Supplementary Information Appendix for

The mirror game as a paradigm for studying the dynamics of two people improvising motion together

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1. Distribution of timing difference in zero velocity events shows many stopping events more precise than 100ms

The absolute difference between zero velocity events of the two players at the end of a given segment is defined as dT. Figure S1 shows the cumulative distribution of dT among segments. About half of the segments show dT<100ms.

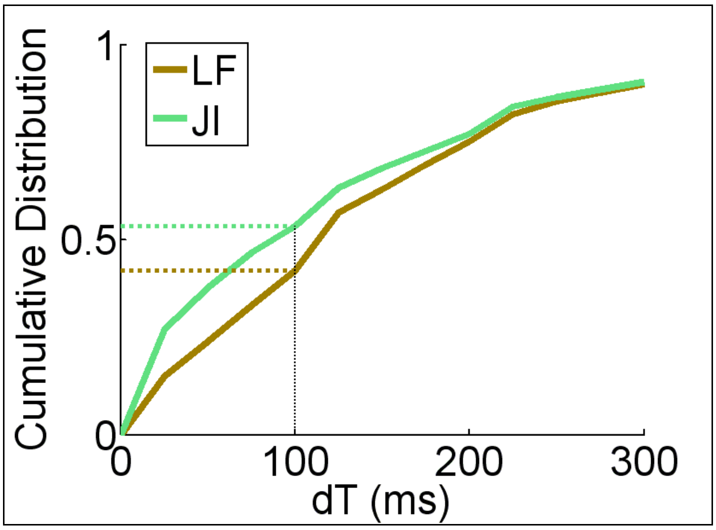


Figure S1. Cumulative distribution of times between ends of segments dT. About 55% of JI and 45% of LF segments have dT<100ms.

2. Precision in position data is similar to that in velocity data

We compare the relative error in position (dX) to the relative error in velocity (dV), reported in the main text. Relative error in position is defined in the same way as dV (see main text, Materials and Methods), where the displacement in each segment replaces the velocity (in each segment, the displacement is defined as the position minus the position at the segment start). The relative error in position is smaller in JI rounds than in LF rounds (Figure S2, non-paired *t*-test, p=0.036, t=2.1).

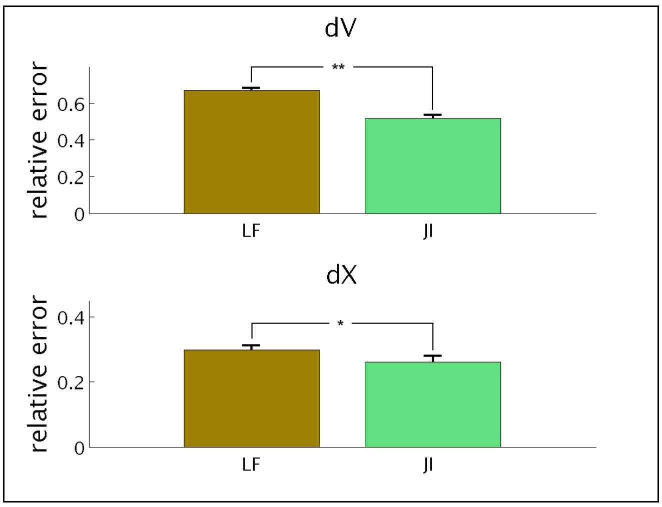


Figure S2. Relative error in pairs of matching movement segments of the two players, computed on velocity signals (dV, used in main text), and position signals (dX) (** p<0.001, * p<0.05).

3. Precision of velocity traces (dV) binned according to frequency shows that for experts improvisers JI is more accurate than LF

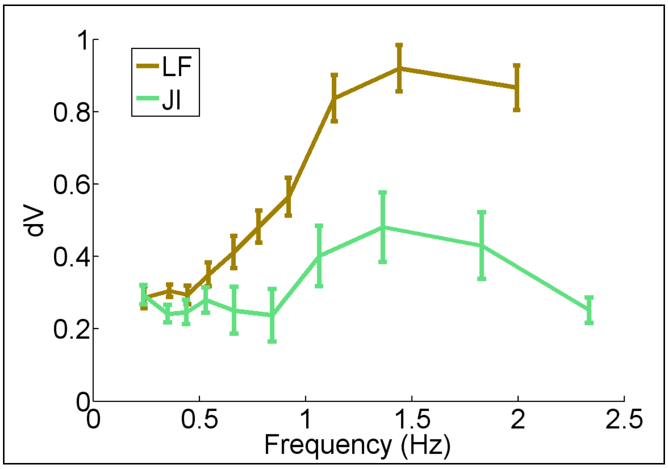


Figure S3. Relative error in velocity (dV) as a function of frequency. Frequency of a segment is defined as 1/D where D is the duration of the segment.

4. Histogram of frequencies of LF and JI

Normalized histogram of segment frequencies (frequency is defined as 1/D, where D is the segment duration), for expert games. Maximal frequencies are about $\omega_{max} = 2.5Hz$, in both JI and LF rounds. Number of segments is n=1227 for LF rounds, and n=661 for JI rounds (note that there are about twice as many LF rounds in each game).

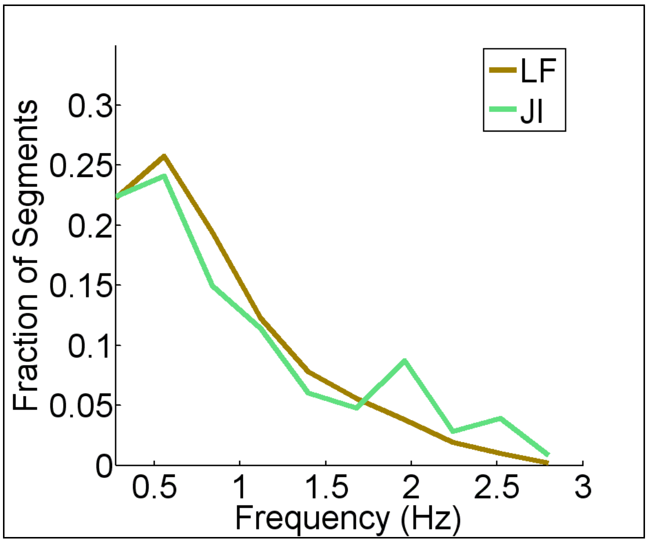


Figure S4. Distribution of segment frequencies (1/duration) for both conditions in expert games.

5. Complexity of JI rounds is at least as large as LF rounds based on wavelet measure and human rater scoring

We compared the complexity of the motions produced by the players in the mirror game in the LF and JI conditions (LF and JI). We employed two complexity measures: (i) a complexity measure based on wavelet decomposition,
(ii) a complexity measure based on human raters. Both measures (described below) show that the motions in the JI condition are at least as complex as the motions in the LF condition.

To measure the complexity of the motions in mirror game we used wavelet analysis, a standard approach for describing signals using a set of building blocks localized in both space and frequency. The wavelet complexity of a signal is defined as the inverse of the number of building blocks needed to describe the signal, up to a prescribed small error.

We applied a wavelet transform to the position traces using Matlab (1D Daubechies wavelet), and used the first 512 coefficients to reconstruct the signal. The width of the smallest wavelet used corresponds to oscillations at 1.7Hz. We reconstructed the signal with an inverse wavelet transform, using different numbers of coefficients, choosing the minimal number of coefficients such that the median error between the original and the reconstructed signal are was smaller than an empirically defined threshold (2mm). The wavelet complexity measure was the compression ratio: the number of coefficient used to achieve the reconstruction divided by the number of samples in the trace (Figure S5).

We computed the wavelet complexity measure of each round in all games. In the LF rounds we used the signal of the leader, and in the JI rounds the average of the complexity of the signals of the two players. The average complexity in LF rounds was smaller than the average complexity in JI rounds (Figure S6, mean (s.e.m): LF = 0.041 (0.002), JI = 0. 043 (0.005)), but the difference was not statistically significant (non-paired t-test, t=-0.37).

We conclude that the movements in the JI condition are at least as complex as the movements in the LF condition according to the wavelet complexity measure.

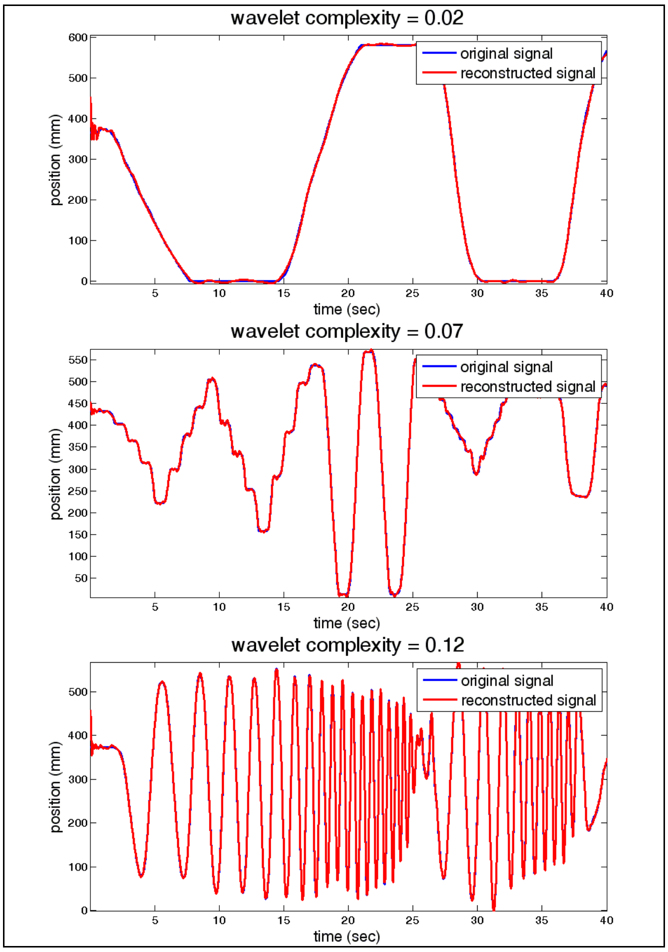


Figure S5. Three examples of wavelet reconstruction and the resulting complexity measures. The original position trace (blue) and the reconstructed trace (using wavelet building block, red), are shown. The reconstruction is very similar to the original trace. The wavelet complexity score is the compression ratio: the number of wavelet used to reconstruct the trace to within 2mm divided by the length of the trace. Shown are three representative examples of traces with low (top), medium (middle) and high (bottom) wavelet complexity score.

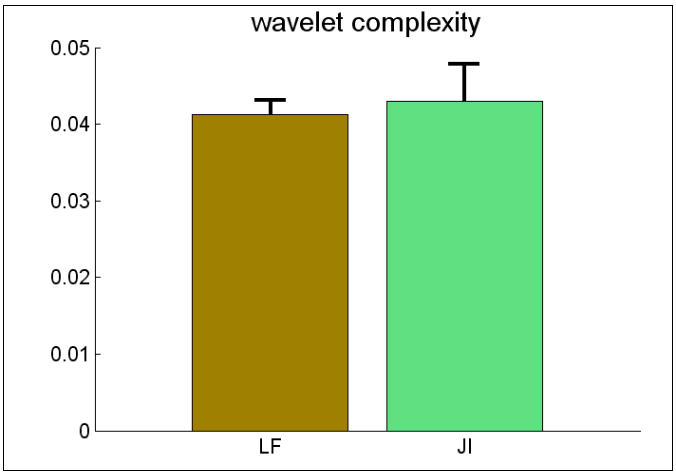


Figure S6. Mean wavelet complexity of LF and JI rounds.

Human rater complexity measure

We also developed a simple complexity measure based on the response of human raters to the dataset. Traces were presented on a printout, each on a separate page, without labels (figure S7), showing the position trace of one of the two players chosen randomly. For each trace the rater recorded the response to the following question: "How complex is the following signal in a scale of 1-3: (1) low complexity (2) intermediate complexity (3) high complexity"? Inter-rater correlation (average across all pairs) was c=0.39, $p<0.05$, kappa=0.24. We took as the human rater complexity score the average of all rater responses. We repeated this also using only the top 50% of traces for which raters most agreed (c=0.6, $p<0.01$, kappa=0.38), showing the same qualitative results: JI traces are at least as complex as LF traces, according to human raters. Note that the two complexity measures, wavelet and human raters, show a significant correlation across rounds of c=0.3, $p<0.05$.

We compared the human rater complexity measure in LF and JI rounds.
The position traces from the 81 expert rounds were shown to 10 raters. For each game the position trace of one player was used, either the leader trace in LF rounds, or a randomly chosen player in JI rounds. The average complexity in LF rounds was similar to the average complexity in JI rounds (Figure S8, mean (s.e.m): LF = 1.96 (0.06), JI = 1.86 (0.09)), and the difference was not statistically significant (non-paired t-test, p=0.36, t=0.93). Using only the top 50% of traces for which raters most agreed the average complexity in LF and JI rounds was even more similar (LF = 1.85 (0.09), JI = 1.8 (0.18), non-paired t-test, p=0.78, t= 0.06). We conclude that according to the human rater complexity measure, similar to the results from the wavelet complexity measure, the JI rounds are as complex as the LF rounds.

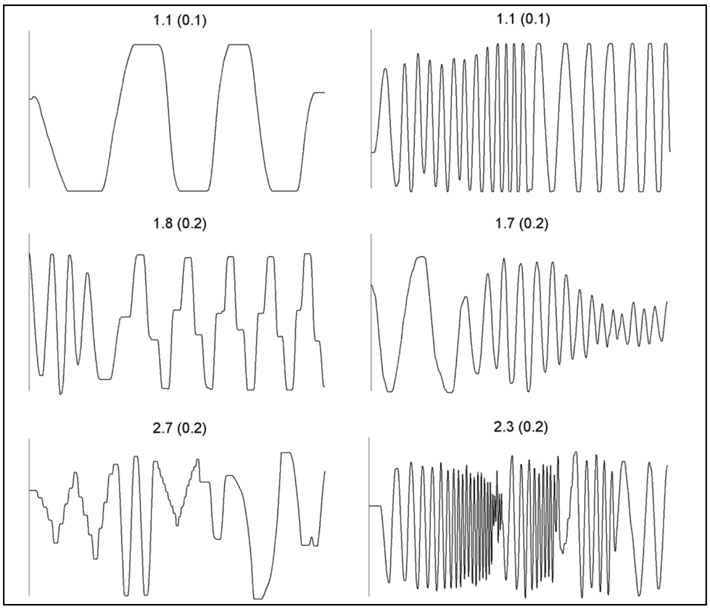


Figure S7. Six examples of stimuli for the human rating of trace complexity. Position signals from all 81 rounds used in the experiment were shown to human raters, who rate the complexity of the trace on a scale of 1(low complexity'), 2 or 3 ('high complexity'). Traces were shown without scaling or unit reference. Shown examples are of tracer with high inter-rater agreement. Also shown for each signal the mean (s.e.m.) score of the 10 human raters. Example shows traces with low (top), medium (middle) and high (bottom) complexity. Note that each complexity class contained traces with both low and high frequencies.

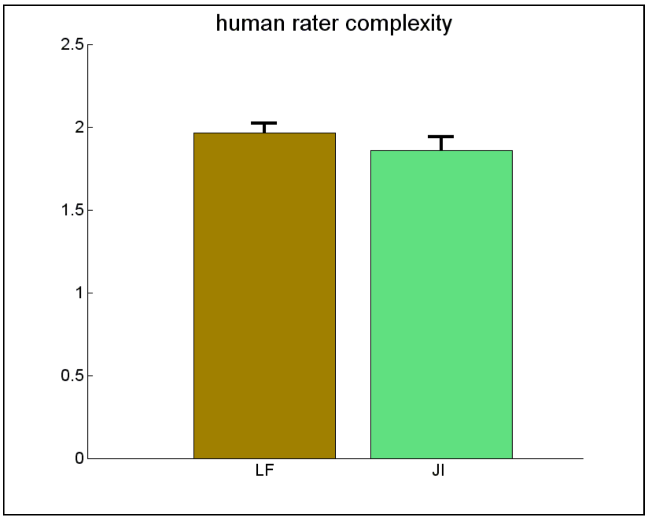


Figure S8. Human rater complexity, averaged over all expert LF and JI rounds.

6. Examples of jitter and co-confident motion

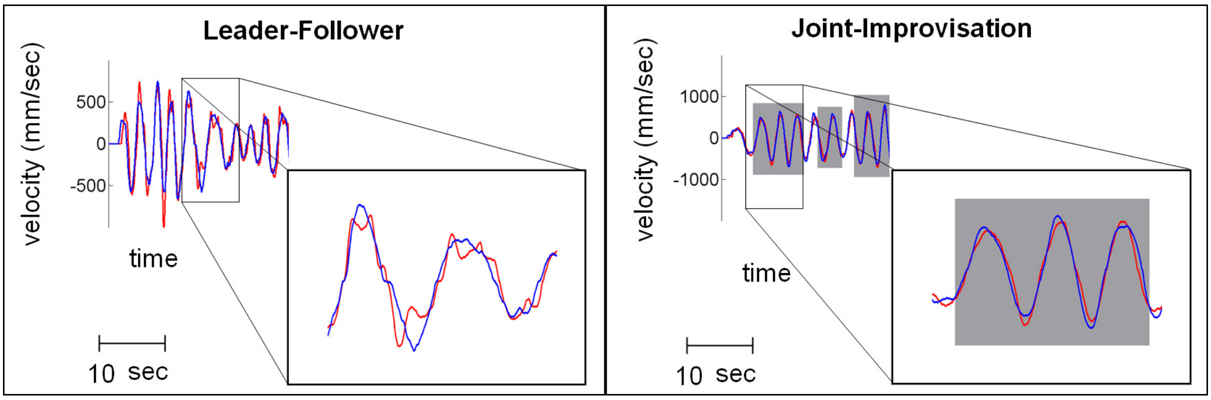


Figure S9. Left: an example of motion from a leader-follower round (game2, round 1), in which the follower perform jitter around the leader smooth motion. The inset shows a close-up of 7.5 seconds. The motion of the follower (the red trace) is composed of a high frequency ascoillation (jitter) around the relatively smooth motion of the leader (the blue trace). Right: an example of motion from a joint-improvisation round (game 5, round 5), in which both players perform motion without jitter (co-confident motion). The inset shows a close-up of 7.8 seconds. Both players perform jitterless motion. The gray areas mark periods detected as co-confident (see Materials and Methods in main text).

7. Distribution of co-confident period duration

The average duration of co-confident (CC) periods in JI rounds (n=27) averaged 4.6 (s.e.m.=0.5). The average duration of CC periods in Lf rounds (n=17) averaged 2.9sec (s.e.m.=0.2). Figure S10 shows the cumulative distribution of the duration of all CC periods in LF and JI rounds.

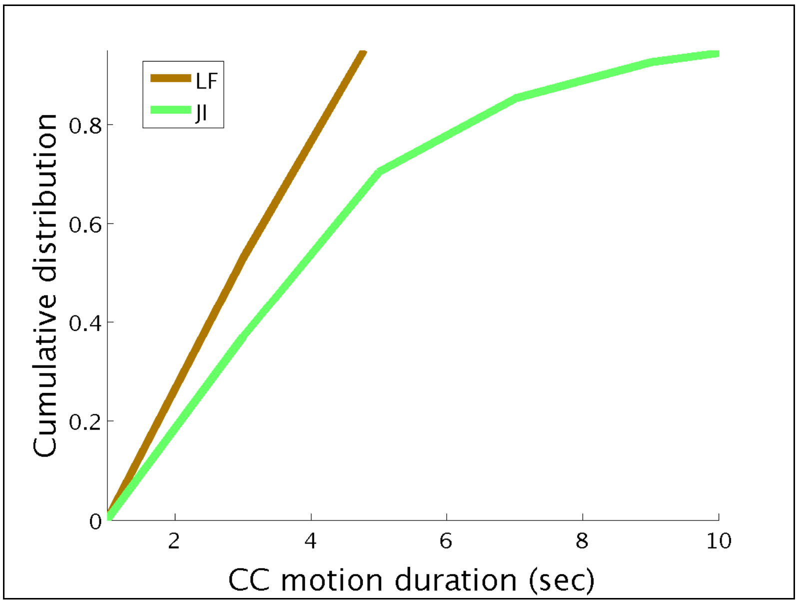


Figure S10. Cumulative distribution of co-confident (CC) motion duration. JI rounds contain longer CC motions, periods in which the two players move in a synchronized manner with little jitter.

8. A JI round which is mostly co-confident motion

Out of the 27 JI rounds in our dataset, 10 rounds (37%) had periods of CC motion, covering on the average 12.3 sec (s.e.m=4) of the 60 sec rounds. Out of the 54 LF rounds in our dataset, 12 rounds (22.2%) had periods of CC motion, covering on the average 4.2sec (s.e.m.=0.7) of the 60 sec rounds. Figure S11 displays the round with the highest fraction of co-confident motion (game 1, round 7). Out of the 39 motion segments in this trial, 27 (~70%) were classified as 'co-confident'. Note the diversity of motion created by the players with high synchrony and little jitter.

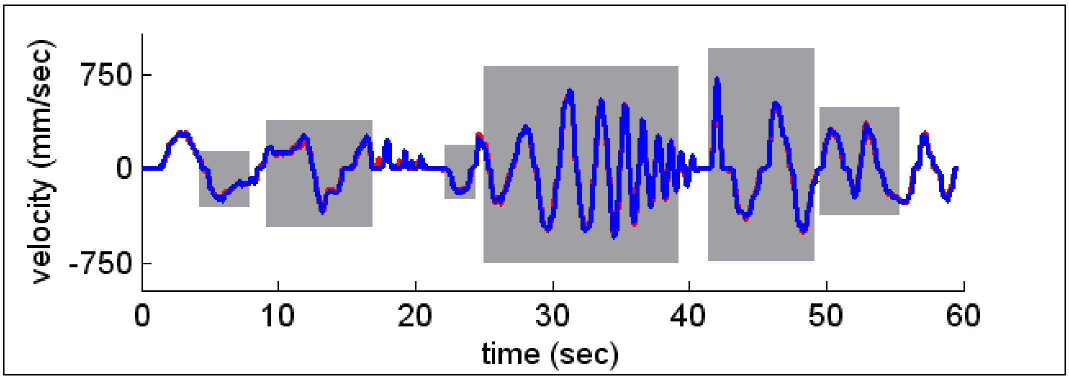


Figure S11. A JI trial with a high fraction of co-confident motion (Game 1 trial 7). Grey highlighted areas are identified as co-confident motion.

9. Co-confident motion is as complex as average motion of leaders in LF rounds

We compared the complexity of the co-confident (CC) periods to randomly sampled periods of the same duration from LF rounds. We first computed the wavelet complexity of the position trace of each CC segment in the JI rounds. We then sampled 1000 random periods of motion of the same durations from the leaders' position traces in LF rounds, excluding the few CC periods in the LF rounds. Our goal in this comparison is to test whether the CC rounds (which are highly synchronized and with little jitter in both players) are not less complex that the average leader trace. We find that the two conditions (average of randomly chosen LF motion versus JI-CC) showed similar complexity scores (FigS12, random LF = 0.10, JI-CC = 0.12; paired t-test: N.S., p=0.25, t=-1.16). The CC periods in JI rounds are therefore at least as complex as leader motion in LF rounds.

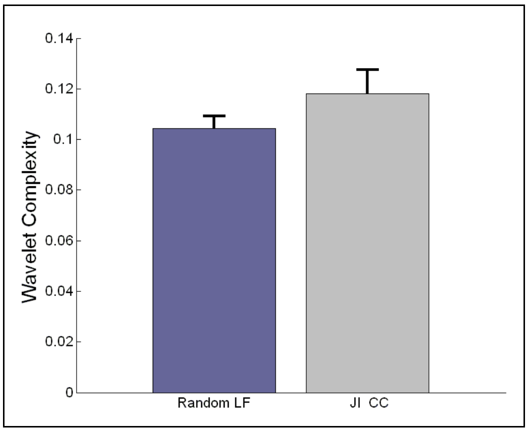


Figure S12. Comparing the complexity of co-confident (CC) periods in JI rounds, to matching, randomly sampled leader motion periods in LF rounds. The 'Random LF' scores are the average complexity score of sampled periods, matched in length to the set of CC periods in JI rounds.

10. Non-co-confident motion in JI rounds is more accurate than LF motion

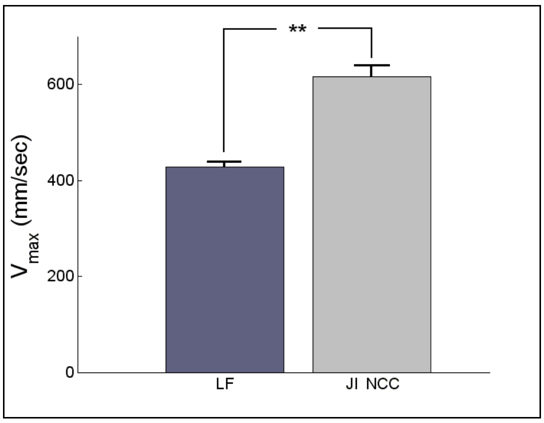


Figure S13. Average maximal segment velocity in LF rounds and in non-co-confident periods of JI rounds (JI NCC) ($p < 0.0001$, t = -9.13).

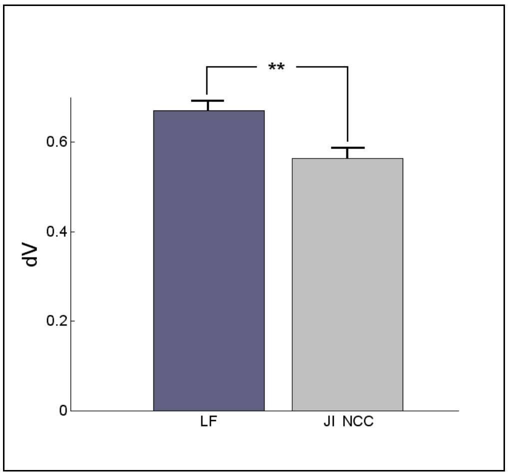


Figure S14. Average velocity error (dV) in LF rounds and in non-co-confident periods of JI rounds (JI NCC) ($p < 0.001$, t = 3.68).

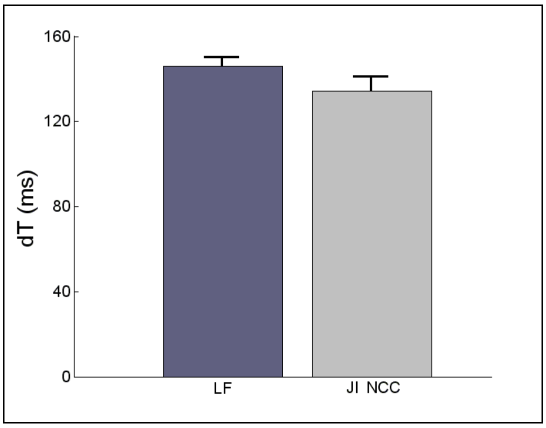


Figure S15. Average difference in stopping times between players (dT) in LF rounds and in non-co-confident periods of JI rounds (JI NCC) ($p =$ N.S., t = 1.52).

11. Novices have lower precision, velocity range, complexity and than experts

As a control we repeated the same procedure reported in the main text with people with no prior training in improvisation (novices, n=12, 4 male and 8 female, age mean (s.e.m.) 29.8 (1.3)).

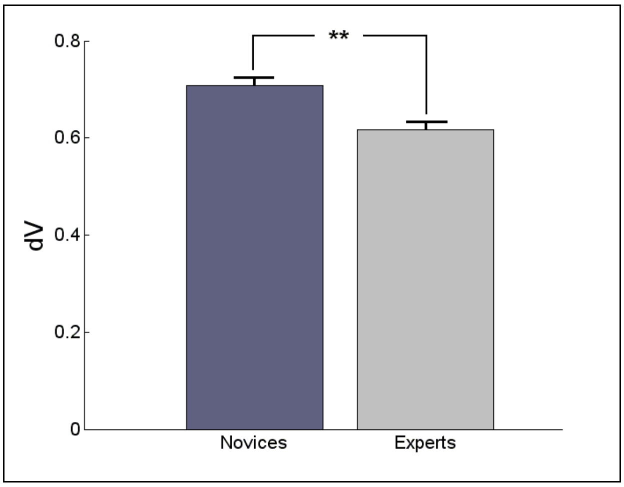


Figure S16. Average velocity error (dV) for all rounds in novices and experts ($p < 0.0001$, $t = 4.23$)

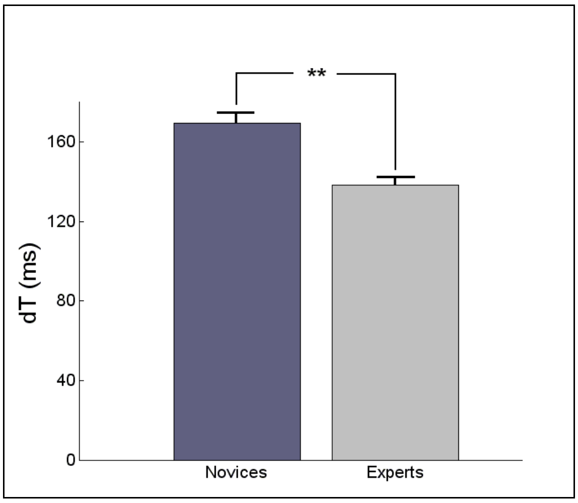


Figure S17. Average difference between player stopping times for all rounds in novices and expert ($p < 0.0001$, $t = 5.67$).

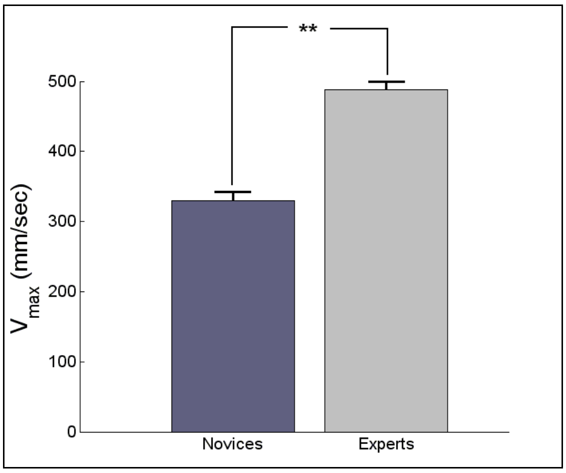


Figure S18. Average maximal segment velocity over all rounds in novices and experts ($p < 0.0001$, $t = -12.41$).

12. Novices show better performance in LF than in JI rounds

Novices show a different pattern of results than experts when the LF and JI rounds are compared. While experts show better precision and a larger range of velocities in JI rounds than in LF rounds (main text Fig 2, B-D) novices show the opposite pattern (Fig S19-S21). Furthermore, comparing the jitter for leaders and followers in LF to the jitter in JI, we find that novices show the opposite pattern than experts. While for experts the jitter in JI is similar to the jitter of leaders and is smaller then the jitter of followers (see main text Fig 3B), for novices the jitter in JI is larger that the jitter of leaders, and is similar to the jitter of followers (Fig S22, *Leader-vs.-JI:* $p < 0.01$, $t = -2.99$, *Follower-vs.-JI: p N.S.,* $t = 0.35$).

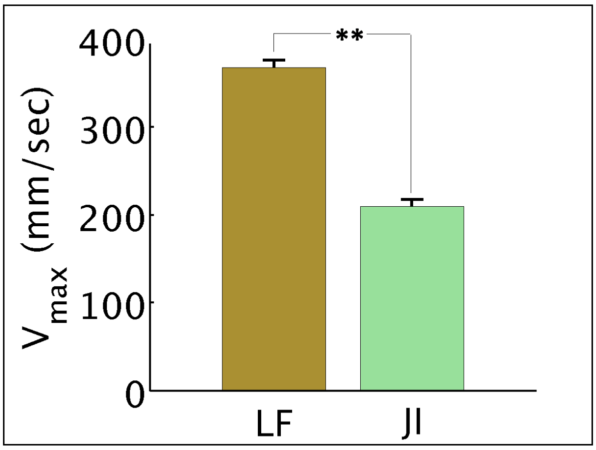


Figure S19. Average maximal segment velocity in novice LF and JI rounds ($p < 0.0001$, $t = 10.44$).

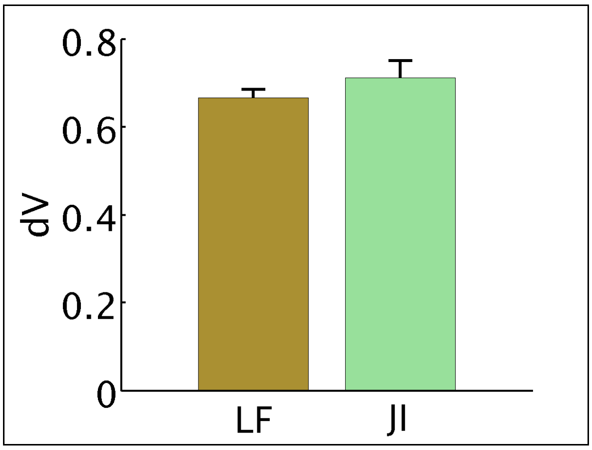


Figure S20. Average velocity error in novice LF and JI rounds (p = N.S., $t = -1.25$).

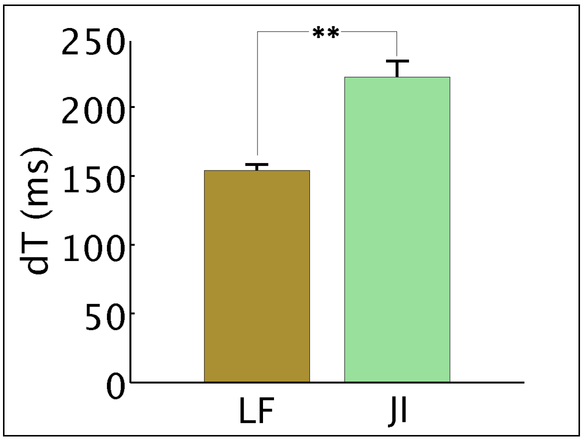


Figure S21. Average difference between player stopping times (dT) in novice LF and JI rounds ($p < 0.001$, t = -6.57).

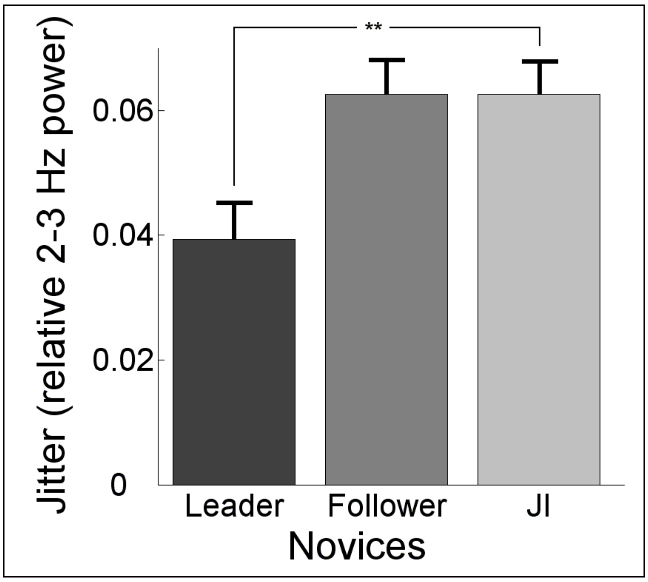


Figure S22. Jitter in novice rounds (*Leader-vs.-JI:* $p < 0.01$, t = -2.99). Compare to Figure 3B in main text.

13. Transient time for decay of jitter in the mathematical JI model

As shown in Fig. 4DF in the main text, the model for the JI configuration approaches, after a transient time, a state where the player move together precisely, with no jitter. Here, we study the transient time needed for reaching jitterless coordinated motion in this model. For simplicity, we consider the model with a single frequency ω for the predictor, and equal predictor learning rates for the two players, g. The velocity of player i is (j denotes the other player)

(1) $dv_i/dt = A_i(t)\omega\cos(\omega t) + f_i$
(2) $df_i/dt = k_i(v_j - v_i)$
(3) $dA_i/dt = g(v_j - A_i sin\omega t)sin\omega t$

We define the difference in velocities as

(4) $u = v_2 - v_1$

and the difference between predictor amplitudes as

(5) $a = A_2 - A_1$

Subtracting the equations for player 1 from those of player 2 yields

(6) $du/dt = a\omega cos\omega t + f_2 - f_1$
(7) $d(f_2 - f_1)/dt = -(k_1 + k_2)u$
(8) $da/dt = -g(u + asin\omega t)sin\omega t$

Differentiating equation (6) by time, yields

(9) $d^2u/dt^2 = -(k_1 + k_2)u + d/dt(a\omega cos\omega t)$

To estimate the transient time, we analyze the slow decay process by means of a new variable y that describes the slow variation in the velocity difference, as follows

(10) $u = ysin\omega t$

This yields the following equation

(11) $da/dt = -g(y + a)sin^2\omega t$

We next analyzed the slowly varying modes in the dynamics. Numerical solutions show that this approach yields excellent approximation to the transient times (Figure S23). In this approximation, one averages over times longer than $1/\omega$. Using $< sin^2\omega t >= 1/2$, yields

(12) $da/dt = -(1/2)g(y + a)$

Note that from here on, y and a denote the time-averaged slow variables $< a >$ and $< y >$. Similarly averaging over time of equation (9), and using $< sin\omega tcos\omega t >= 0$, yields

(13) $d^2y/dt^2 = -a\omega^2 + (\omega^2 - 2\omega_c^2)y$, where $\omega_c^2 = (k_1 + k_2)/2$.

Note that we have arrived at two coupled linear differential equations, that relate y and a: a first order equation [equation (12)], and a second order equation [equation (13)]. The solution of these equations is a sum of three exponential of time, with complex eigenvalues. The eigenvalues λ are the roots of a cubic polynomial

(14) $\lambda^3 + \frac{g}{2}\lambda^2 + (2\omega_c^2 - \omega^2)\lambda + g(\omega_c^2 - \omega^2) = 0$

The roots can be solved analytically. One can show that the eigenvalues have negative real values as long as $\omega < \omega_c$, so that the velocity difference u decays to zero. When frequency exceeds the critical frequency, $\omega > \omega_c$, an eigenvalue with a positive real part emerges, and the equations become unstable.

The rate of decay of y (given by the smallest real part among the three eigenvalues λ) is plotted in Figure S23 as a function of ω/ω_c. The transient time is given by the inverse of this eigenvalue, $1/\lambda$. Note that transient times are large (λ is small) for both low and high frequencies. Transient time is minimal, and equal to about $6/g$, at about $\omega = 0.9\omega_c$. One can calculate the limiting values of the decay rate, to find that at small frequencies

(15) $\lambda \sim 0.12g(\omega/\omega_c)^2$

and at frequencies approaching ω_c, one finds

(16) $\lambda = 2g\omega_c/(\omega_c - \omega)$

These limiting estimates are plotted as dashed lines in Figure S23. Agreement with full numerical solution of equations (1)-(3) (dots in Figure S23) is good.

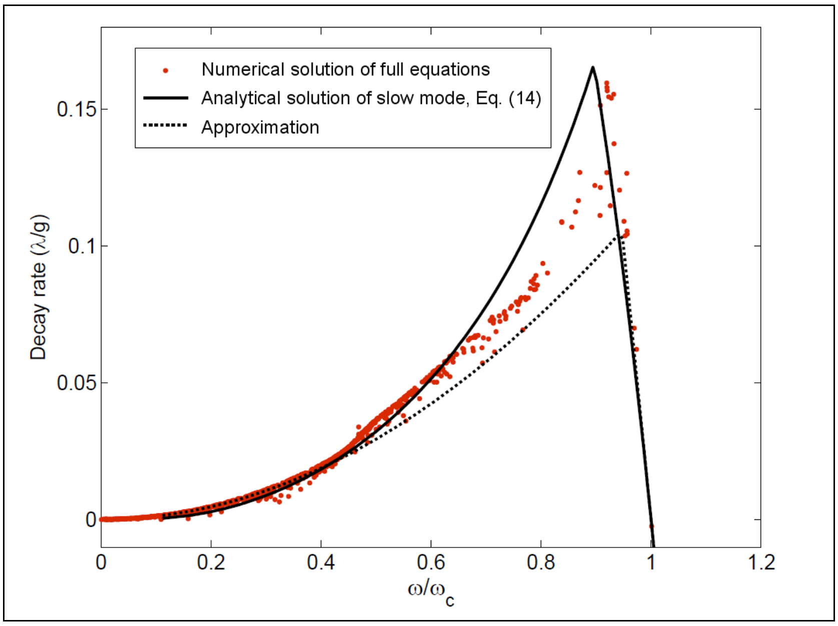


Figure S23. Decay rate (inverse of transient time) to reach synchrony in the JI mathematical model of two mirrored controllers. The difference between player velocities decays exponentially at rateλ. The transient time is $1/\lambda$. Black lines: λ/g as a function of ω/ω_c where λ is the eigenvalue of the smallest real part which solves equation (14) (this is the eigenvalue that dominates the solution at long times), g is the learning rate of the predictor, ω is the frequency of the predictor and $\omega_c = \sqrt{(k_1+k_2)/2}$ is the maximal stable frequency, and is similar to the jitter frequency $\omega_{jitter} = \sqrt{k_i}$ when player i follows a leader (player j). Dots are decay rates from numerical simulations of the model equations (1)-(3) for a range of ω, with k_i values sampled in the range $[0..40]$, with initial conditions $v_1(0) = v_2(0), A_1(0) = 1, A_2(0) = 2.$ Dashed lines are the limiting approximation to the analytical decay rate estimates, equation (15) and (16).

14. Full instructions for players

Hello, my name is ___ and thanks for taking part in this study. We will play the mirror games together. This is a game, not a competition, and the goal is simply to enjoy producing movements together.
In each game you will sit next to this table with your partner, holding the handle with both hands. One of you is designated the 'blue' player and the other the 'red'

player. The game has three types of rounds. In the first, the blue player will perform movements with this slider, and the red player will imitate them, in a mirror-like fashion. In the second, the red player will perform movements with this slider, and the blue player will imitate them. In the third type of rounds, you will produce the mirror-like movements together, without a designated leader or follower.
We will play 9 rounds, three one minute rounds of each type, and a then a final 3-minute round without a designated leader. The lights on the side of the box will indicate which type of round we will be playing. A blue light indicates that the blue player will lead, a red light indicates that the red player will lead, and both lights indicate that you create the movement together, without a designated leader. The light will turn on, and a few seconds later you will hear a bell sound signaling the start of the round. The same sound will be heard to signal the end of the round.
Between rounds you will have a short 10 second break. You can remove your arms from the handles and stretch a bit of you wish to. The game in total will take about 15 minutes. Please do not speak during this time.

Before the actual game we will play three short practice rounds, one of each type, to get use to the indicating light and to the handles.
I would be glad to tell you more about this game and the purpose of this study after the experiment.
Remember, your goal is to imitate each other, create synchronized and interesting motions, and enjoy playing together. Any questions? Great, let's start!

[- practice -]

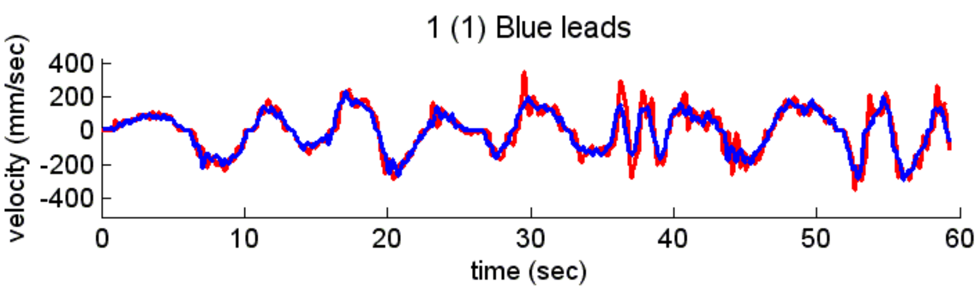
Great, that was good! Anything that is not clear? Any questions? Ok, let's start!

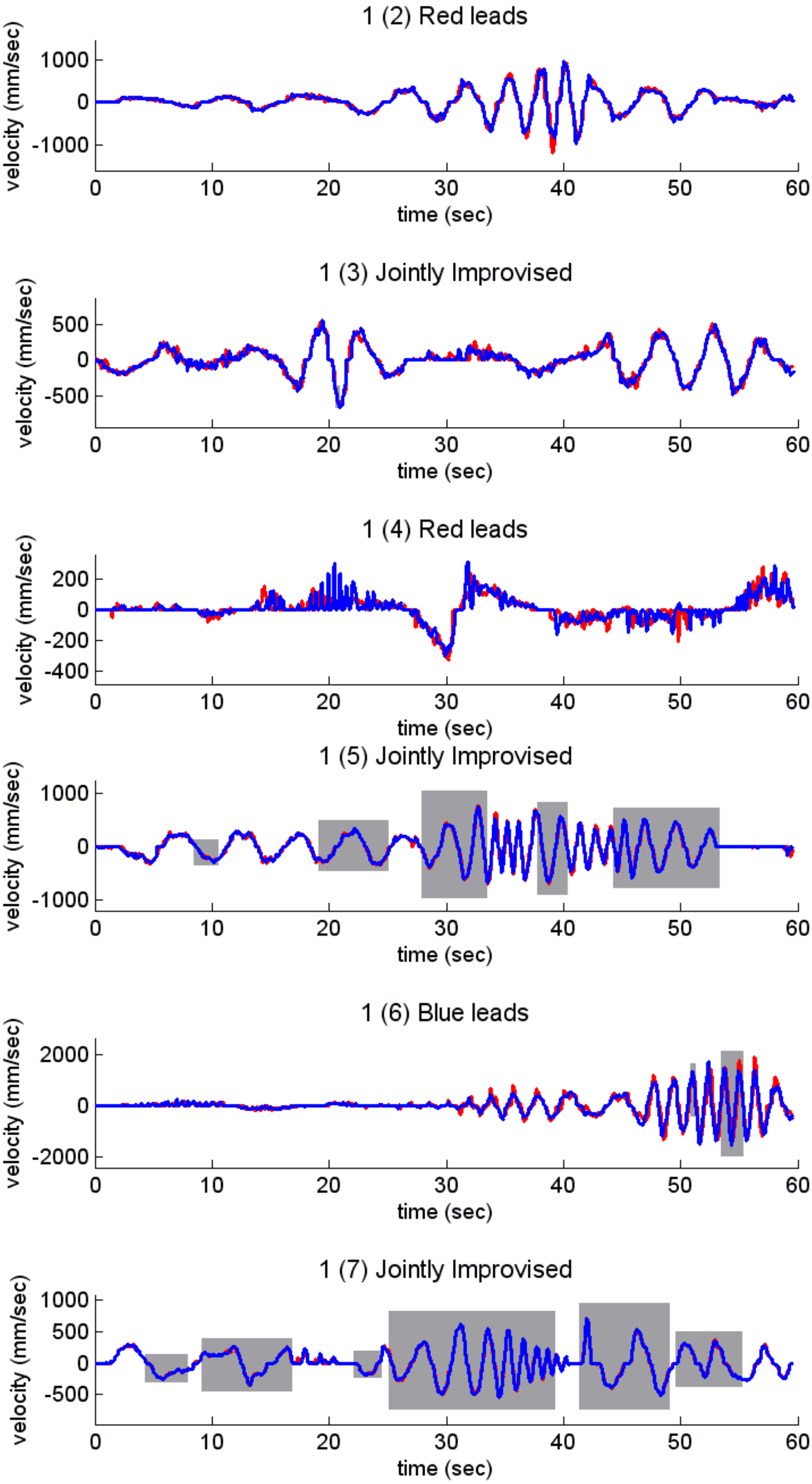
[- game --]

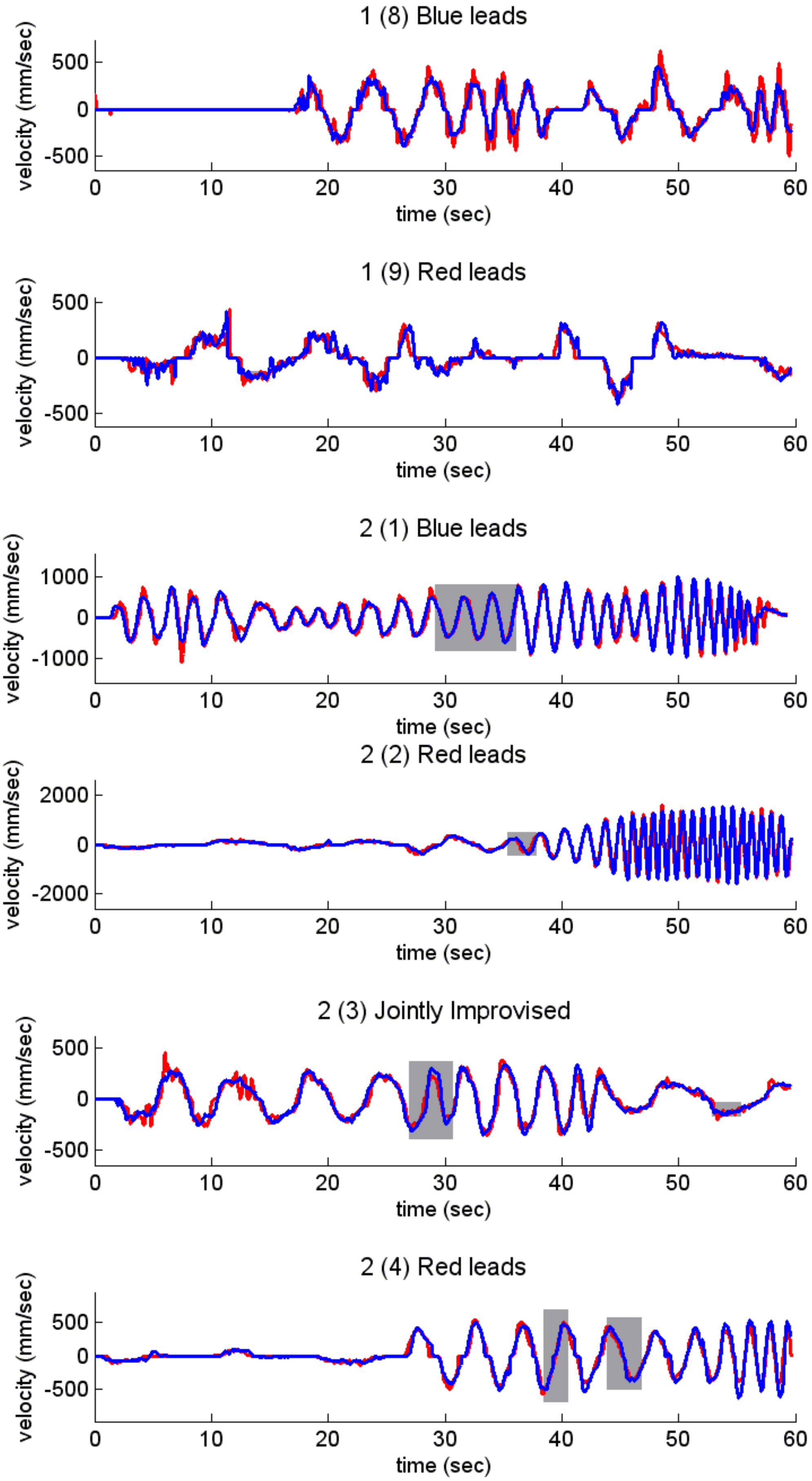
15. Complete experimental dataset

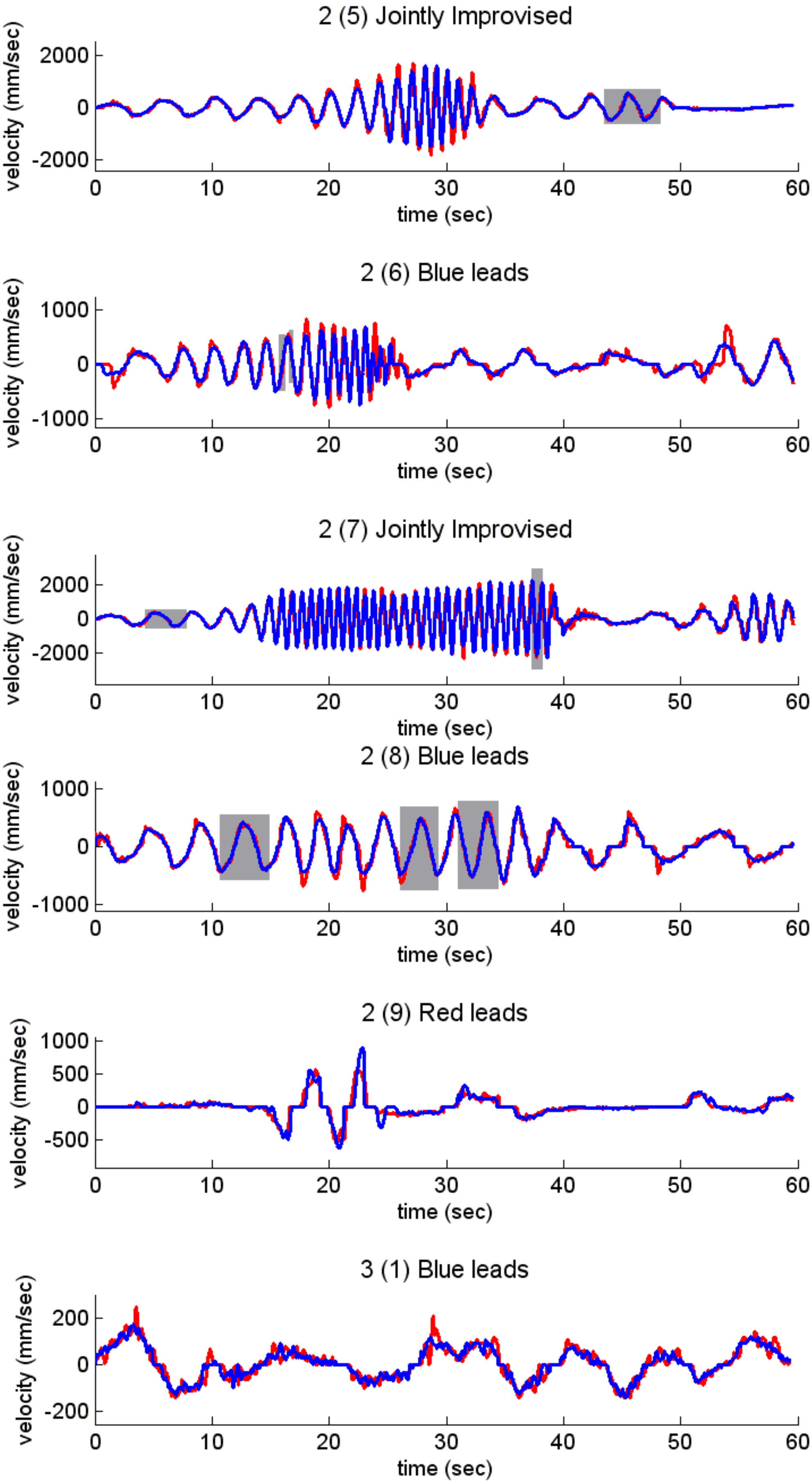
The following figures describe the complete dataset in this study.

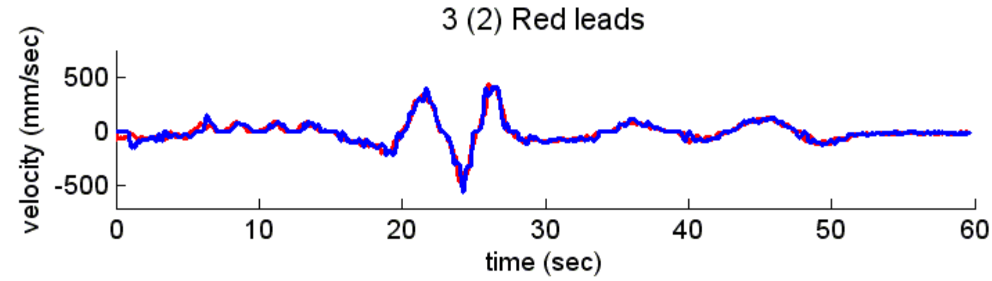
Figure S24. Velocities of players in expert games. Titles show game and round (total of nine games with nine rounds each) and the condition (*Blue leads*, *Red leads* or *Jointly improvised*). Grey rectangles: periods of co-confident motion, as described in the main text.

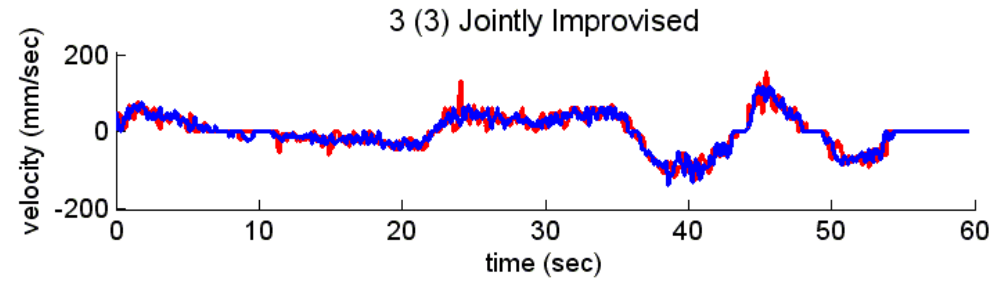


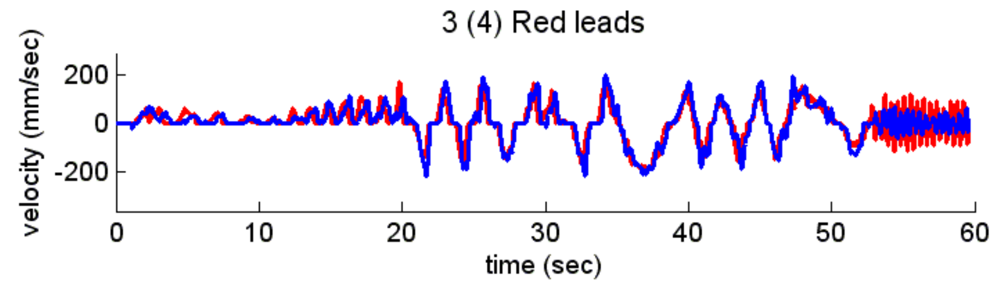

1 (2) Red leads
velocity (mm/sec)
1000
0
-1000
0
10
20
30
40
50
60
time (sec)
1 (3) Jointly Improvised
velocity (mm/sec)
500
0
-500
0
10
20
30
40
50
60
time (sec)
1 (4) Red leads
velocity (mm/sec)
200
0
-200
-400
0
10
20
30
40
50
60
time (sec)
1 (5) Jointly Improvised
velocity (mm/sec)
1000
0
-1000
0
10
20
30
40
50
60
time (sec)
1 (6) Blue leads
velocity (mm/sec)
2000
0
-2000
0
10
20
30
40
50
60
time (sec)
1 (7) Jointly Improvised
velocity (mm/sec)
1000
500
0
-500
0
10
20
30
40
50
60
time (sec)

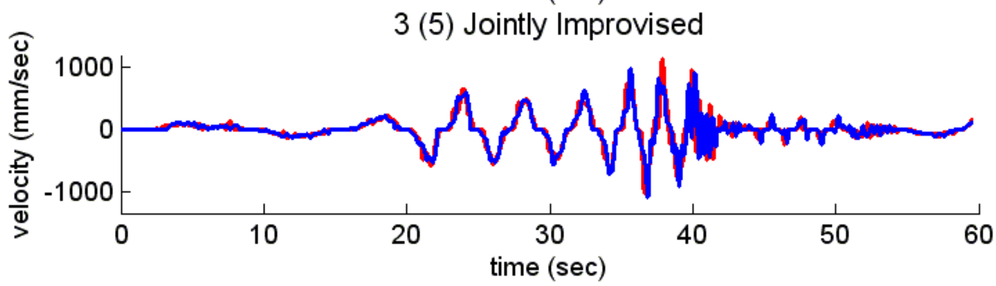

1 (8) Blue leads
velocity (mm/sec)
500
0
-500
0 10 20 30 40 50 60
time (sec)
1 (9) Red leads
velocity (mm/sec)
500
0
-500
0 10 20 30 40 50 60
time (sec)
2 (1) Blue leads
velocity (mm/sec)
1000
0
-1000
0 10 20 30 40 50 60
time (sec)
2 (2) Red leads
velocity (mm/sec)
2000
0
-2000
0 10 20 30 40 50 60
time (sec)
2 (3) Jointly Improvised
velocity (mm/sec)
500
0
-500
0 10 20 30 40 50 60
time (sec)
2 (4) Red leads
velocity (mm/sec)
500
0
-500
0 10 20 30 40 50 60
time (sec)

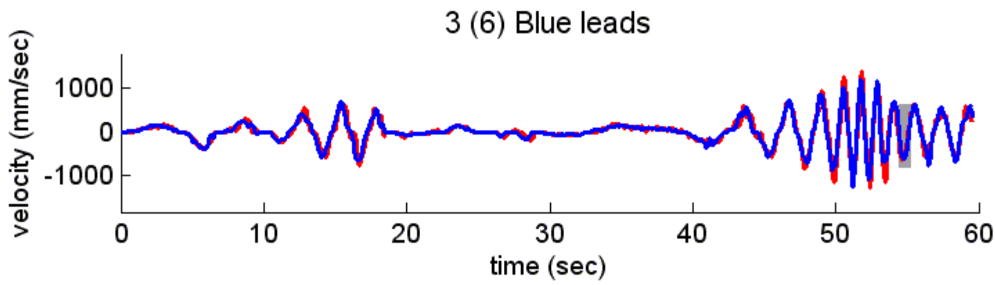

2 (5) Jointly Improvised
velocity (mm/sec)
2000
0
-2000
0 10 20 30 40 50 60
time (sec)
2 (6) Blue leads
velocity (mm/sec)
1000
0
-1000
0 10 20 30 40 50 60
time (sec)
2 (7) Jointly Improvised
velocity (mm/sec)
2000
0
-2000
0 10 20 30 40 50 60
time (sec)
2 (8) Blue leads
velocity (mm/sec)
1000
0
-1000
0 10 20 30 40 50 60
time (sec)
2 (9) Red leads
velocity (mm/sec)
1000
500
0
-500
0 10 20 30 40 50 60
time (sec)
3 (1) Blue leads
velocity (mm/sec)
200
0
-200
0 10 20 30 40 50 60
time (sec)

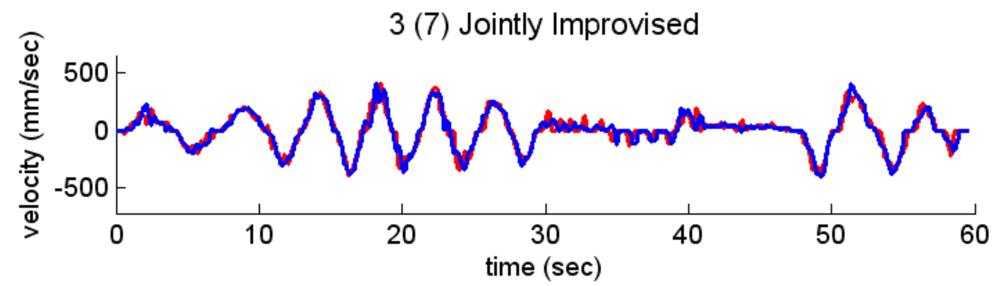

3 (2) Red leads
velocity (mm/sec)
500
0
-500
0
10
20
30
40
50
60
time (sec)

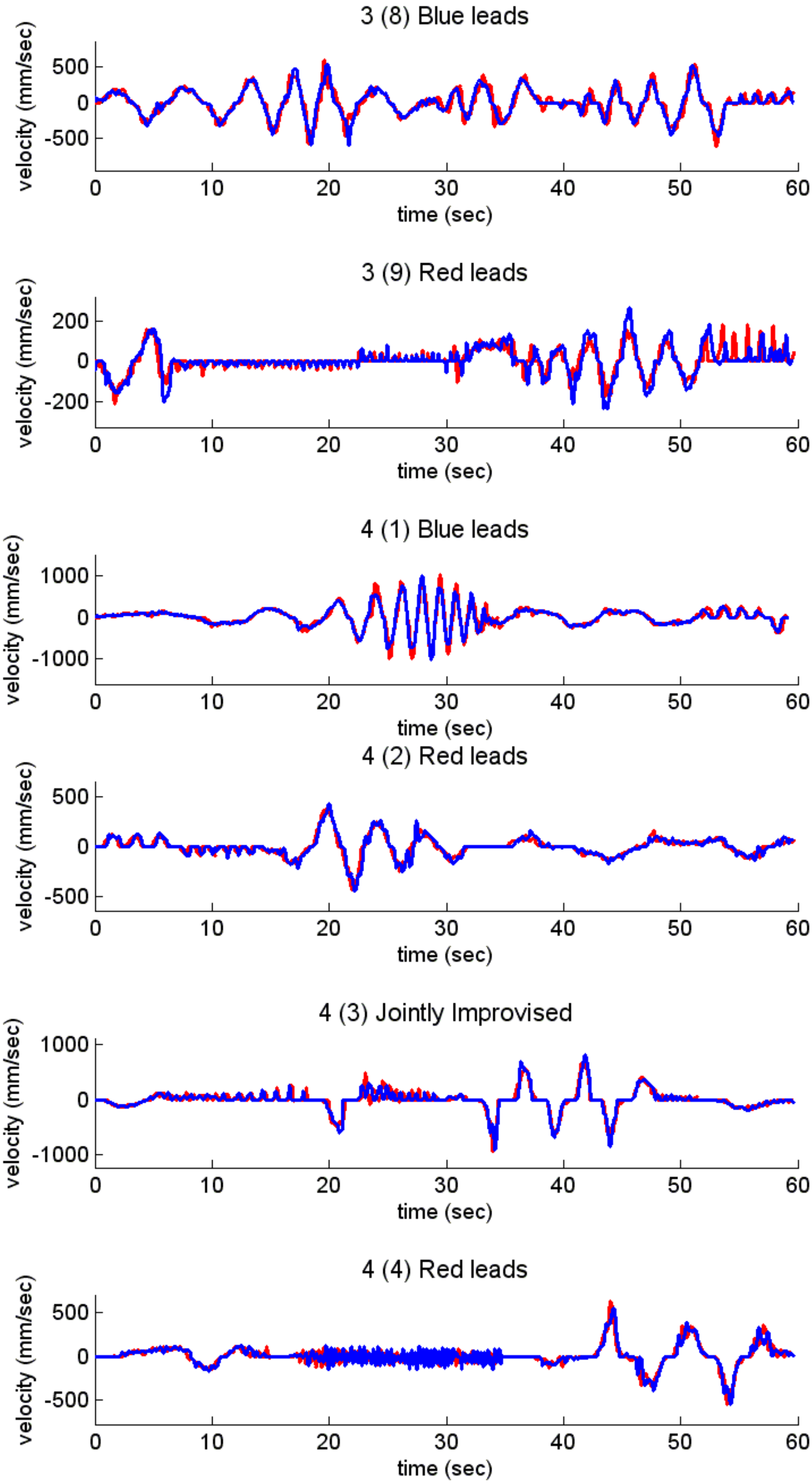

3 (3) Jointly Improvised
velocity (mm/sec)
200
0
-200
0
10
20
30
40
50
60
time (sec)

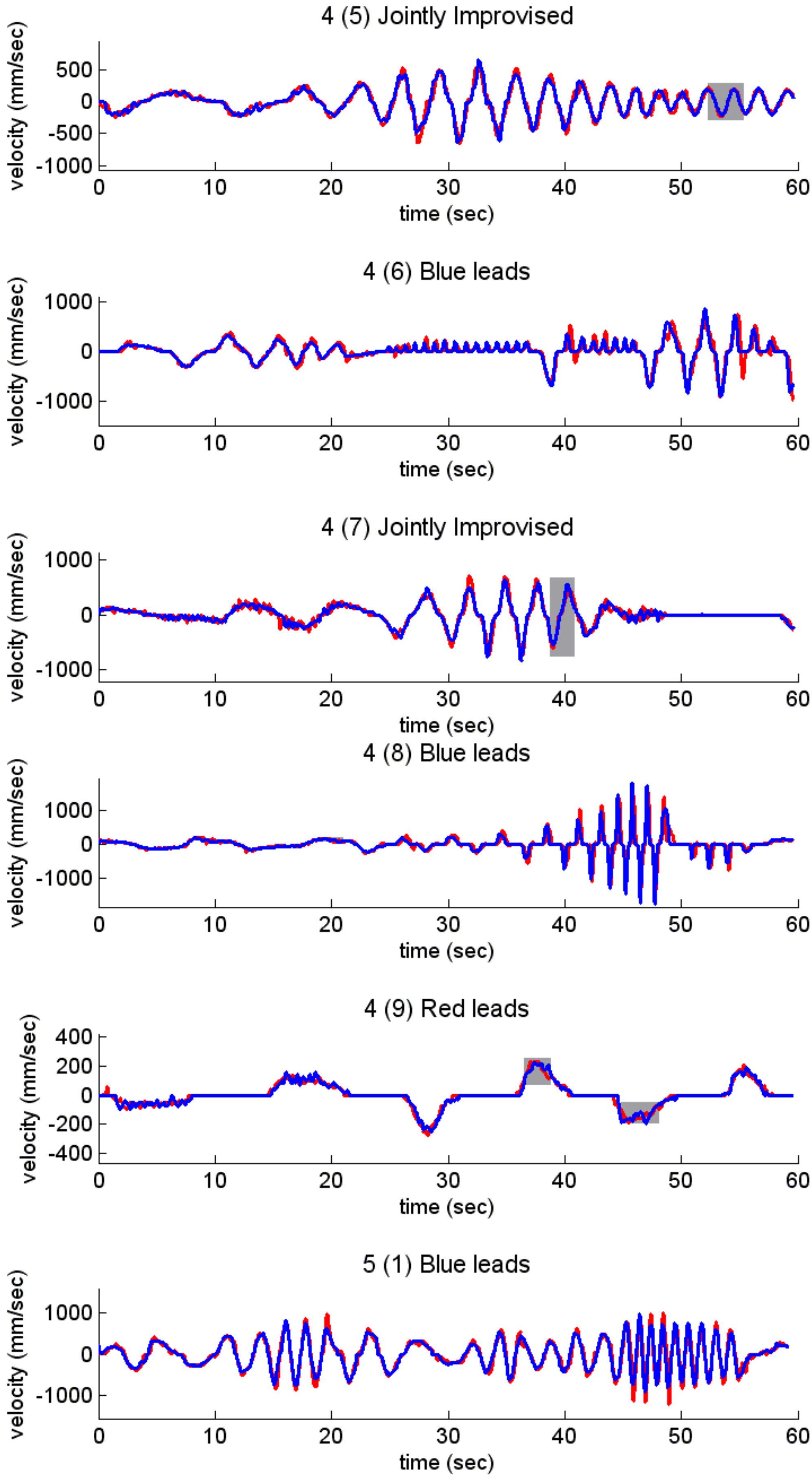

3 (4) Red leads
velocity (mm/sec)
200
0
-200
0
10
20
30
40
50
60
time (sec)

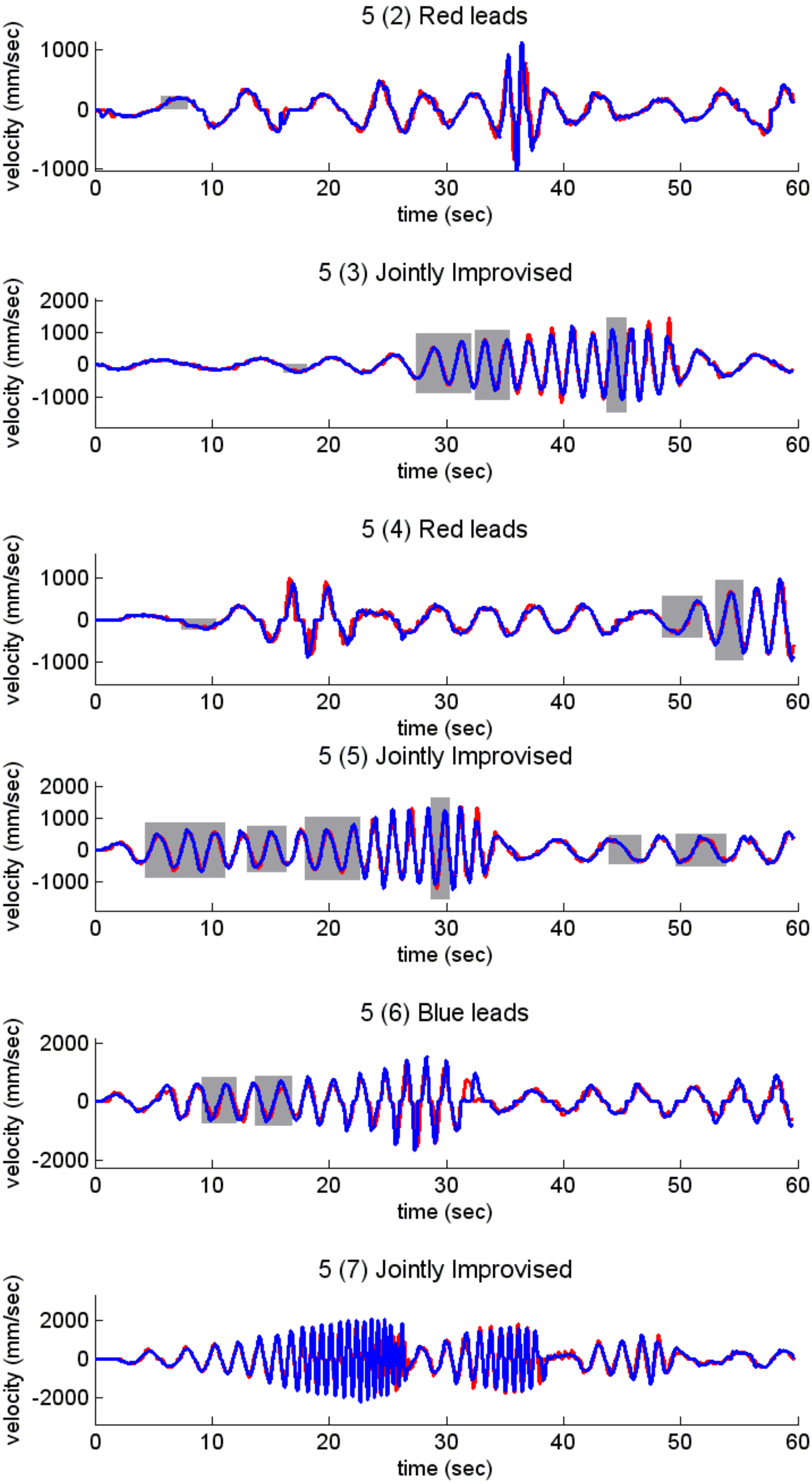

3 (5) Jointly Improvised
velocity (mm/sec)
1000
0
-1000
0
10
20
30
40
50
60
time (sec)

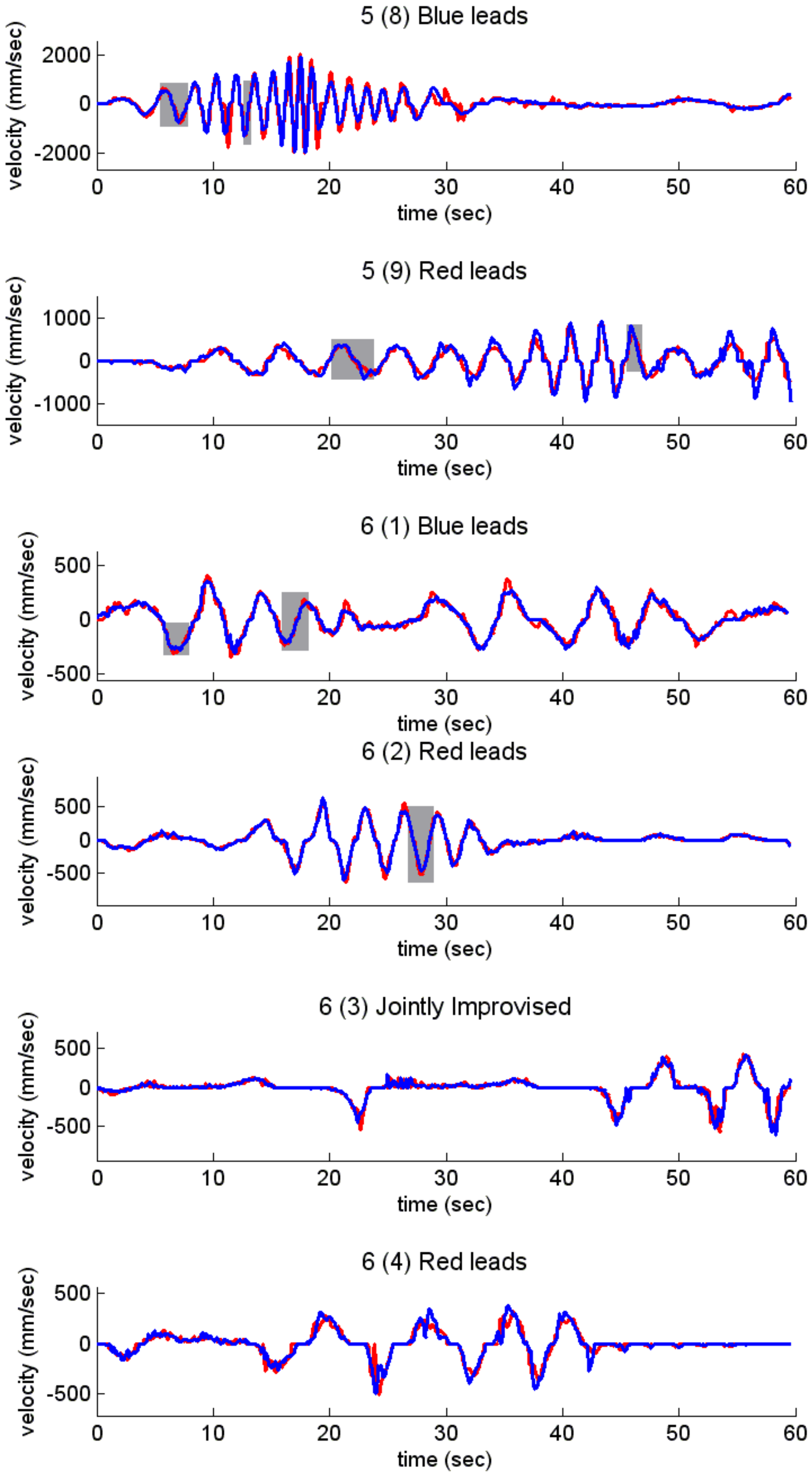

3 (6) Blue leads
velocity (mm/sec)
1000
0
-1000
0
10
20
30
40
50
60
time (sec)

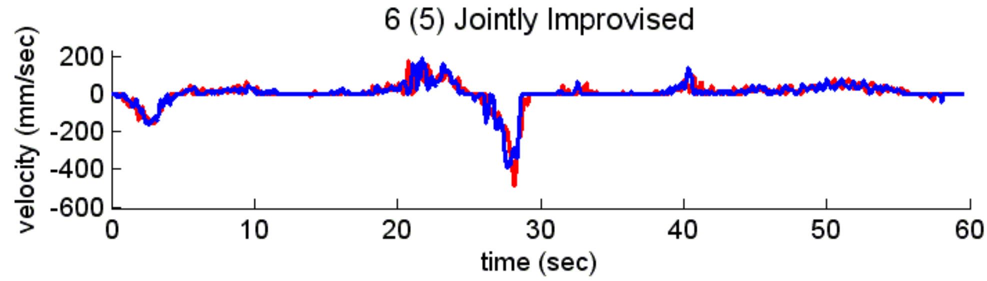

3 (7) Jointly Improvised
velocity (mm/sec)
500
0
-500
0
10
20
30
40
50
60
time (sec)

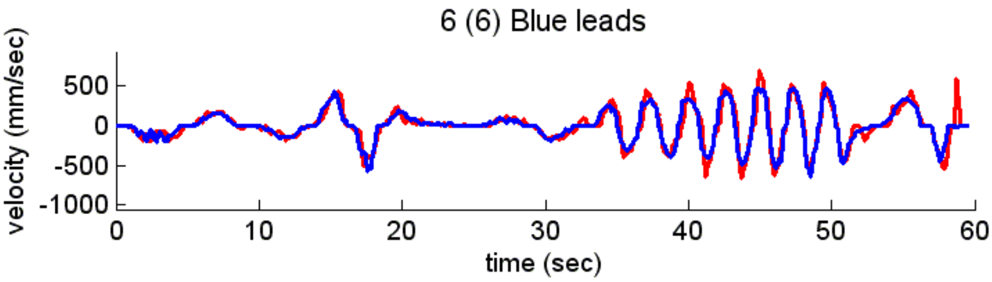

3 (8) Blue leads
velocity (mm/sec)
500
0
-500
0 10 20 30 40 50 60
time (sec)
3 (9) Red leads
velocity (mm/sec)
200
0
-200
0 10 20 30 40 50 60
time (sec)
4 (1) Blue leads
velocity (mm/sec)
1000
0
-1000
0 10 20 30 40 50 60
time (sec)
4 (2) Red leads
velocity (mm/sec)
500
0
-500
0 10 20 30 40 50 60
time (sec)
4 (3) Jointly Improvised
velocity (mm/sec)
1000
0
-1000
0 10 20 30 40 50 60
time (sec)
4 (4) Red leads
velocity (mm/sec)
500
0
-500
0 10 20 30 40 50 60
time (sec)

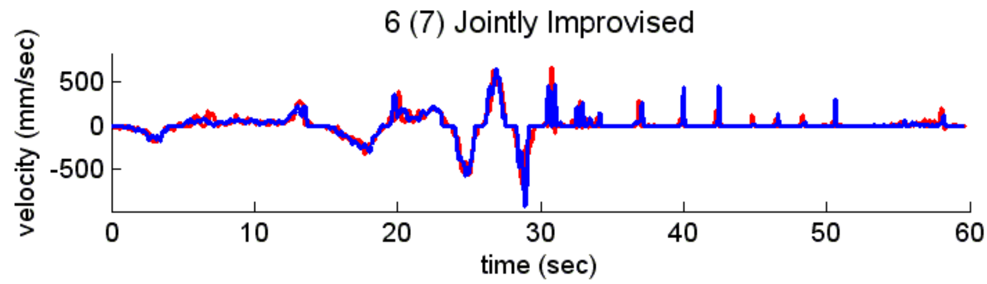

4 (5) Jointly Improvised
velocity (mm/sec)
500
0
-500
-1000
0
10
20
30
40
50
60
time (sec)
4 (6) Blue leads
velocity (mm/sec)
1000
0
-1000
time (sec)
4 (7) Jointly Improvised
velocity (mm/sec)
1000
0
-1000
time (sec)
4 (8) Blue leads
velocity (mm/sec)
1000
0
-1000
time (sec)
4 (9) Red leads
velocity (mm/sec)
400
200
0
-200
-400
time (sec)
5 (1) Blue leads
velocity (mm/sec)
1000
0
-1000
time (sec)

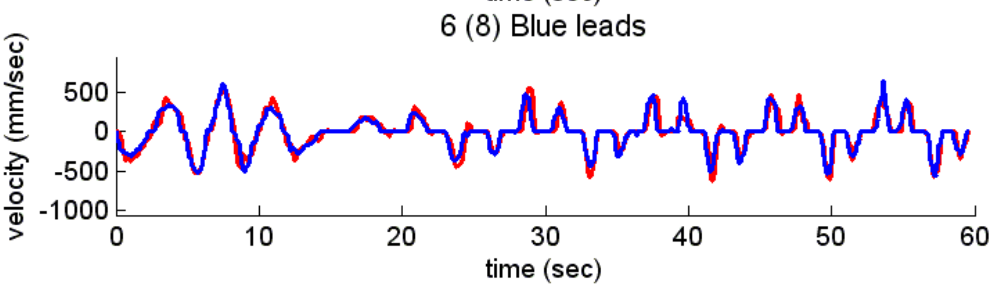

5 (2) Red leads
5 (3) Jointly Improvised
5 (4) Red leads
5 (5) Jointly Improvised
5 (6) Blue leads
5 (7) Jointly Improvised
velocity (mm/sec)
time (sec)

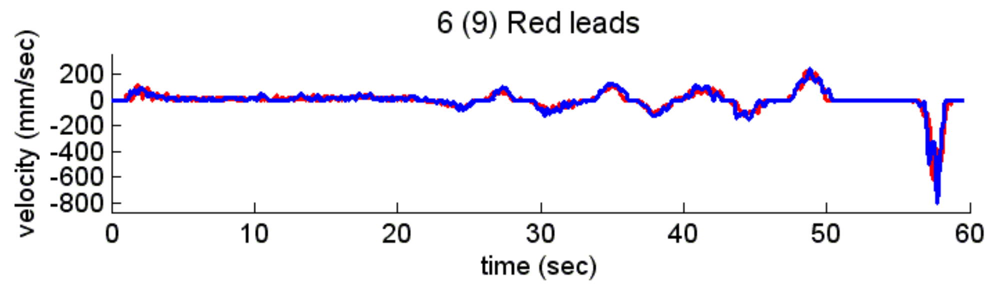

5 (8) Blue leads
velocity (mm/sec)
2000
0
-2000
0 10 20 30 40 50 60
time (sec)
5 (9) Red leads
velocity (mm/sec)
1000
0
-1000
0 10 20 30 40 50 60
time (sec)
6 (1) Blue leads
velocity (mm/sec)
500
0
-500
0 10 20 30 40 50 60
time (sec)
6 (2) Red leads
velocity (mm/sec)
500
0
-500
0 10 20 30 40 50 60
time (sec)
6 (3) Jointly Improvised
velocity (mm/sec)
500
0
-500
0 10 20 30 40 50 60
time (sec)
6 (4) Red leads
velocity (mm/sec)
500
0
-500
0 10 20 30 40 50 60
time (sec)

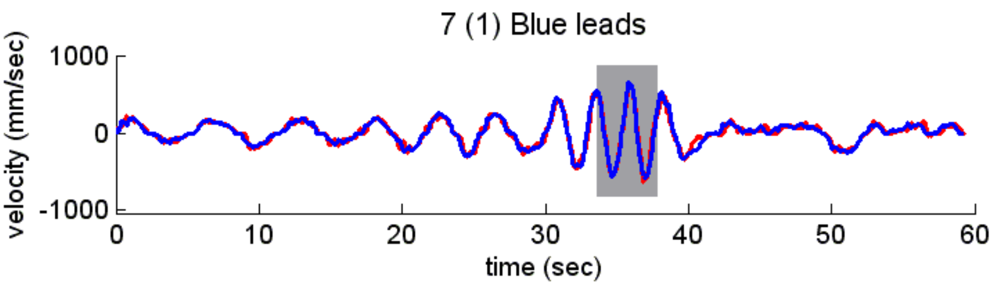

6 (5) Jointly Improvised
velocity (mm/sec)
200
0
-200
-400
-600
0
10
20
30
40
50
60
time (sec)

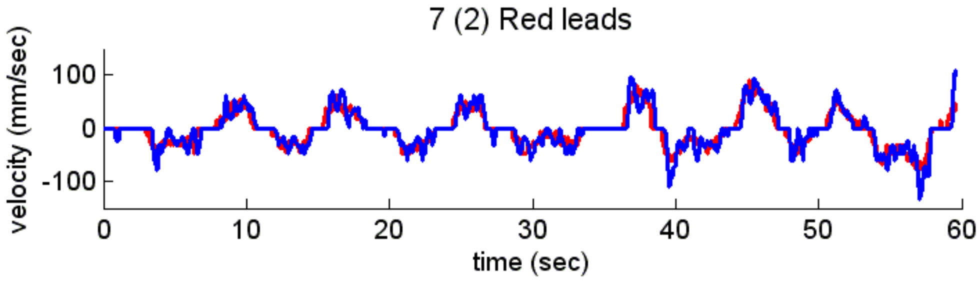

6 (6) Blue leads
velocity (mm/sec)
500
0
-500
-1000
0
10
20
30
40
50
60
time (sec)

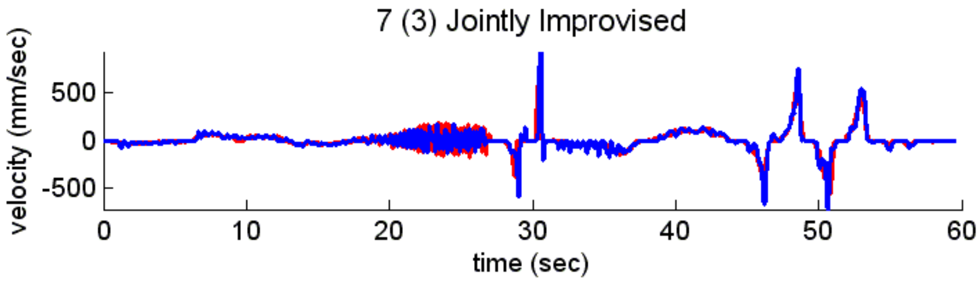

6 (7) Jointly Improvised
velocity (mm/sec)
500
0
-500
0
10
20
30
40
50
60
time (sec)

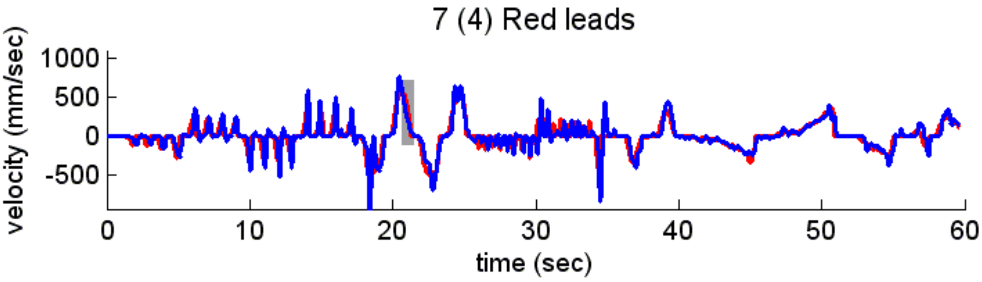

6 (8) Blue leads
velocity (mm/sec)
500
0
-500
-1000
0
10
20
30
40
50
60
time (sec)

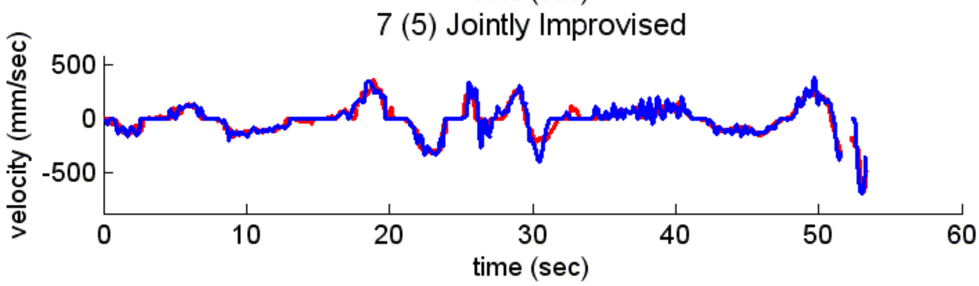

6 (9) Red leads
velocity (mm/sec)
200
0
-200
-400
-600
-800
0
10
20
30
40
50
60
time (sec)

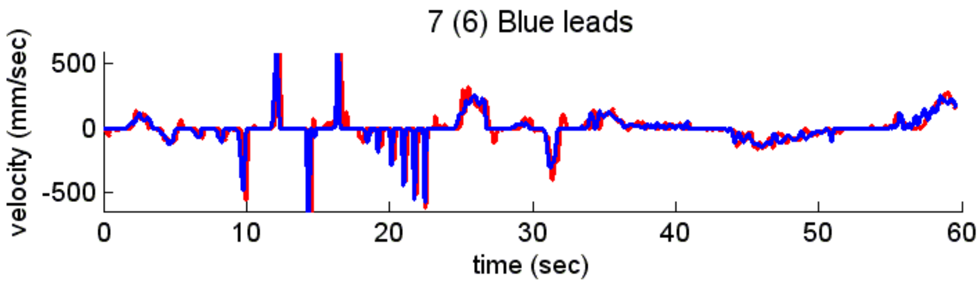

7 (1) Blue leads
velocity (mm/sec)
1000
0
-1000
0
10
20
30
40
50
60
time (sec)

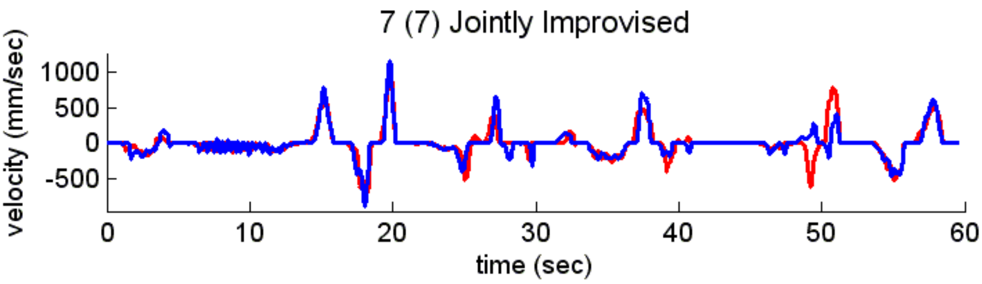

7 (2) Red leads
velocity (mm/sec)
100
0
-100
0
10
20
30
40
50
60
time (sec)

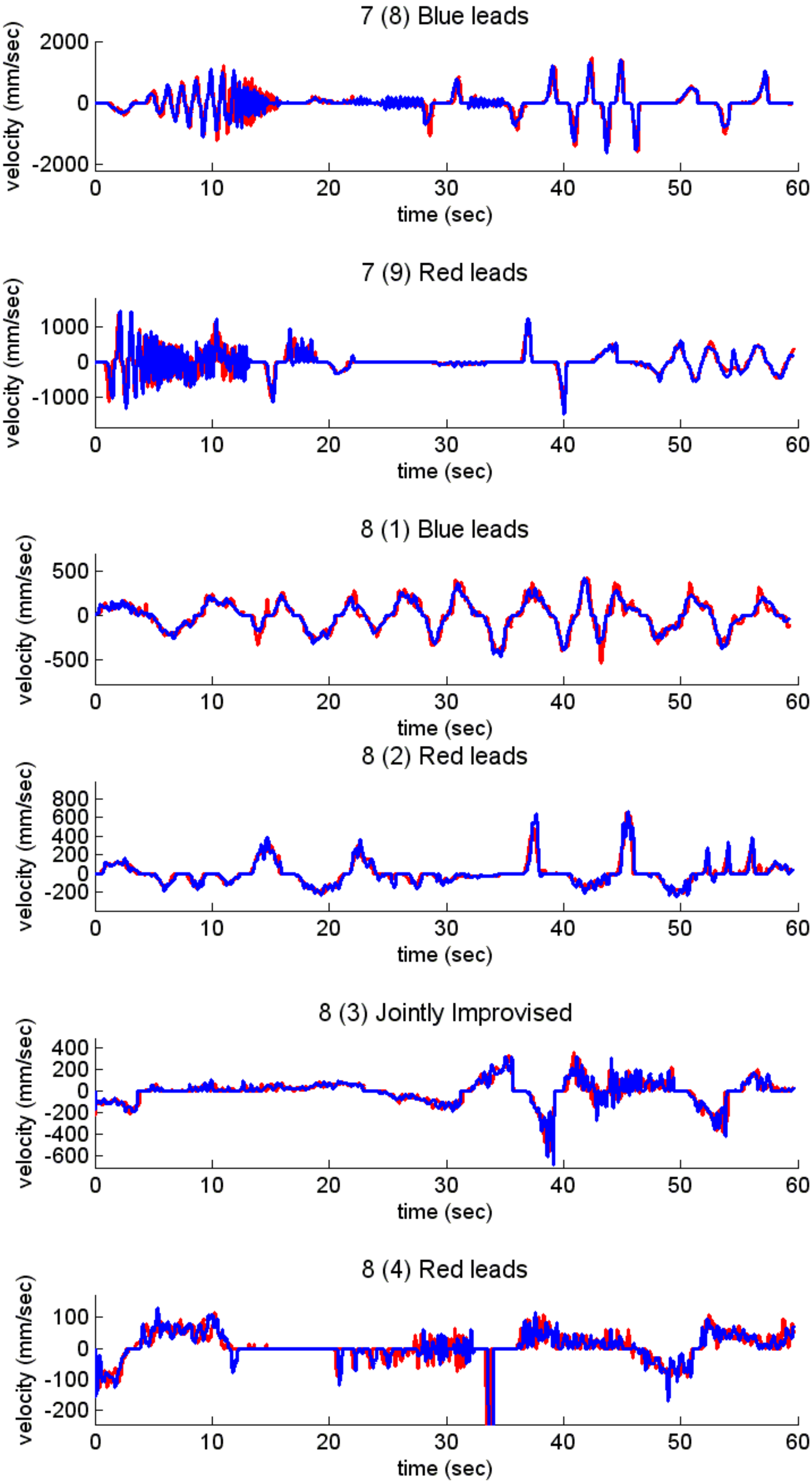

7 (3) Jointly Improvised
velocity (mm/sec)
500
0
-500
0
10
20
30
40
50
60
time (sec)

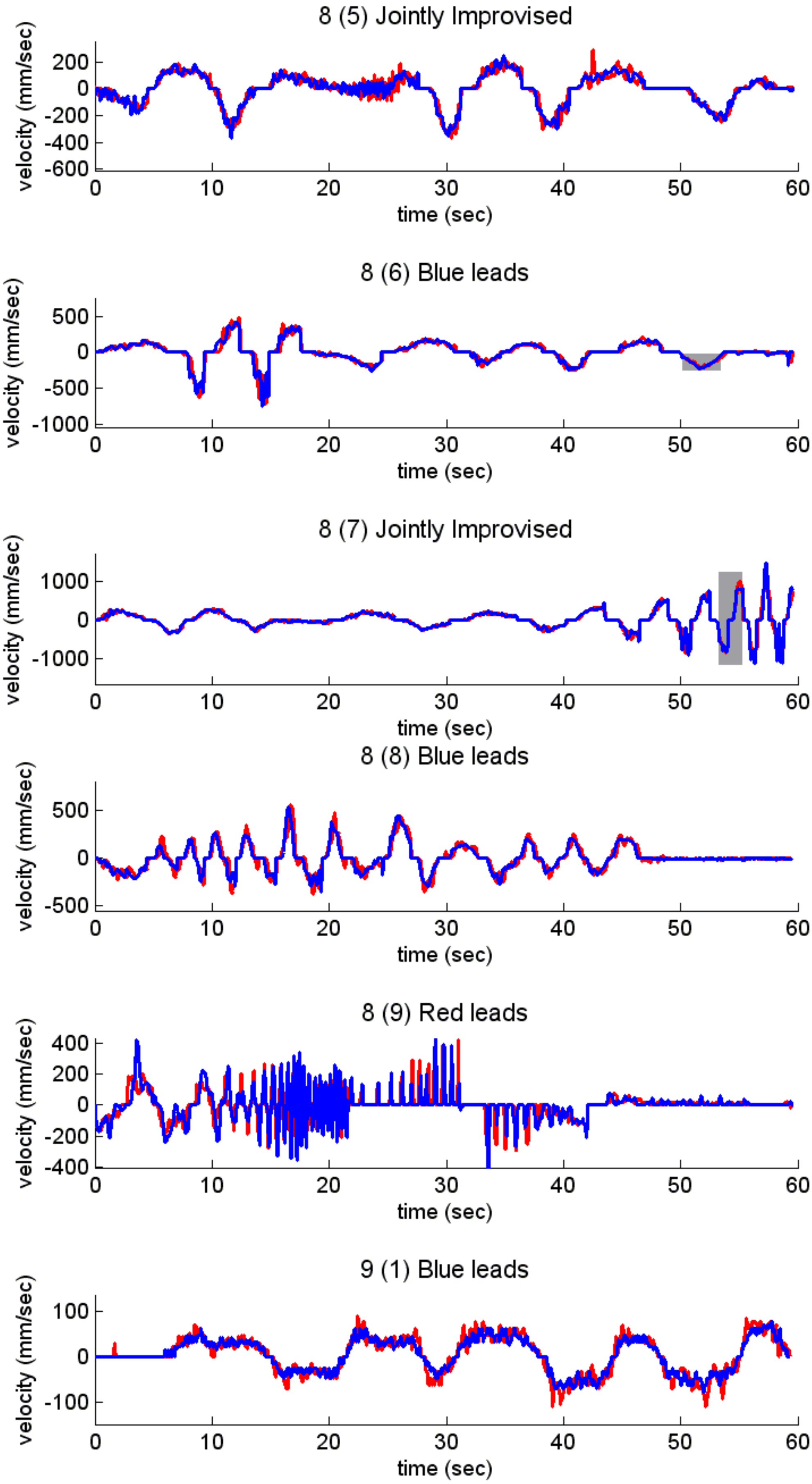

7 (4) Red leads
velocity (mm/sec)
1000
500
0
-500
0
10
20
30
40
50
60
time (sec)

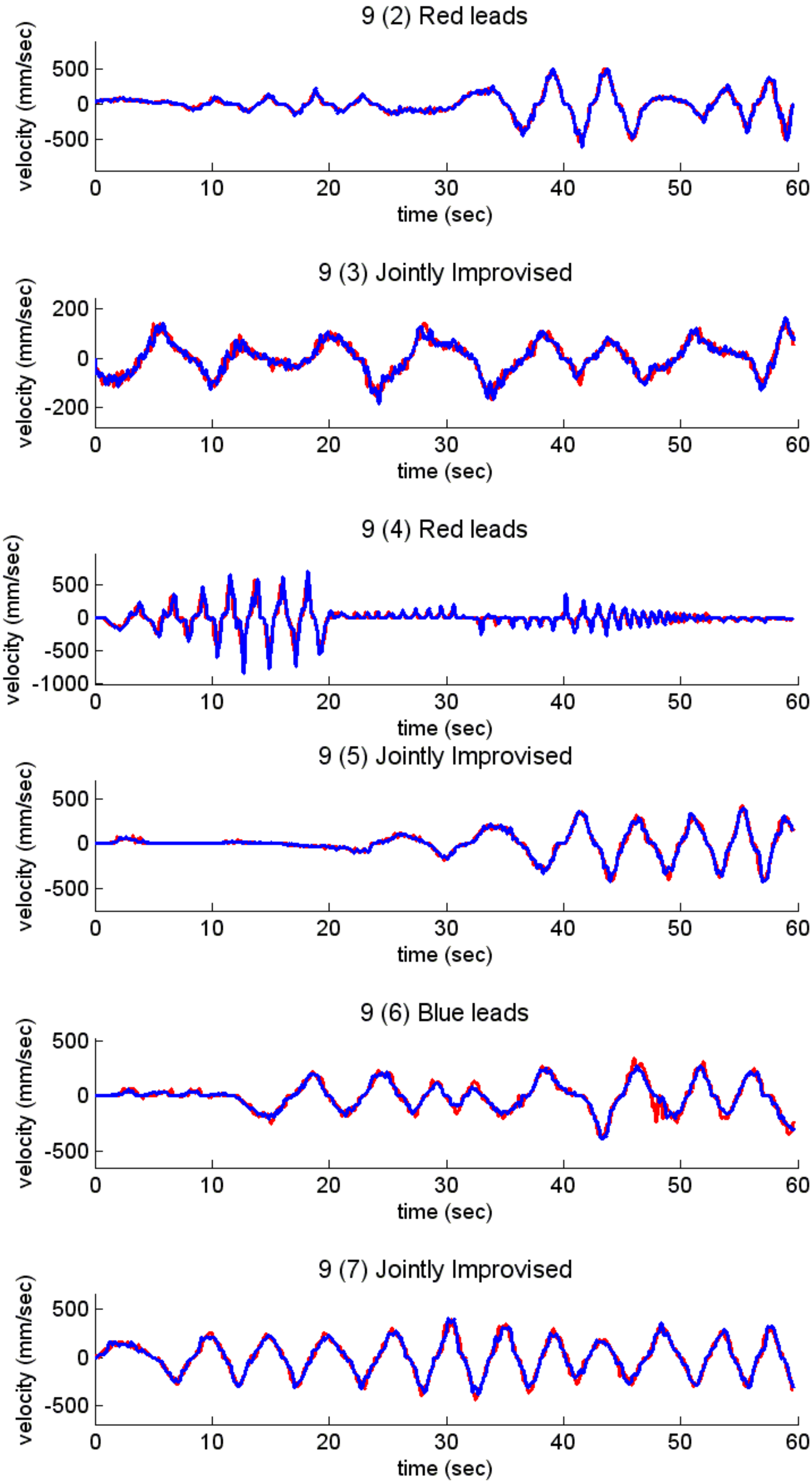

7 (5) Jointly Improvised
velocity (mm/sec)
500
0
-500
0
10
20
30
40
50
60
time (sec)

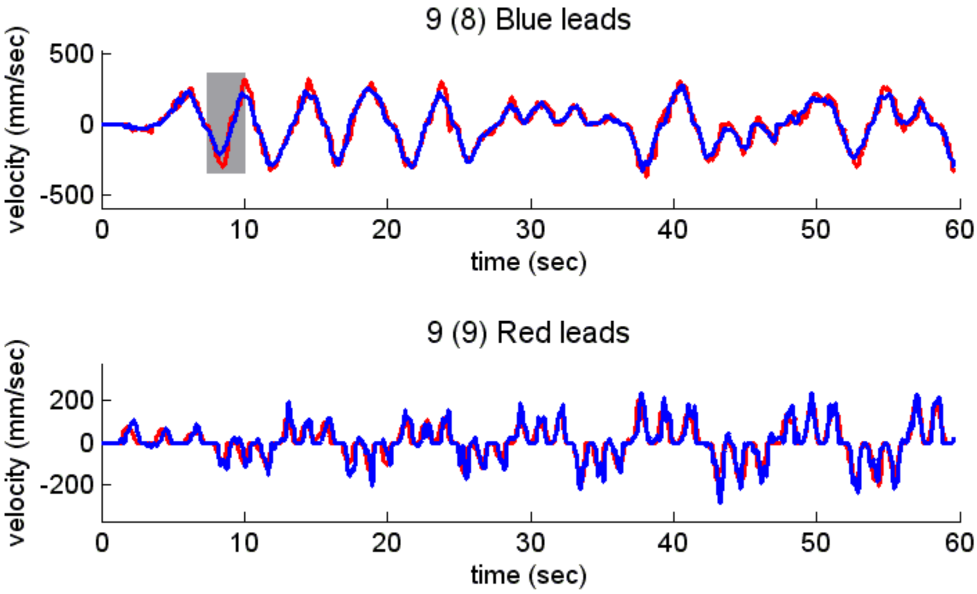

7 (6) Blue leads
velocity (mm/sec)
500
0
-500
0
10
20
30
40
50
60
time (sec)


7 (7) Jointly Improvised
velocity (mm/sec)
1000
500
0
-500
0
10
20
30
40
50
60
time (sec)


7 (8) Blue leads
velocity (mm/sec)
2000
0
-2000
0 10 20 30 40 50 60
time (sec)
7 (9) Red leads
velocity (mm/sec)
1000
0
-1000
0 10 20 30 40 50 60
time (sec)
8 (1) Blue leads
velocity (mm/sec)
500
0
-500
0 10 20 30 40 50 60
time (sec)
8 (2) Red leads
velocity (mm/sec)
800
600
400
200
0
-200
0 10 20 30 40 50 60
time (sec)
8 (3) Jointly Improvised
velocity (mm/sec)
400
200
0
-200
-400
-600
0 10 20 30 40 50 60
time (sec)
8 (4) Red leads
velocity (mm/sec)
100
0
-100
-200
0 10 20 30 40 50 60
time (sec)


8 (5) Jointly Improvised
velocity (mm/sec)
200
0
-200
-400
-600
0 10 20 30 40 50 60
time (sec)
8 (6) Blue leads
velocity (mm/sec)
500
0
-500
-1000
0 10 20 30 40 50 60
time (sec)
8 (7) Jointly Improvised
velocity (mm/sec)
1000
0
-1000
0 10 20 30 40 50 60
time (sec)
8 (8) Blue leads
velocity (mm/sec)
500
0
-500
0 10 20 30 40 50 60
time (sec)
8 (9) Red leads
velocity (mm/sec)
400
200
0
-200
-400
0 10 20 30 40 50 60
time (sec)
9 (1) Blue leads
velocity (mm/sec)
100
0
-100
0 10 20 30 40 50 60
time (sec)


9 (2) Red leads
velocity (mm/sec)
500
0
-500
0 10 20 30 40 50 60
time (sec)
9 (3) Jointly Improvised
velocity (mm/sec)
200
0
-200
0 10 20 30 40 50 60
time (sec)
9 (4) Red leads
velocity (mm/sec)
500
0
-500
-1000
0 10 20 30 40 50 60
time (sec)
9 (5) Jointly Improvised
velocity (mm/sec)
500
0
-500
0 10 20 30 40 50 60
time (sec)
9 (6) Blue leads
velocity (mm/sec)
500
0
-500
0 10 20 30 40 50 60
time (sec)
9 (7) Jointly Improvised
velocity (mm/sec)
500
0
-500
0 10 20 30 40 50 60
time (sec)



9 (8) Blue leads
velocity (mm/sec)
500
0
-500
0
10
20
30
40
50
60
time (sec)
9 (9) Red leads
velocity (mm/sec)
200
0
-200
0
10
20
30
40
50
60
time (sec)