLab (Lartillot & Toiviainen, 2007). One way to analyse sound is by looking at its waveform (signal strength over time). A sudden increase in signal energy, for example, can indicate a new sound event (Collins, 2010). We used the *onset detection* function in the MIR Toolbox that performs peak detection on the audio signal in order to estimate the positions of the notes. However, the sound of Hardanger fiddle is complex and it is difficult to determine which, if any, of the peaks in the fiddler performance's waveform that is likely to represent the beginning of notes.

In his work on asymmetrical grooves in Norwegian folk music, Mats Johansson (2009) concludes that the best method for sound analysis investigating rhythmical structures in telespringar is to combine auditory cues with visual clues. Johansson recorded the music of interest into a computer program displaying the music's waveform and playing back the sound at the same time. By moving the cursor back and fourth, Johansson tried to determine where one sound unit seemed to stop and the next start. Here we combined the method described by Johansson with the onset data from the onset detection, that is we moved the cursor back and forth in order to manually pick the onsets that were closest to a beat (Figure 2).

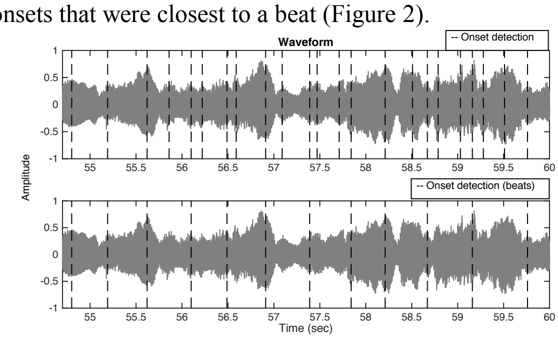

Figure 2. Visualization of the sound of four measures of telespringar playing. The audio waveform with all the onset data estimated using the onset detection function indicated as dotted lines (top), and the manually selected beat positions based on the onset detection indicated as dotted lines (bottom).

The beat durations based on the selected onsets were calculated as inter-onset-intervals. The durations of the beats were measured in seconds and subsequently converted to percentages according to their percentage of the measure, in a total of 36 measures. The calculated duration of the first beat was on average 41 % (SD=2.1) of a measure, the second beat 34 %, (SD=2.4) and the third beat 25 % (SD=1.6). Our audio analysis thus confirmed the *long – medium – short* beat duration pattern. However, these results should be interpreted with caution since the waveform may not be the best point of departure for estimating the position of sound events in telespringar playing.

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IV. MOTION ANALYSIS

The motion data, obtained from the motion capture recordings, were analysed using the MoCap Toolbox for Matlab (Burger & Toiviainen, 2013) and custom-made script.

According to previous research the fiddler's foot stamping (Kvifte, 1999; Ahlbäck, 2003) and the dancers' libration pattern (Blom, 2006) are of particular interest in rhythm studies of traditional dance music in asymmetrical triple meter. Consequently, we focus on the fiddler's ancillary body motions, namely foot stamping and upper body swaying, and the vertical movements of the dancers' centre of gravity (libration pattern).

C. The fiddler's foot stamping

In order to analyze the foot stamping of the fiddler in present study, we plotted the vertical motions of the markers attached on the fiddler's heels and toes on both feet (Figure 3). The plots indicate that the right heel stamps on every beat, the left heel stamps on every first beat and the left toe stamps on every third beat. Since the right heel seems to stamp on every beat in a bar, we calculated the beat duration pattern based on the vertical motion of the right heel. Each foot stamp resulted in an unambiguous downward spike in the motion data that could easily be measured. The beat duration were estimated by calculating the interval between the foot stamps in seconds. Subsequently the beat durations were converted into percentages of the measure. A total of 120 beat durations (40 measures) were measured. The calculated duration of the first beat was on average 41 % (SD=0.2) of a measure, the second beat 34 % (SD=0.2), and the third beat 25 % (SD=0.2). Analysis of variance showed significant differences between beat durations (p<0.001), and Bonferroni-corrected post-hoc tests showed significant differences between the durations of the first, second, and third beat (all p<0.001), showing that the duration pattern of the foot stamping is *long – medium – short*. In addition, the standard deviations for the mean duration values are all 0.02, which indicates that the *long – medium – short* pattern in the foot stamping is very steady. Considering that foot stamping is an integrated part of telespringar playing, and given the stability of the pattern, these results suggest that the beats of the foot stamping may represent an underlying beat pattern of telespringar.

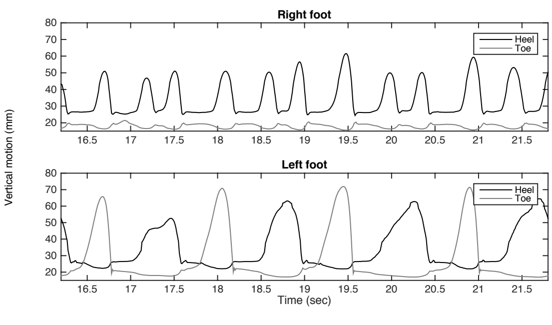

Figure 3. Plots of the vertical movements of the markers placed on the fiddler's right heel, right toe, left heel and left toe for four measures.

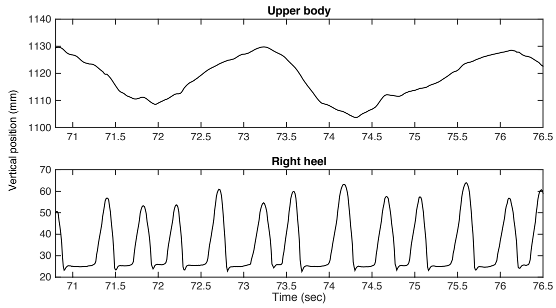

Figure 4. Plots showing the vertical motions of the markers placed on the fiddler's neck (upper body) and right heel for four measures. The upper body motion seems to be in synchrony with bar level.

D. The fiddler's upper body motion

The fiddler in the present study swayed his upper body back and forth in a regular pattern and we wanted to investigate whether this upper body swaying corresponded to a metric layer. The vertical position of the marker attached to the fiddler's neck was plotted over time. The visualization of this marker indicates that this swaying is synchronized with the measure level of the telespringar determined by the vertical movements of the foot stamping (Figure 4).

E. The *libration pattern* of telespringar dancing

As mentioned previously, Blom (1981) argues that the up/down pattern of telespringar dancing (*libration pattern*) is related to the musical meter in telespringar. In a motion capture study carried out by Turid Mårds (1999) the libration curves and force used in different types of Norwegian folk dancing were analysed. The libration curves were estimated based on the vertical position of a reflecting marker placed on the dancers' head. In addition, the dancers' steps were registered using rectangular force plates. The motion curves based on the telespringar dancers' heads showed that the duration of the first down/up motion was approximately one half of the measure, while the remaining down and up motion lasted approximately a quarter of the measure each. There are, however, some issues regarding these results. First, the libration curves are based on the motion of the dancers' heads, not the movement of what Blom referred to as the body's center of gravity. Second, the dancers' steps were measured using rectangular force plates forcing the dancers to dance in a straight line, and not in a circle, as they would normally do. One might wonder whether the use of rectangular force plates might have restrained the execution of the dance and skewed the motion-capture results.

Here then, the motion analysis was based on the markers placed on the dancers' lower back, rather than the ones placed on their heads, and the dancers were dancing in a circle. In order to investigate the correspondence between the up/down pattern of telespringar dancing (*libration pattern*) and the musical meter, we plotted the vertical position of the markers attached to the dancers' lower back and the fiddler's foot beats (Figure 5).

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The visualization of the dancers' lower back seems to confirm that dancers perform two down/up motions in every measure, as suggested by Blom (1981).

Next, we wanted to investigate whether the dancers' libration pattern corresponds with musical meter in telespringar as identified in the audio analysis, that is the first down/up motion in the dance corresponds to the first beat, the second down movement in the dance corresponds to the second beat and the last up motion in the dance corresponds to the third beat. A Butterworth smoothing filter was applied to reduce the noise in the motion data and a custom made script for picking the *peaks* and the *troughs* in a graph. The beat durations based on the libration curve was estimated by calculating the interval between the first peak and the second peak in the libration curve (beat 1), the second peak and the second thought (beat 2), and the second trough and the first peak in the following measure (beat 3). The durations were measured in seconds and subsequently converted into percentages of the measure. The result revealed a ratio of 48 – 27 – 25 (%) for dancer 1 and 46 – 27 – 27 (%) for dancer 2. Analysis of variance showed significant differences between beat durations (p<0.001), and Bonferroni-corrected post-hoc tests showed significant differences between the durations of the first and the second beats and the first and the third beats (both p<0.001), but no significant differences between the second and the third beats (p>0.70 for dancer 1 and p>0.99 for dancer 2). This indicates that the libration pattern in this study differs from the music meter being *long – short – short* rather than *long – medium – short*. This is, however, similar to Mårds' (1999) findings.

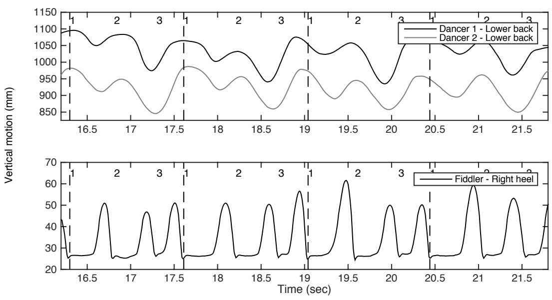

Figure 5. Plots showing the vertical motions of the markers attached to the dancers' lower back and the fiddler's right heel for four measures. The positions of the first beat in every measure, estimated from the fiddler's foot stamping, are indicated by dotted lines.

V. DISCUSSION

In this paper we wanted to investigate the asymmetrical meter of telespringar by including the body motions of performers playing and dancing telespringar. Our motion analysis of the fiddler's foot stamping confirmed a stable *long – medium – short* beat duration pattern. We interpret these findings in support of this pattern being an essential rhythmic structure in telespringar.

The patterns identified through visualization of the vertical motions of the dancers' lower back confirm Blom's libration pattern hypothesis, that is, the assumption that the dancers make two down/up motion in every measure. However, the estimated beat durations, based on the libration curves' peaks and troughs, revealed a *long – short – short* duration pattern, which differs from Blom's (1981) hypothesis, but is similar to Mårds' (1999) findings. A possible explanation can be that while Blom's model is based on his own practical experience and close observation, Mårds' and our findings are based on motion capture recordings. One may argue that since motion capture systems provide high position position data, motion analysis based on motion capture offers a more precise representation of the dance motions than motion analysis based on observations. On the other hand, since motion capture recordings often are carried out in a motion capture lab, the dancers may feel awkward and restricted when dancing. However, some previous studies have concluded that the participant's professional experience can balance the influence of the artificial environment (Nevada & Leman, 2008; Haugen & Godøy, 2014).

The dancers' libration curves should probably be analysed in relation to the corresponding dance steps. The position data of the markers placed on the dancers' feet in this study were quite noisy, and a rhythm pattern was not easily detected by looking at the position plots. However, the video recording indicates that the dancers perform three steps in each measure. Our motion analysis of the vertical motion of the dancer's lower back indicates a *long – short – short* beat duration pattern corresponding to the dancers' down/up – down – up motion pattern, with beat ratio 47 – 27 – 26 % when averaging the results from the two dancers. However, instead of understanding the libration pattern as consisting of three parts, one may look at it as two down/up motions, that divides the measure into two parts. In that case the libration pattern may represent an additional metrical layer that interacts with the dancers' steps, as well as an underlying asymmetrical triple meter. However, more telespringar recordings have to be carried out in order to decide whether this is a general rhythm pattern in telespringar dance or only represents the motion patters of the dancers in this study.

VI. CONCLUSION

The results from this study indicate that prominent rhythm features of telespringar are present in performers' body motion. Motion analysis of the fiddler's foot stamping confirms the *long–medium–short* hypothesis regarding the underlying pattern of beat durations in telespringar. In addition, the fiddler's upper-body movements and the dancers' libration pattern seem to be in synchrony with the bar level. Our results suggest that rather than considering the asymmetrical musical beats in telespringar as deviating from an underlying isochronous pulse, the underlying pulse should be understood as asymmetrical in and of itself, that is, as consisting of beats with uneven duration.

VII. LIMITATIONS AND FUTURE RESEARCH

Our audio analysis based on onset detection showed a *long – medium – short* beat duration pattern. However, the audio signal of a Hardanger fiddle is complex and using onset detection alone is probably not the best method for analysing rhythm structure in telespringar music. In future studies a combination of feature extractors should be included in the audio analysis.

Since the results presented in this paper are based on only one recording of a fiddler and one recording of two dancers, it should be considered as preliminary. If more general conclusions are to be drawn, more telespringar performance recordings should be included. In addition, future studies should also incorporate recordings of dancers and fiddler performing simultaneously, rather than separately. There is undoubtedly an intimate relation between the music and the dance in telespringar, however, the link between their rhythmical patterns remain to be understood.

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