

WorldSID-50M

RibEye Crash Test Report

2020 Hyundai Santa Fe MDB Test

January 28, 2021

This document supplements the data presented in the Test Report. In the Test Report, the RibEye channels shown were up-sampled from 10 kHz as recorded by the RibEye system to 20 kHz to match the sampling rate of the rest of the data collected. When error codes appear in the data, the up-sampling caused anomalous overshoot as seen in the plots in Appendix B of the Test Report. This supplementary document includes new plots of the RibEye data sampled at 10 kHz as recorded, in which no overshoot occurs. In addition, a separate time channel for the 10 kHz sampling rate has been added to the EV5 file for RibEye.

Error Code and Maximum Length Change Summary

| Rib | LED | Error Code | Start Time (ms) | End Time (ms) | Maximum Length Change (mm) | Time of Maximum Length Change (ms) | Comments |
|-----------|--------|------------|-----------------|---------------|----------------------------|------------------------------------|----------|
| Shoulder | Rear | None | N/A | N/A | 12.7 | 39.9 | |
| | Middle | None | N/A | N/A | 43.0 | 41.2 | |
| | Front | None | N/A | N/A | 52.0 | 45.9 | |
| Thorax 1 | Rear | None | N/A | N/A | 19.8 | 39.2 | |
| | Middle | None | N/A | N/A | 34.4 | 39.2 | |
| | Front | None | N/A | N/A | 30.9 | 39.4 | |
| Thorax 2 | Rear | None | N/A | N/A | 16.3 | 45.0 | |
| | Middle | None | N/A | N/A | 20.7 | 44.6 | |
| | Front | None | N/A | N/A | 16.6 | 44.7 | |
| Thorax 3 | Rear | None | N/A | N/A | 14.8 | 41.2 | |
| | Middle | None | N/A | N/A | 20.6 | 41.3 | |
| | Front | None | N/A | N/A | 13.2 | 44.1 | |
| Abdomen 1 | Rear | None | N/A | N/A | 21.4 | 39.9 | |
| | Middle | None | N/A | N/A | 29.9 | 39.3 | |
| | Front | None | N/A | N/A | 19.5 | 39.4 | |
| Abdomen 2 | Rear | None | N/A | N/A | 19.2 | 40.1 | |
| | Middle | None | N/A | N/A | 25.4 | 39.0 | |
| | Front | None | N/A | N/A | 17.1 | 40.1 | |

Maximum Shoulder Length Change

Maximum Thorax Length Change

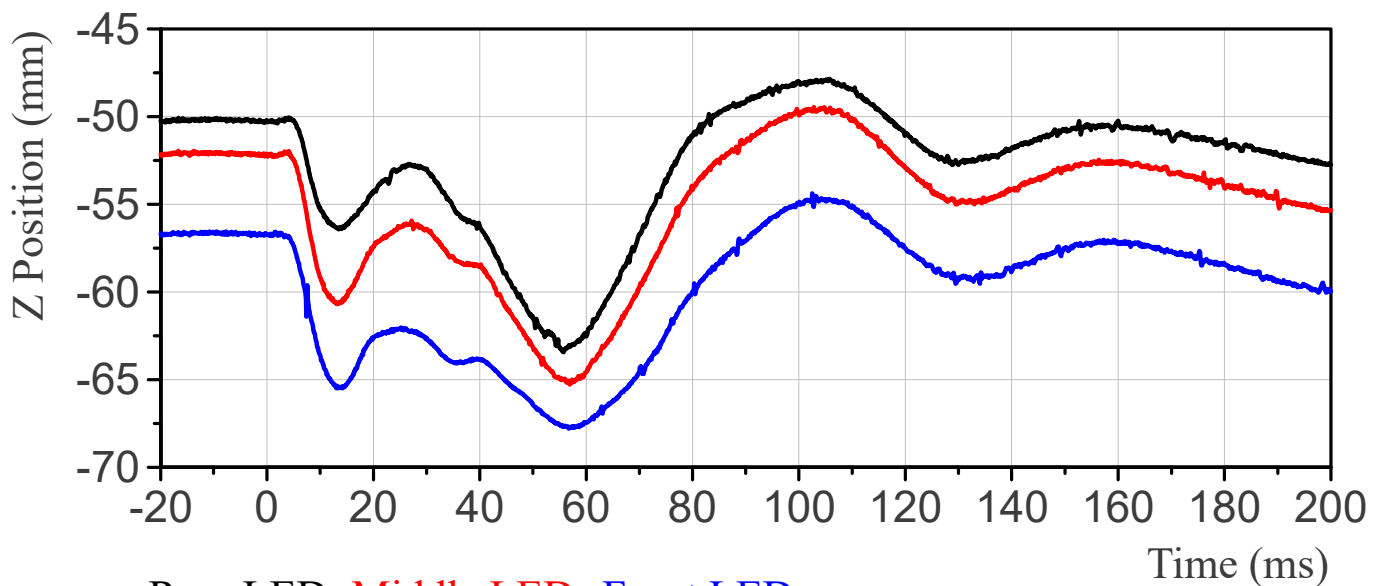
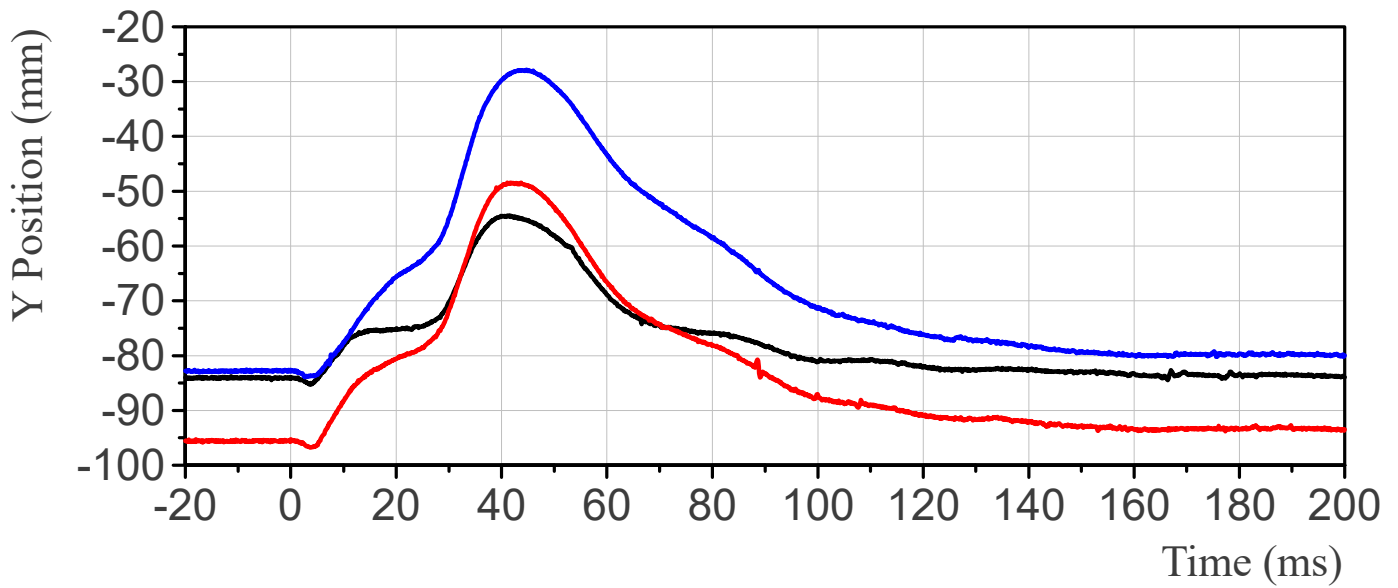
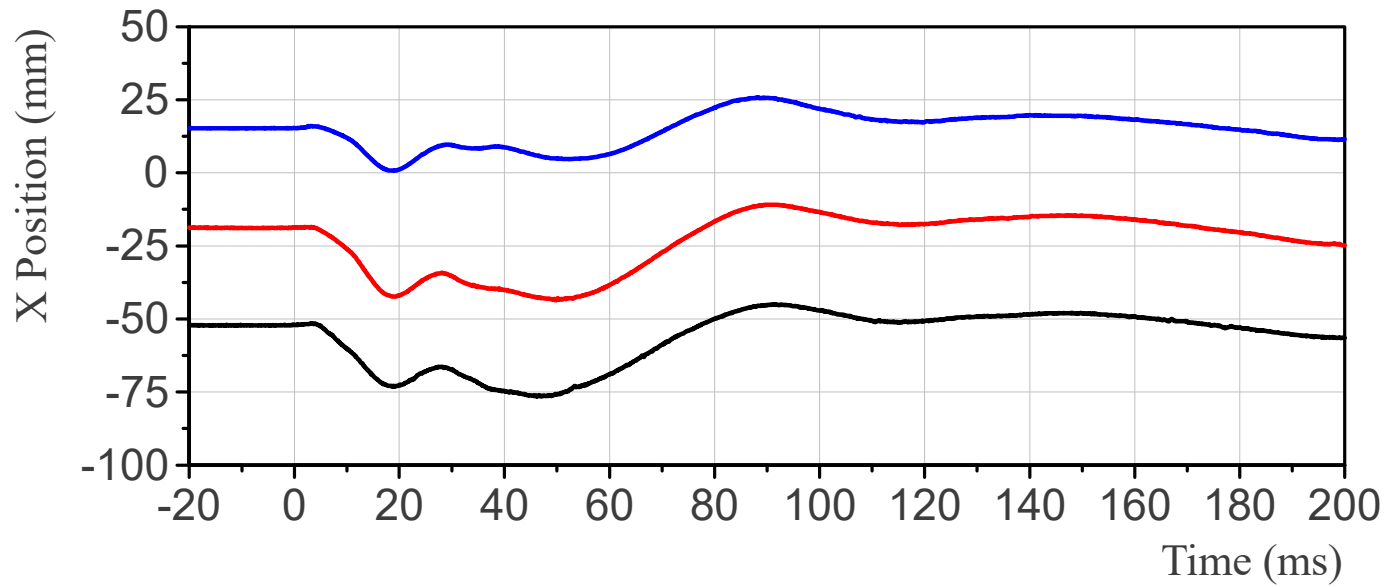
Maximum Abdomen Length Change

| Error Code | Error Code Description |
|------------|------------------------------------|
| 1 | Top Sensor Blocked |
| 2 | Bottom Sensor Blocked |
| 3 | Top and Bottom Sensor Blocked |
| 4 | Middle Sensor Blocked |
| 5 | Middle and Top Sensor Blocked |
| 6 | Middle and Bottom Sensor Blocked |
| 7 | All Tree Sensors Blocked |
| 8 | Divide-By -Zero Condition |
| 9 | LED Moved Out of Calibration Range |

LED Initial Positions

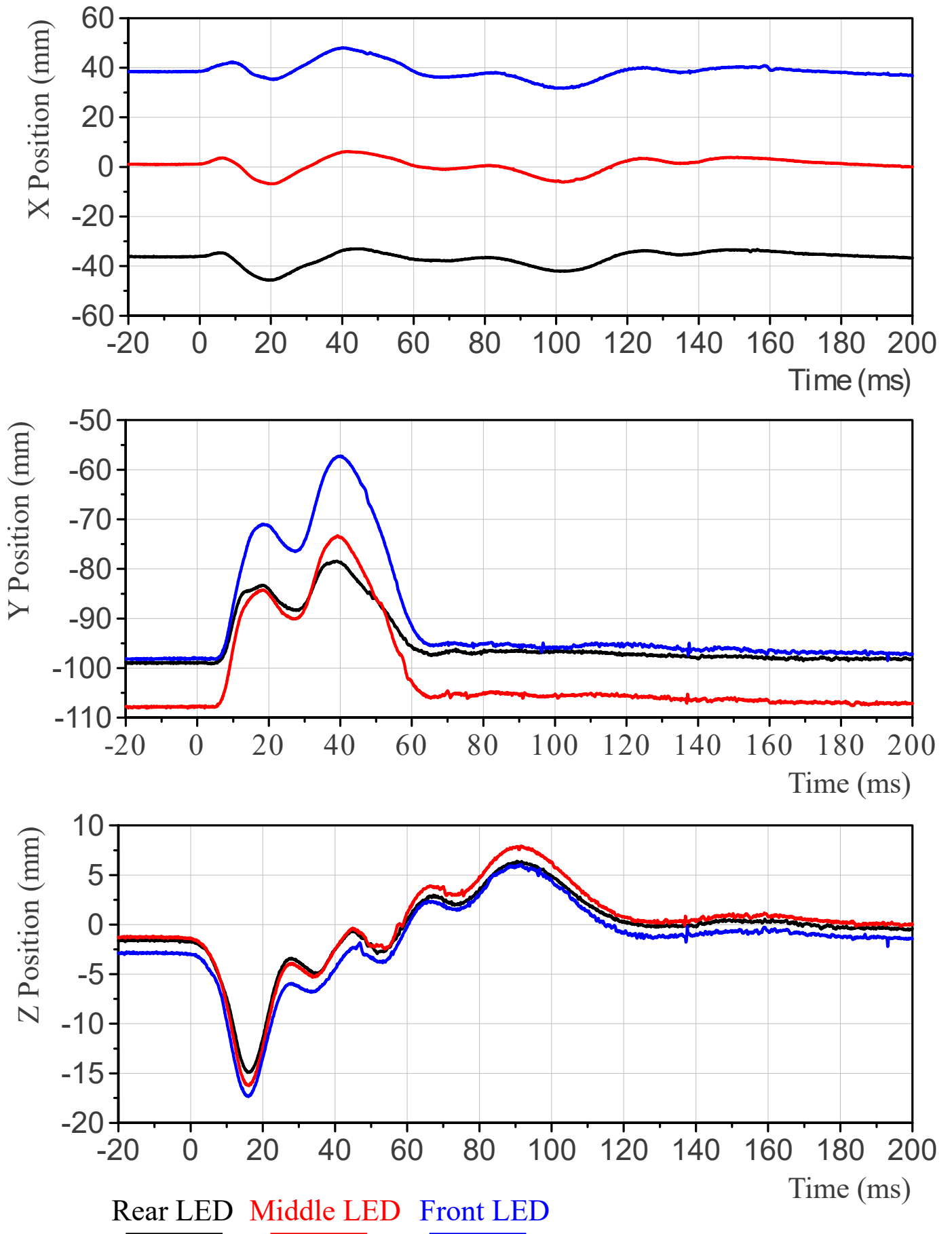
| LED | x-axis | y-axis | z-axis |
|------------------|---------------|---------------|---------------|
| Shoulder Rear | -51.9 | -84.1 | -50.4 |
| Shoulder Middle | -18.6 | -95.7 | -52.4 |
| Shoulder Front | 15.5 | -82.9 | -56.9 |
| Thorax 1 Rear | -36.1 | -99.1 | -1.8 |
| Thorax 1 Middle | 1.2 | -107.9 | -1.5 |
| Thorax 1 Front | 38.6 | -98.2 | -3.1 |
| Thorax 2 Rear | -28.6 | -99 | 41 |
| Thorax 2 Middle | 7.2 | -109.8 | 42 |
| Thorax 2 Front | 43.7 | -102 | 46.5 |
| Thorax 3 Rear | -48.2 | -93.6 | -35.4 |
| Thorax 3 Middle | -17.3 | -101.1 | -33.7 |
| Thorax 3 Front | 13.8 | -92.1 | -35.1 |
| Abdomen 1 Rear | -31.4 | -95.4 | -1.6 |
| Abdomen 1 Middle | 2.5 | -104.2 | -1.1 |
| Abdomen 1 Front | 34.9 | -95.8 | -2.6 |
| Abdomen 2 Rear | -11.5 | -93.1 | 32.2 |
| Abdomen 2 Middle | 20.1 | -103.4 | 30.3 |
| Abdomen 2 Front | 50.7 | -95.3 | 32.3 |

Shoulder Rib Absolute Position, Relative to Thorax Rib 1 Origin

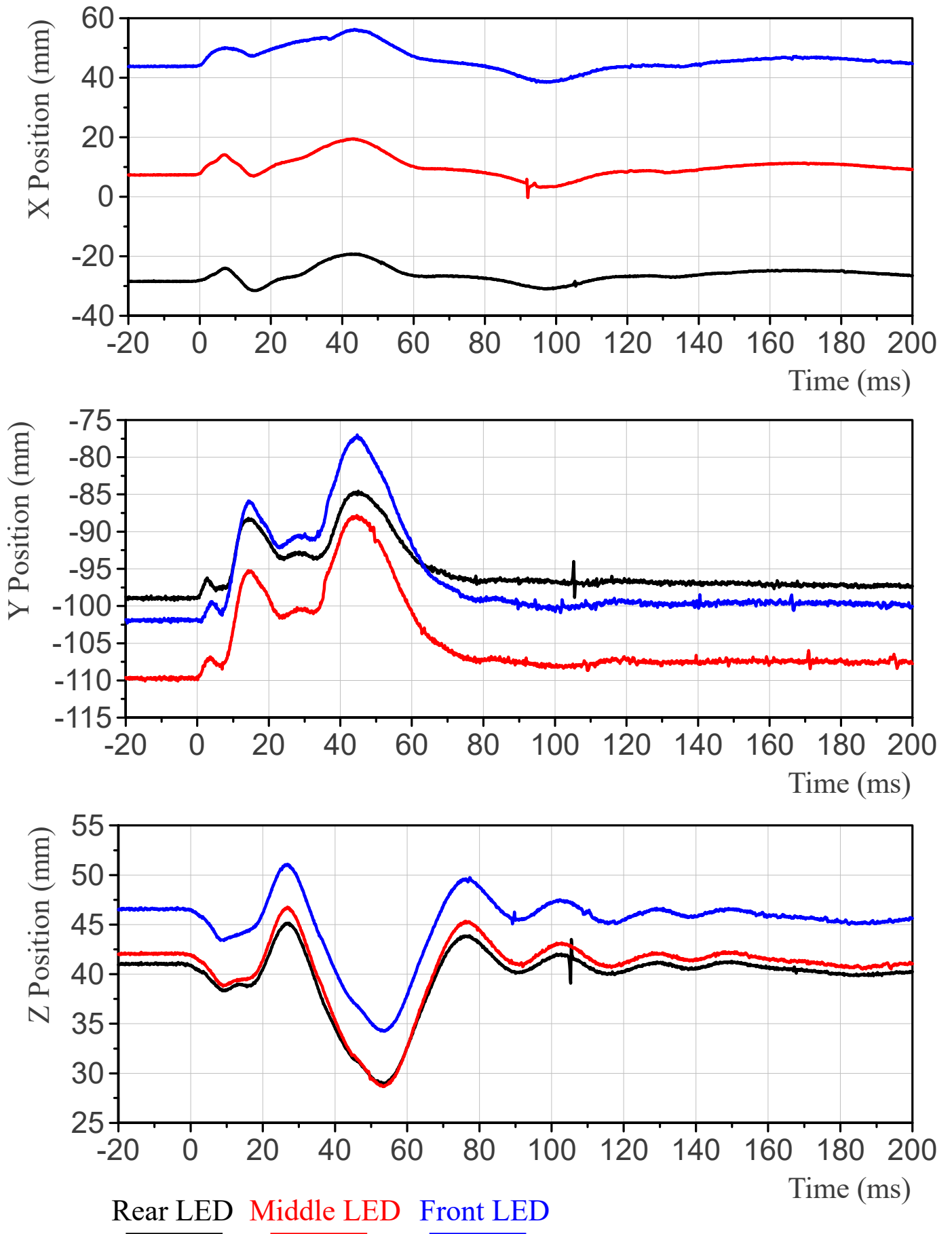


Rear LED Middle LED Front LED

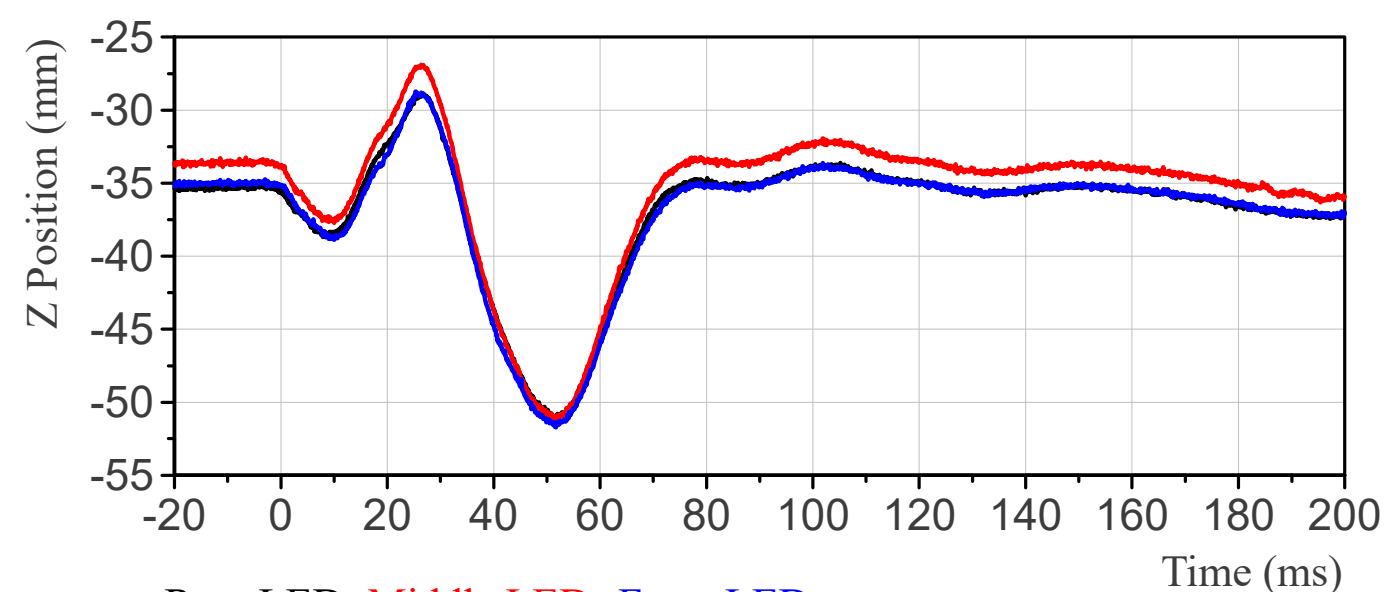
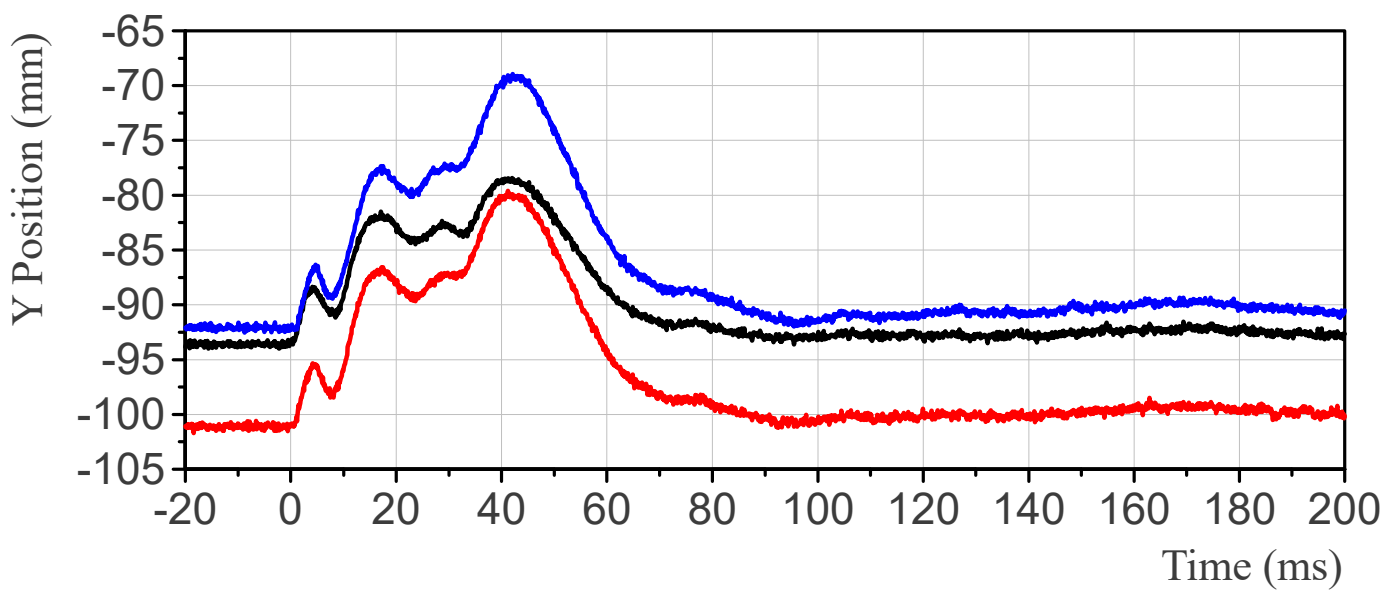
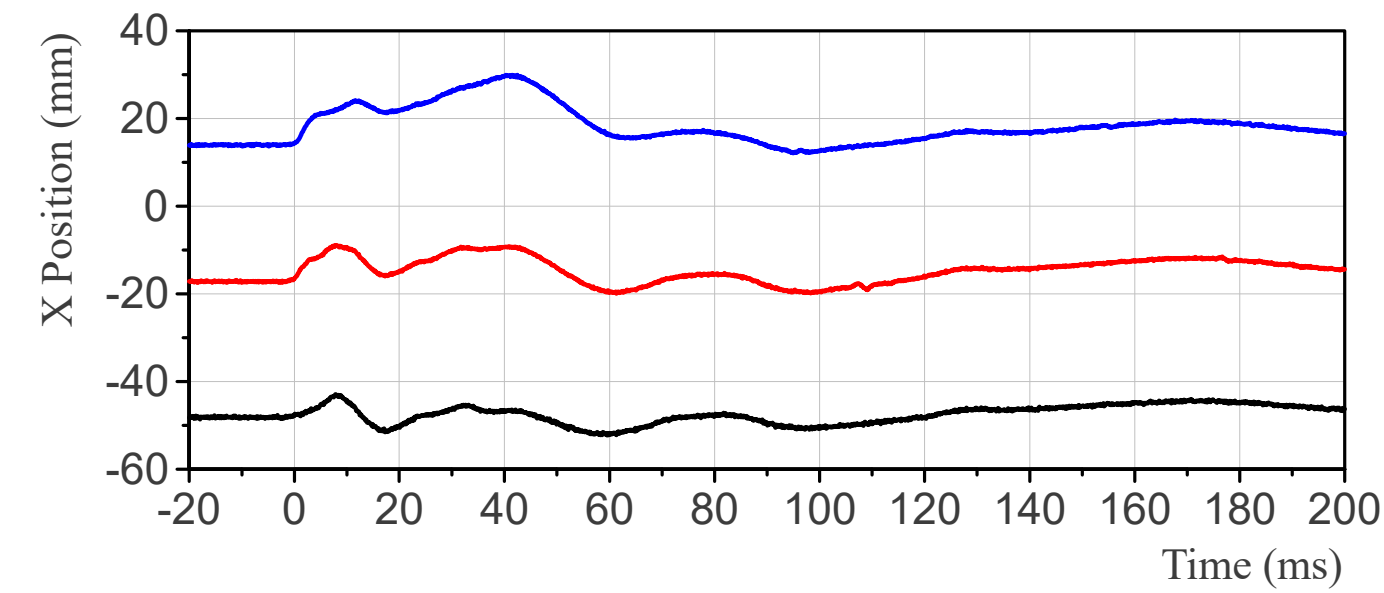
Thorax Rib 1 Absolute Position, Relative to Thorax Rib 1 Origin



Thorax Rib 2 Absolute Position, Relative to Thorax Rib 1 Origin

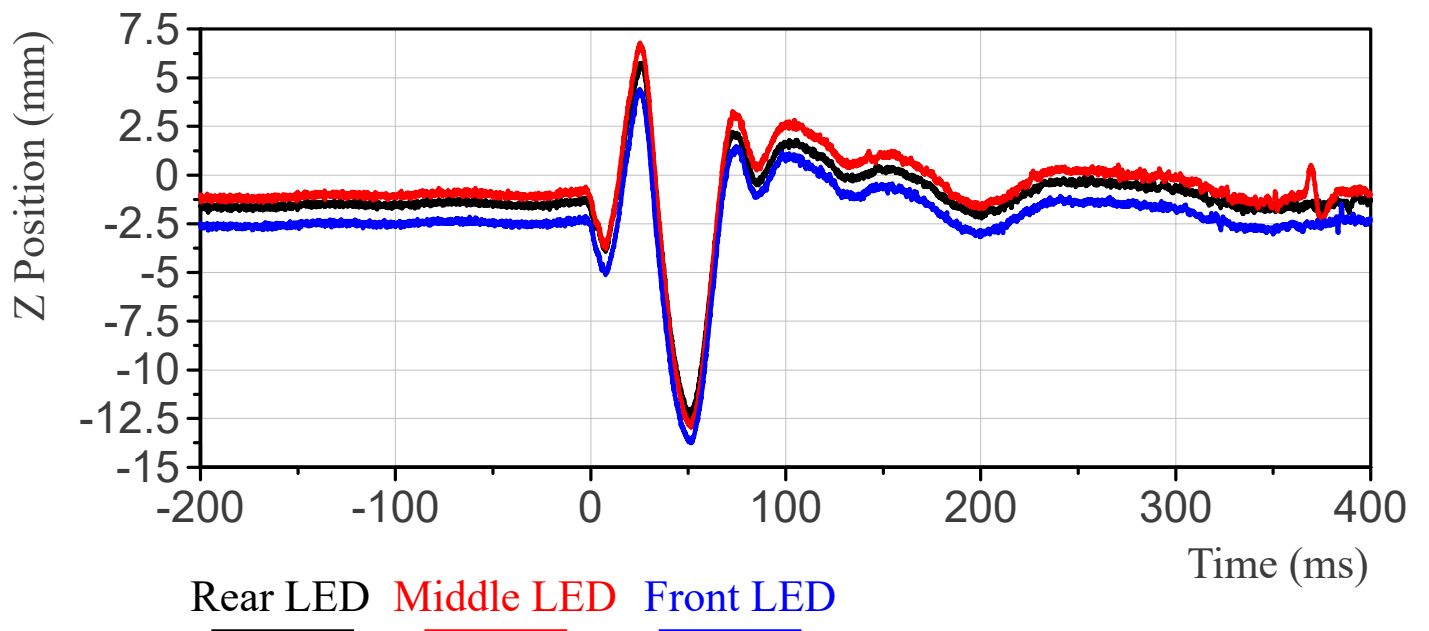
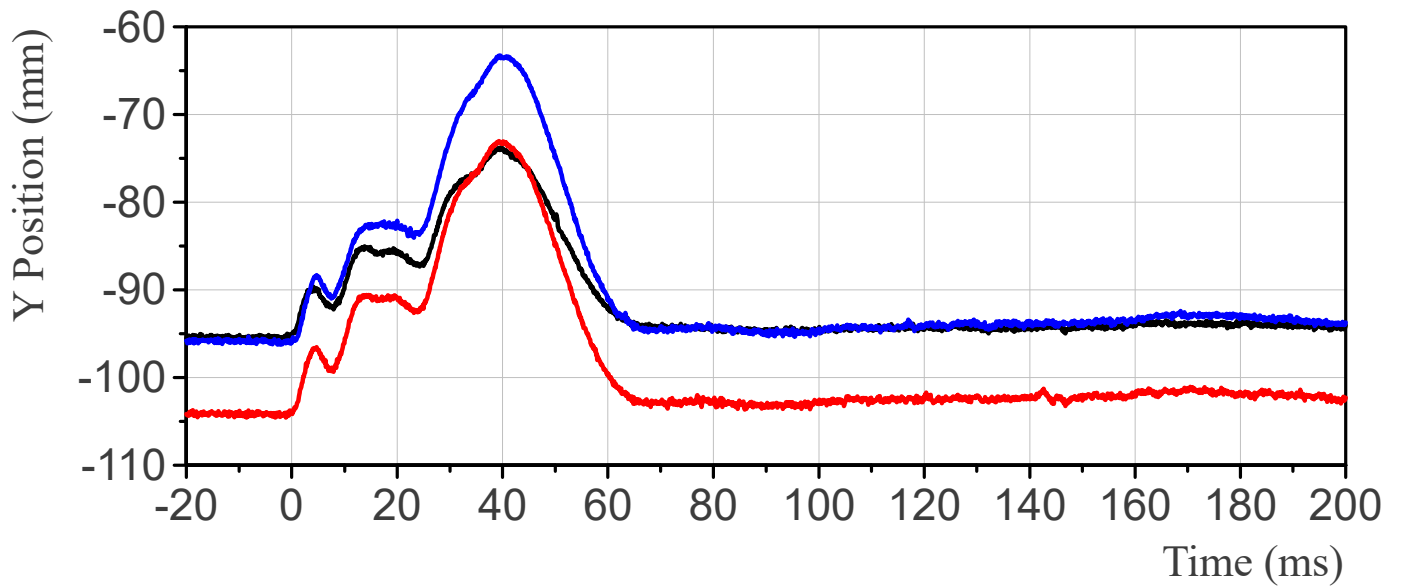
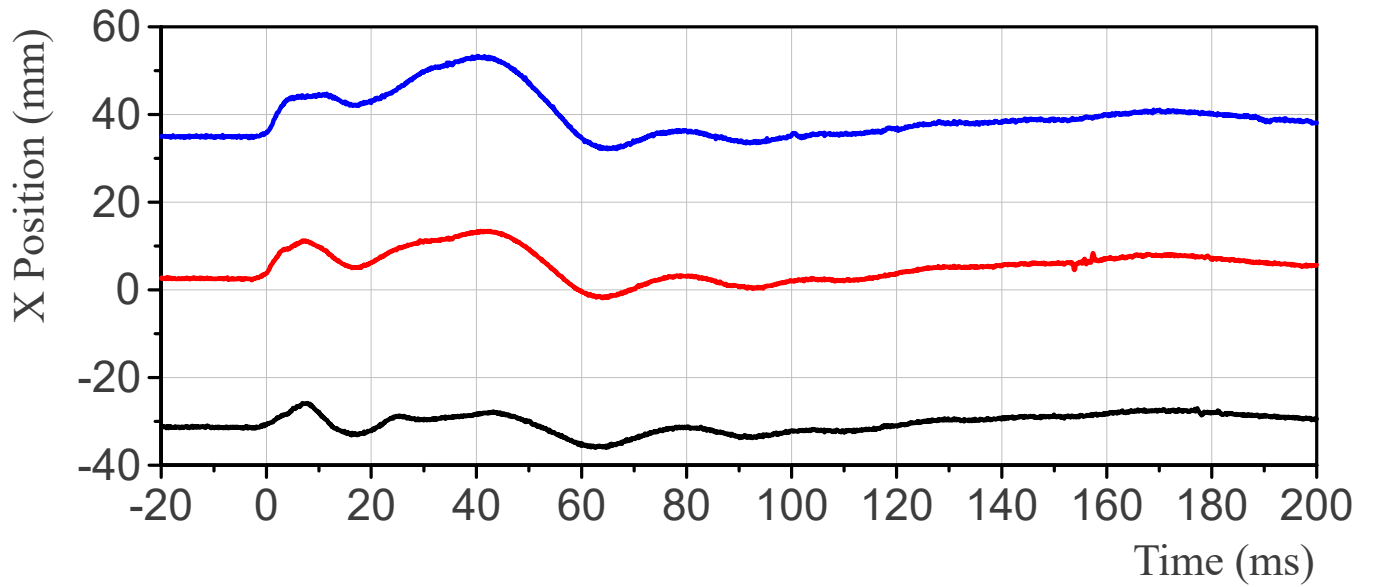


Thorax Rib 3 Absolute Position, Relative to Abdomen Rib 1 Origin



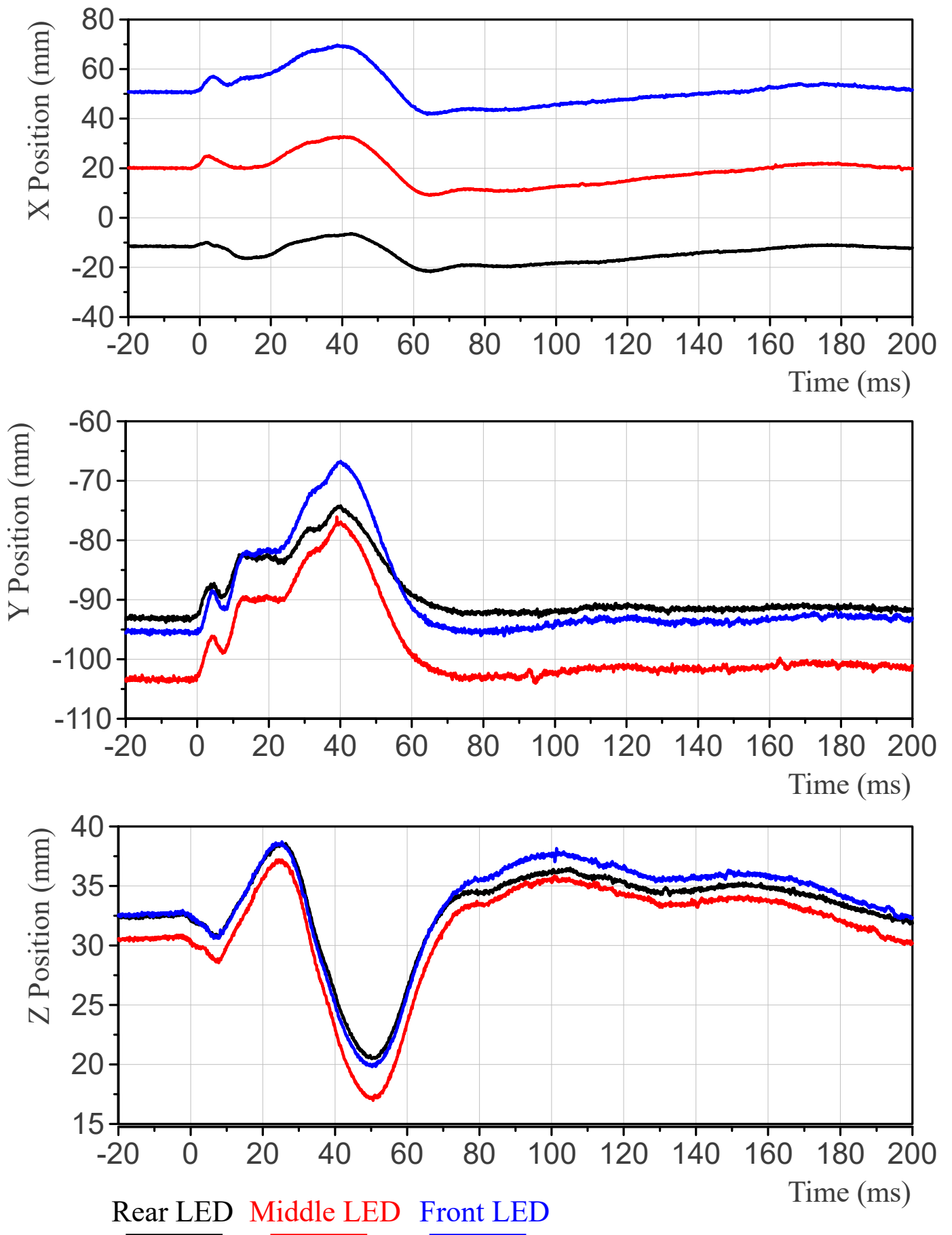
Rear LED Middle LED Front LED

Abdomen Rib 1 Absolute Position, Relative to Abdomen Rib 1 Origin

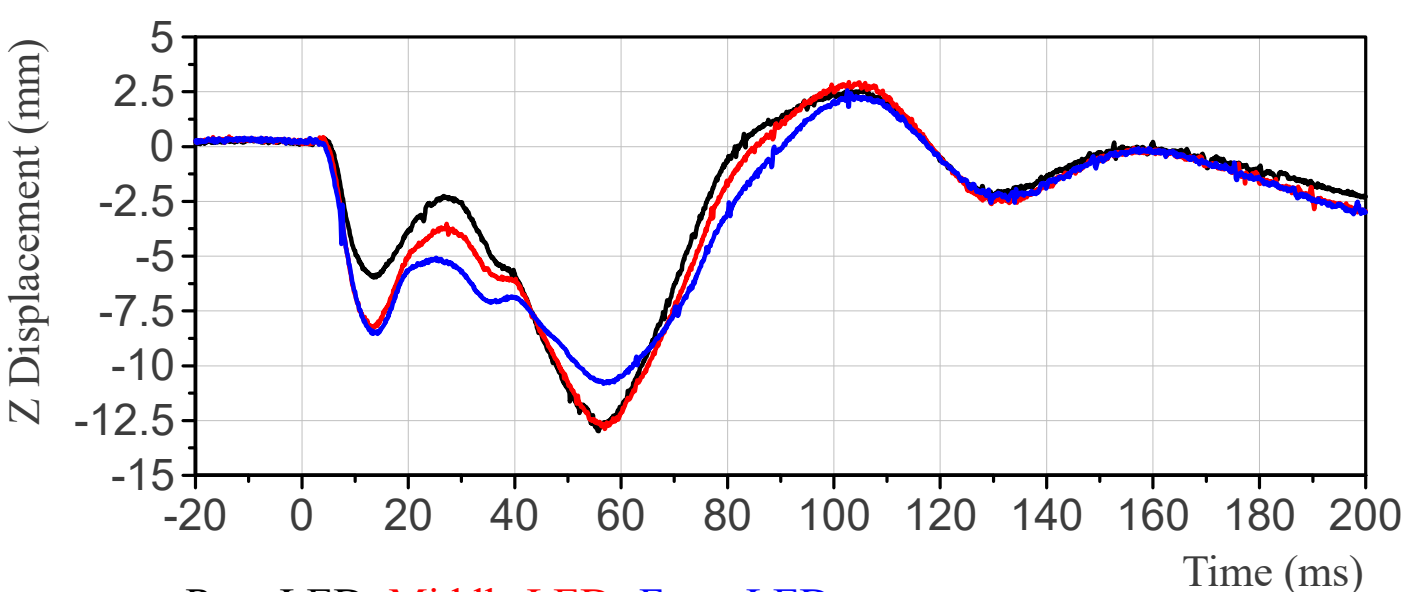
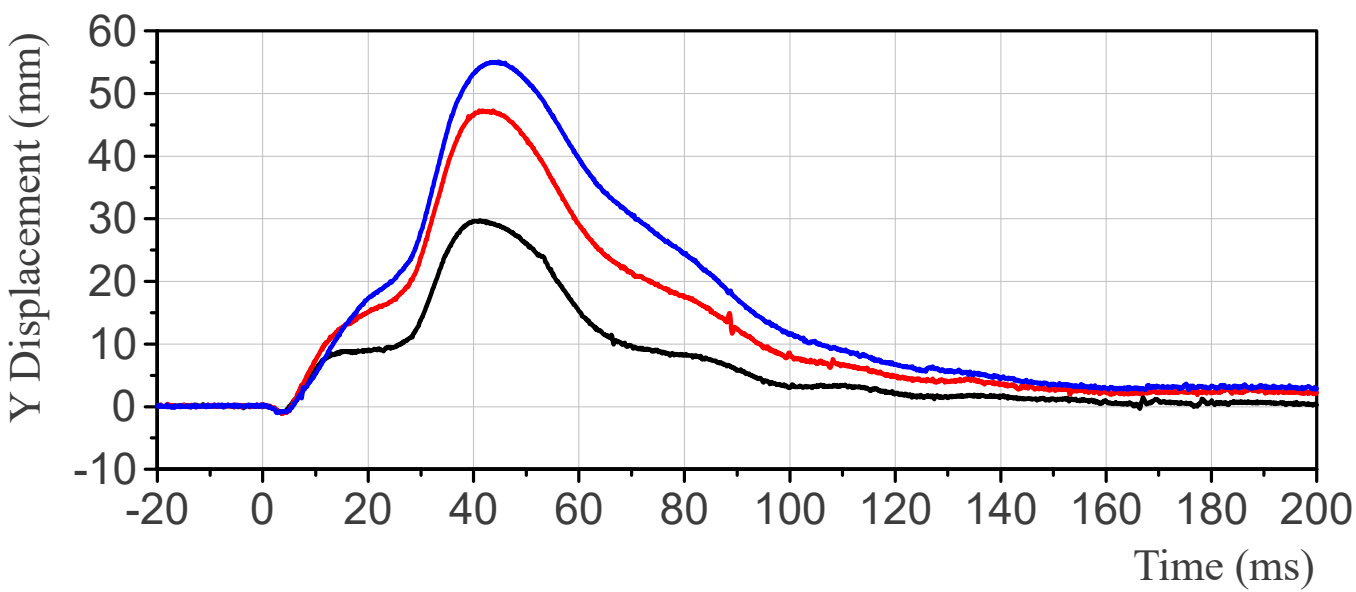
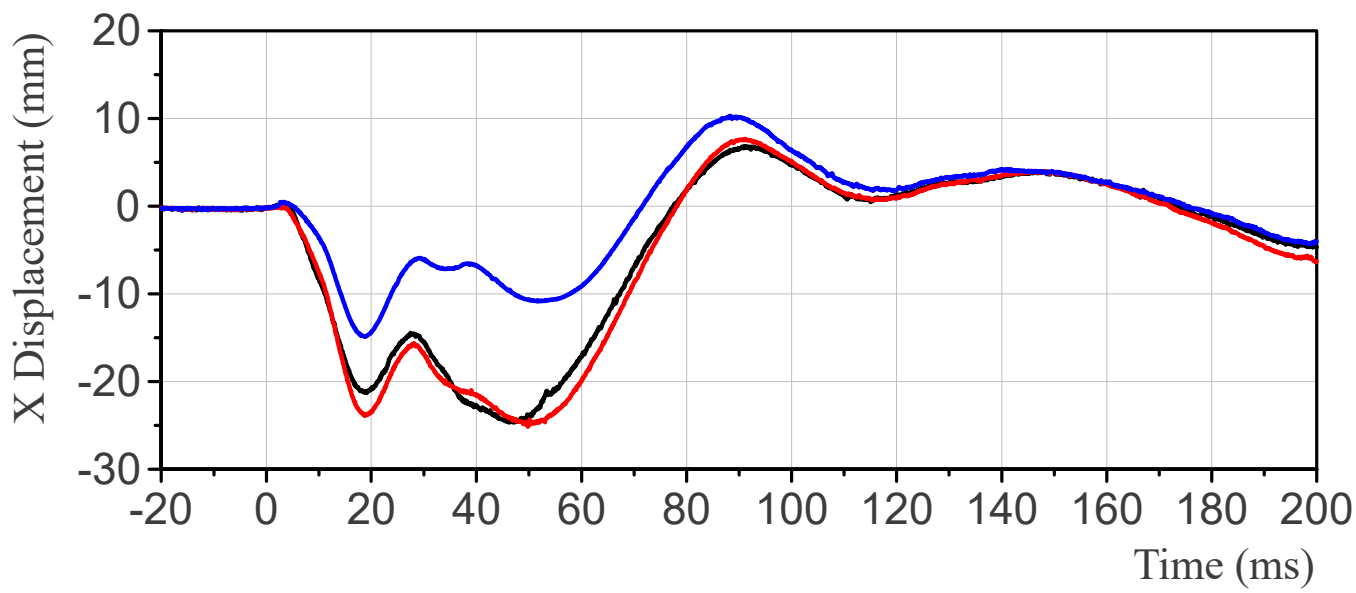


Rear LED Middle LED Front LED

Abdomen Rib 2 Absolute Position, Relative to Abdomen Rib 1 Origin

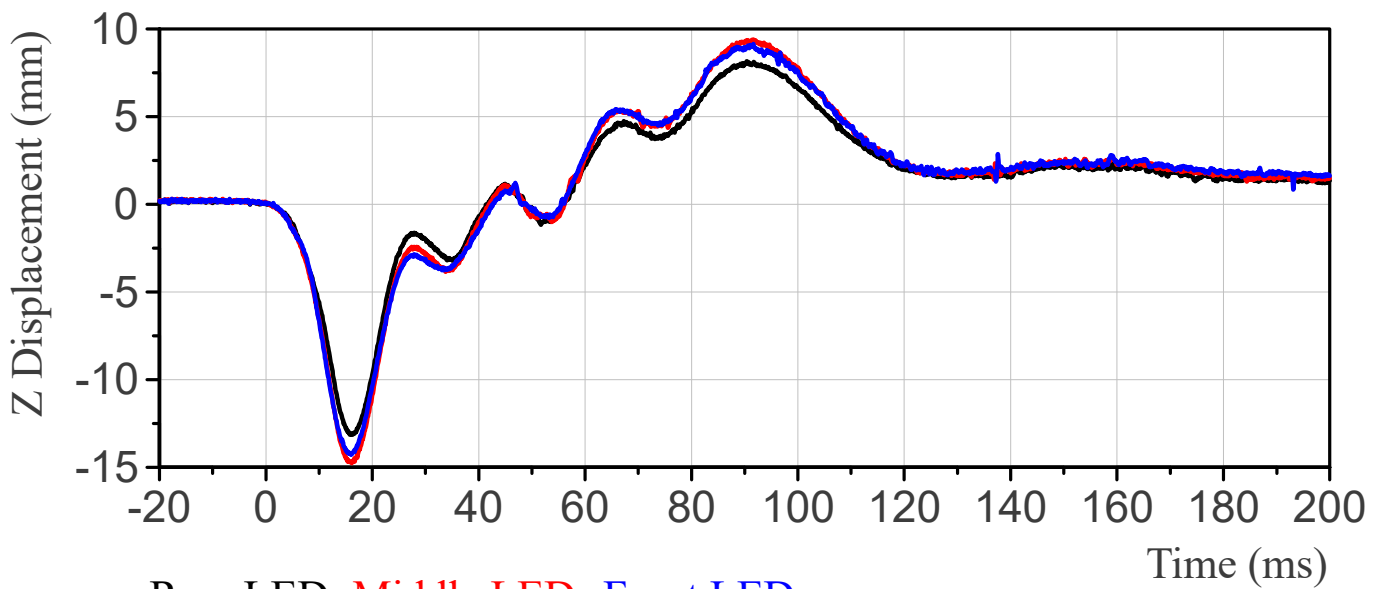
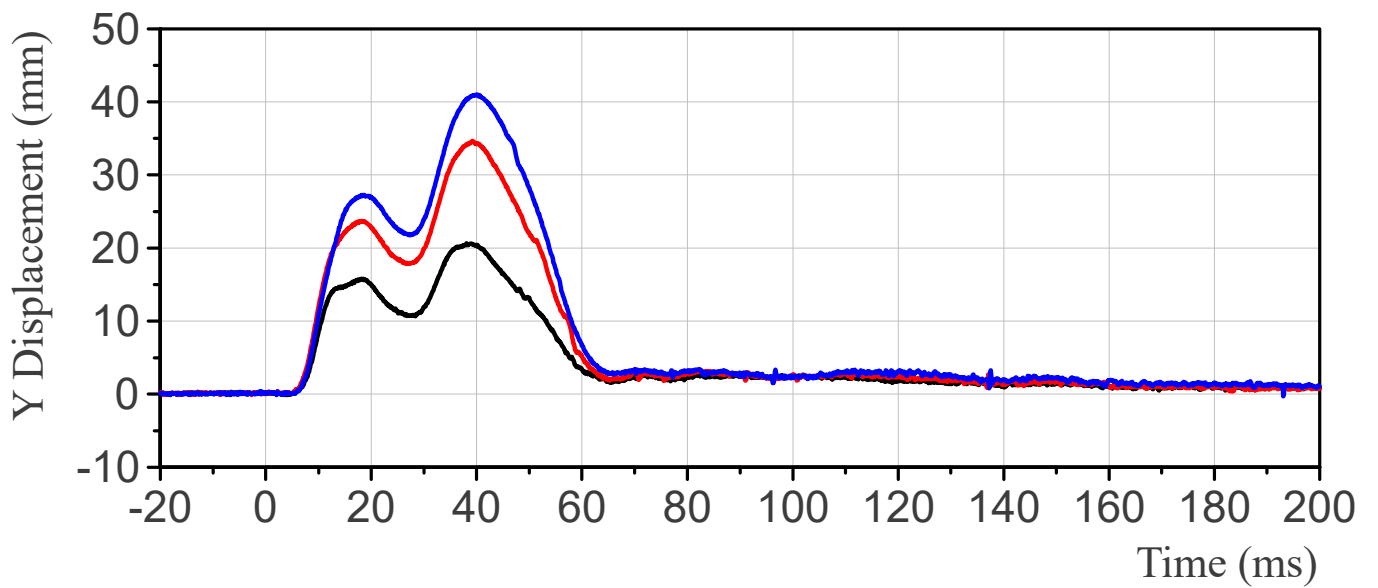
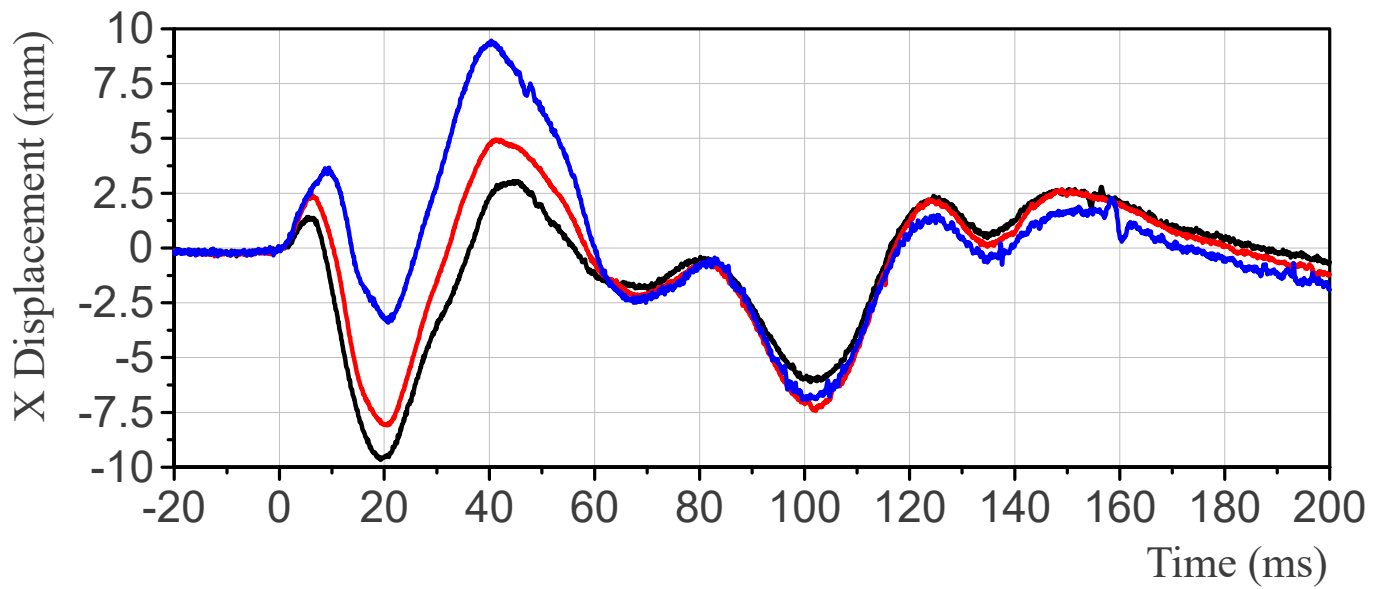


Shoulder Rib Displacement



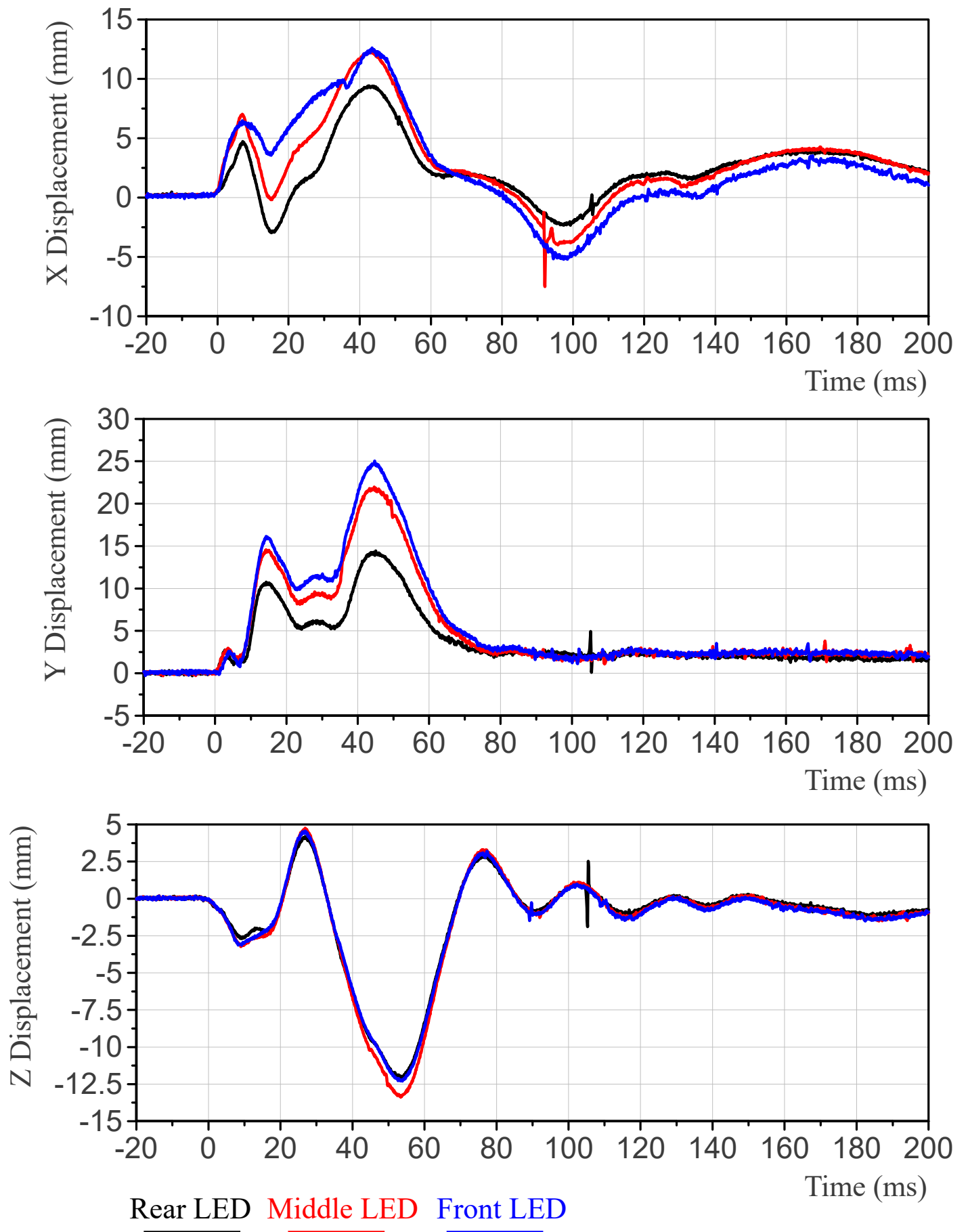
Rear LED Middle LED Front LED

Thorax Rib 1 Displacement

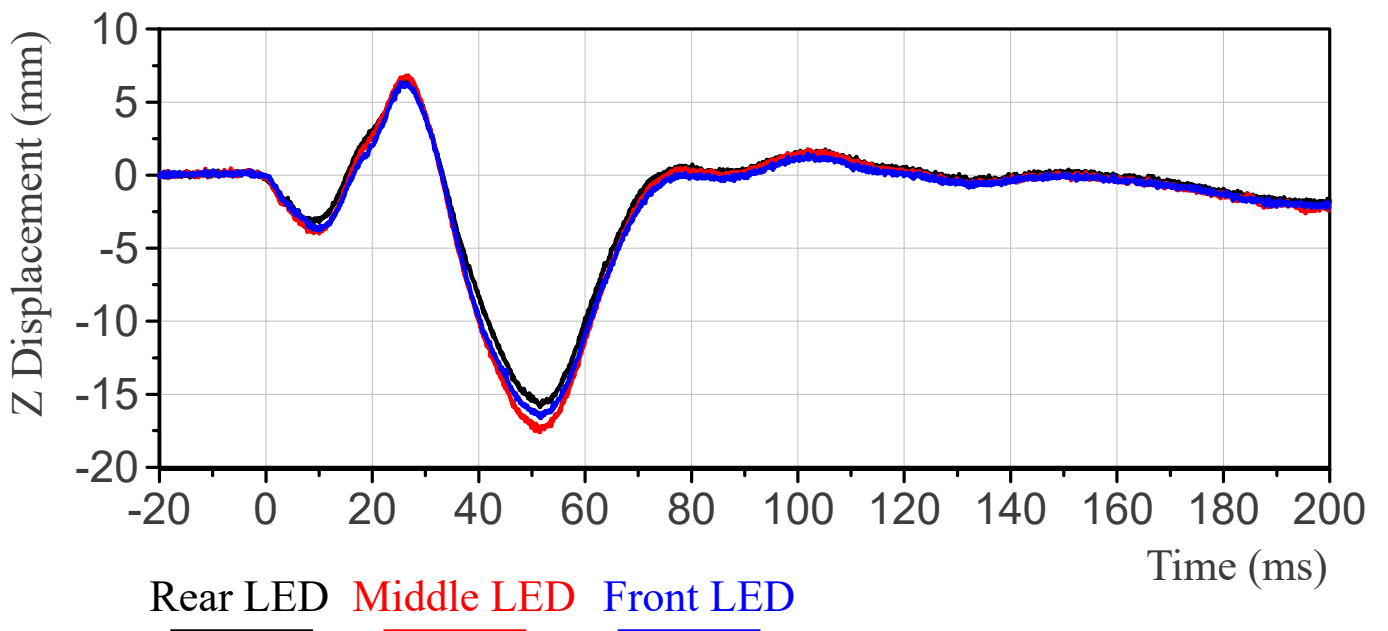
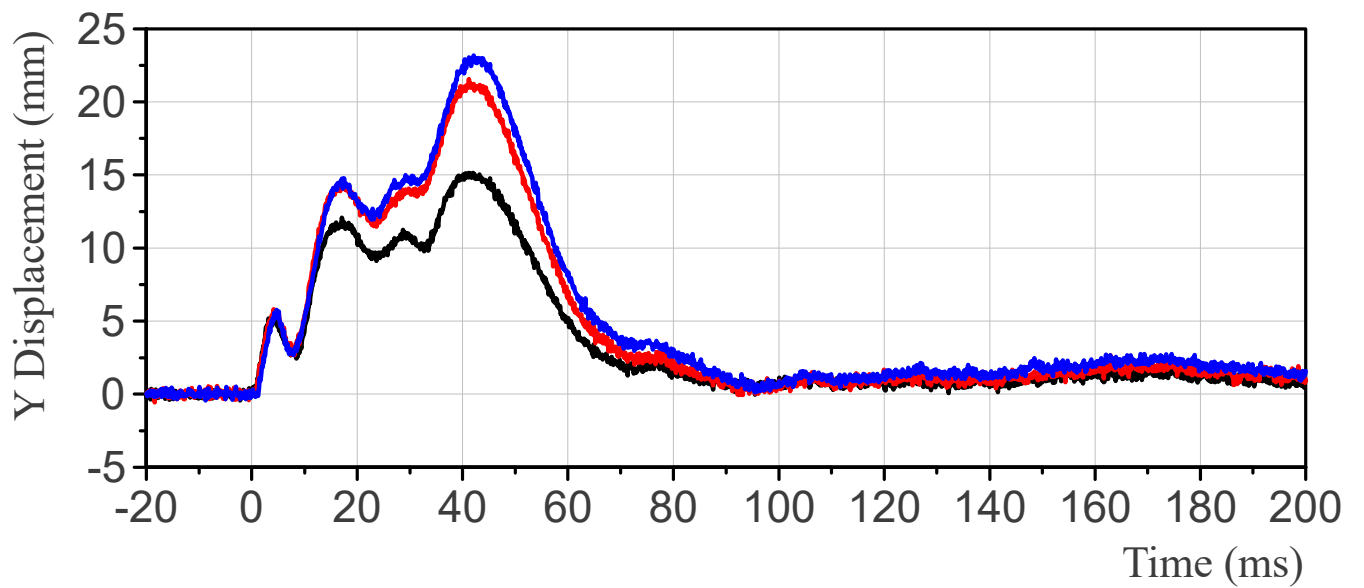
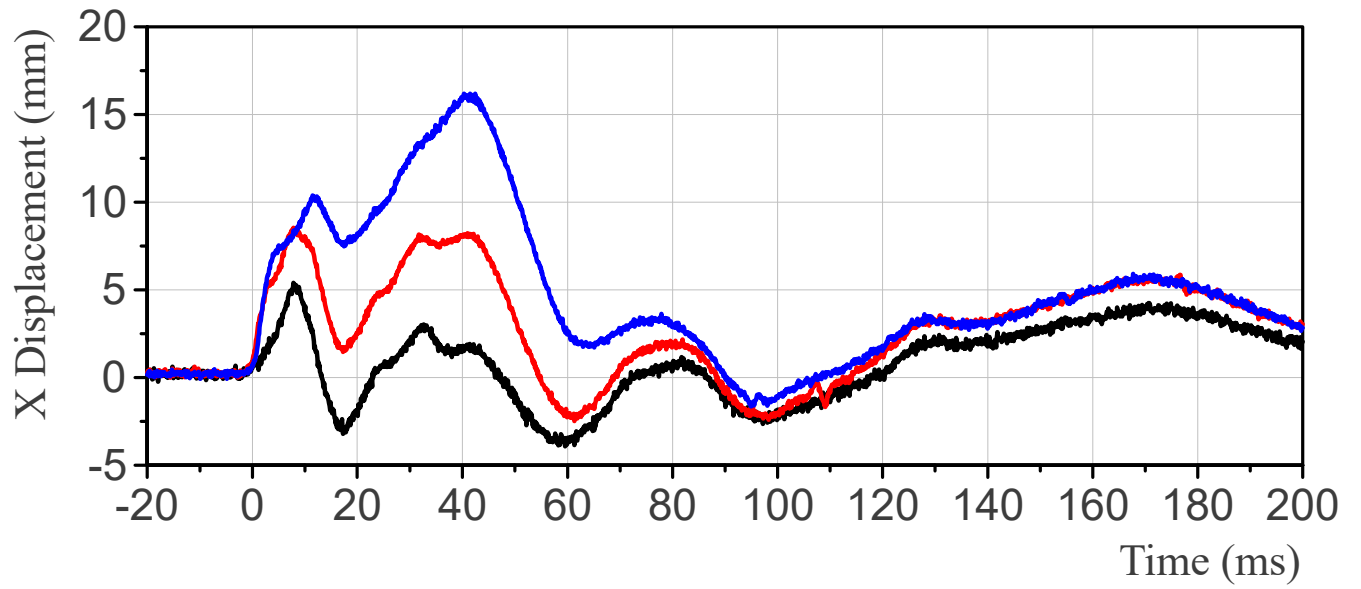


Rear LED Middle LED Front LED

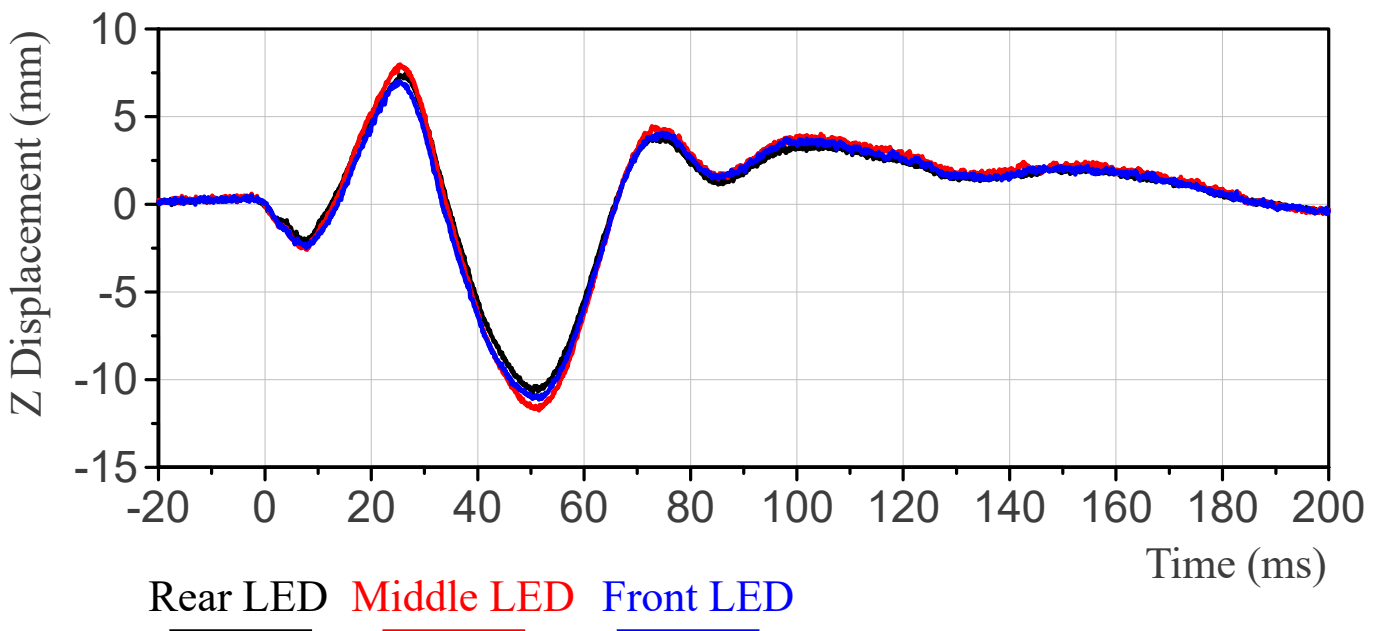
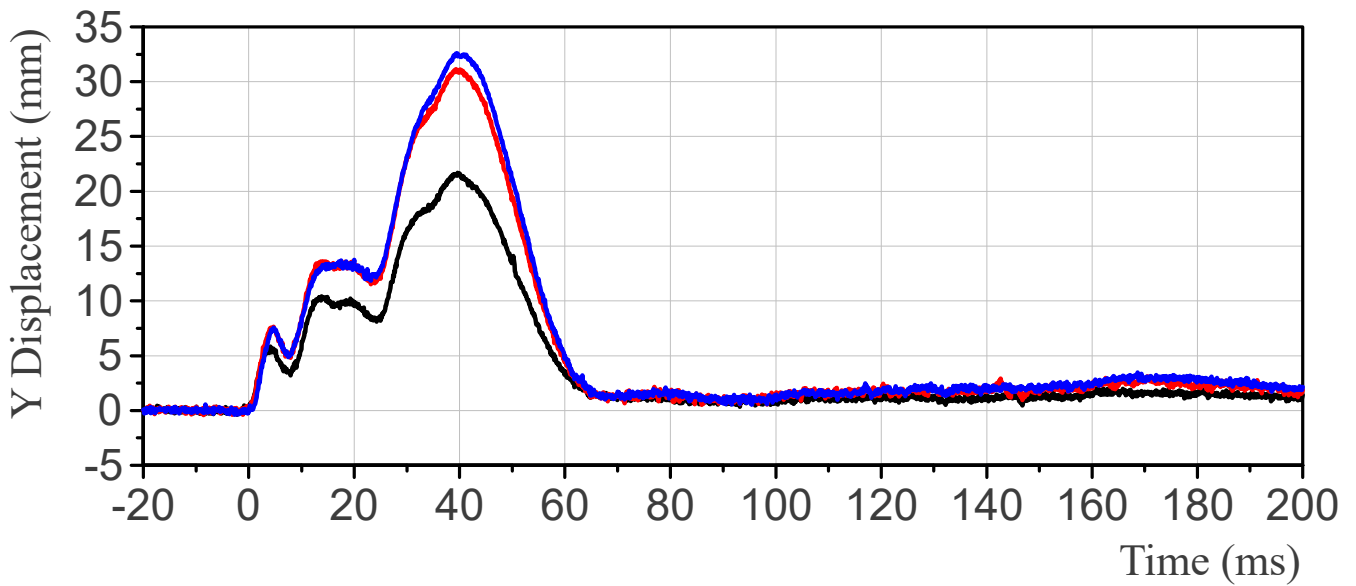
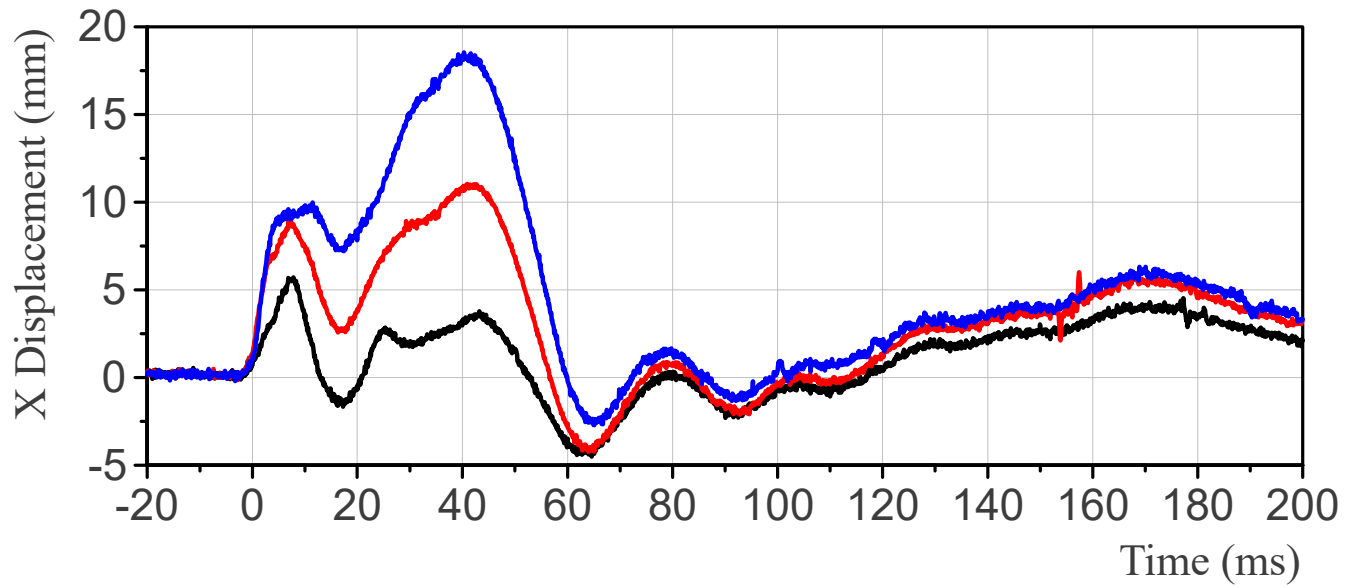
Thorax Rib 2 Displacement



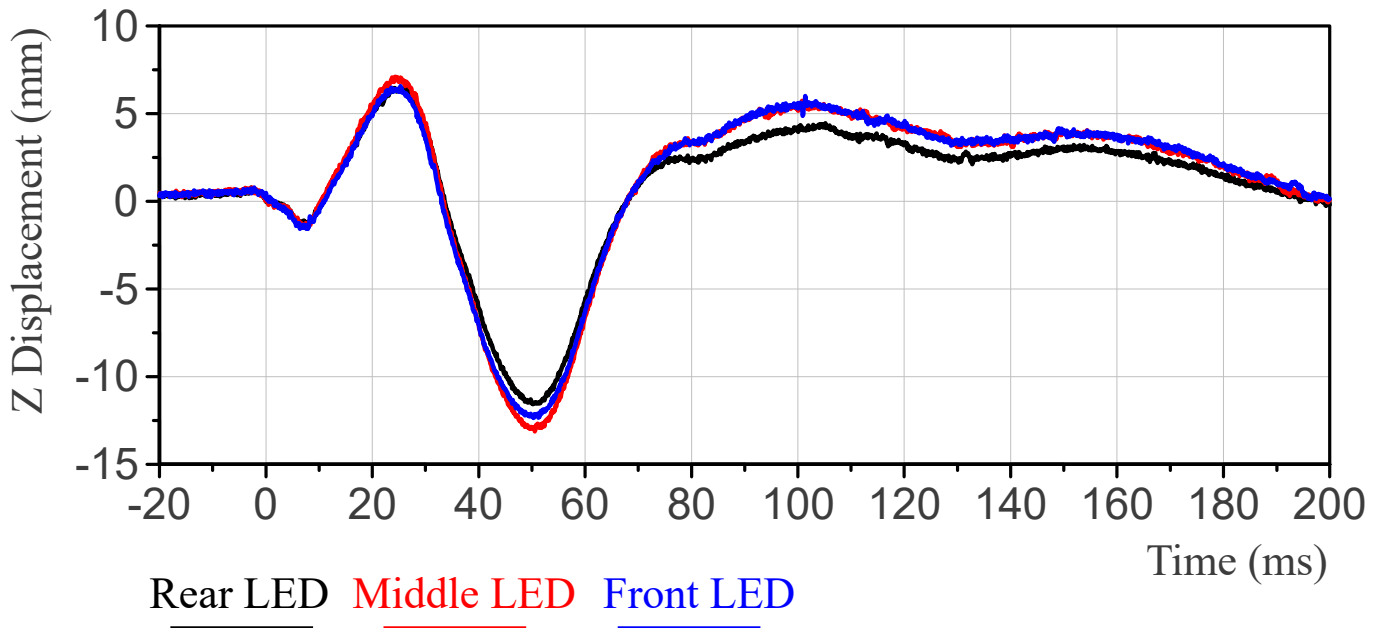
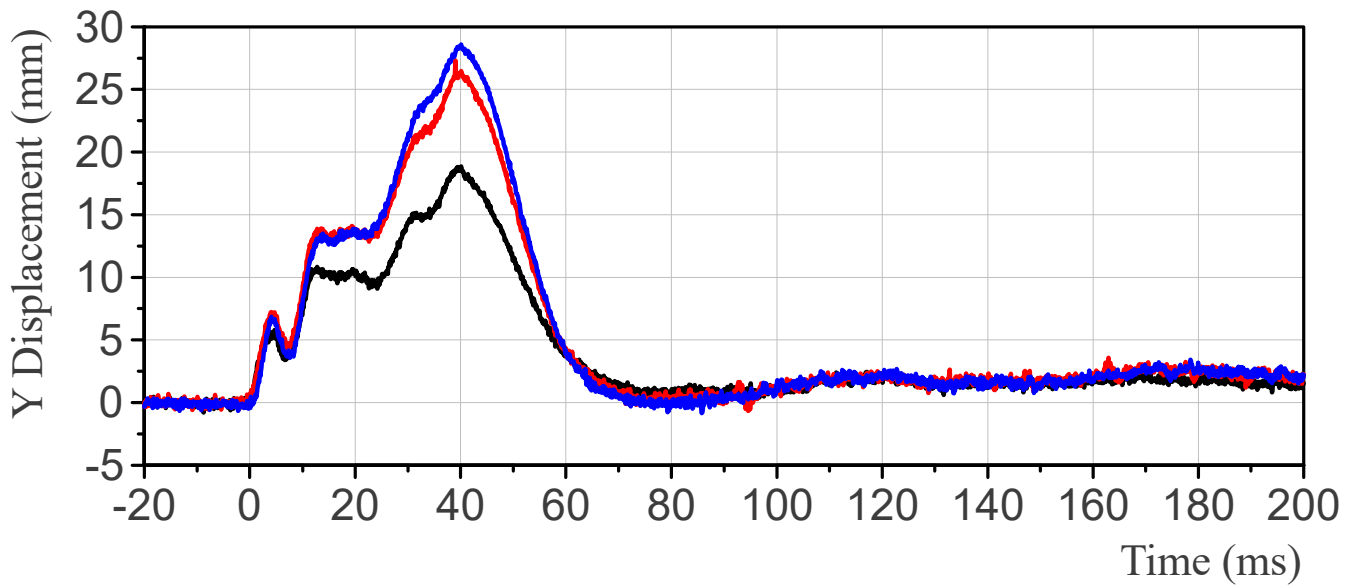
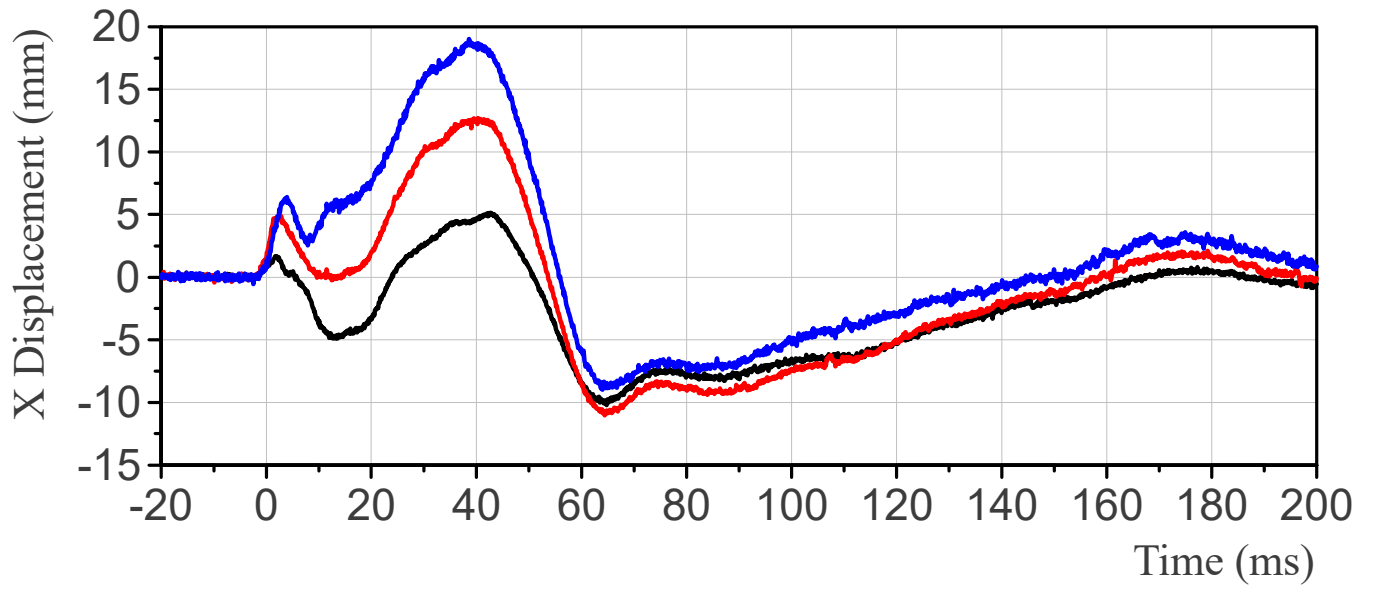
Thorax Rib 3 Displacement



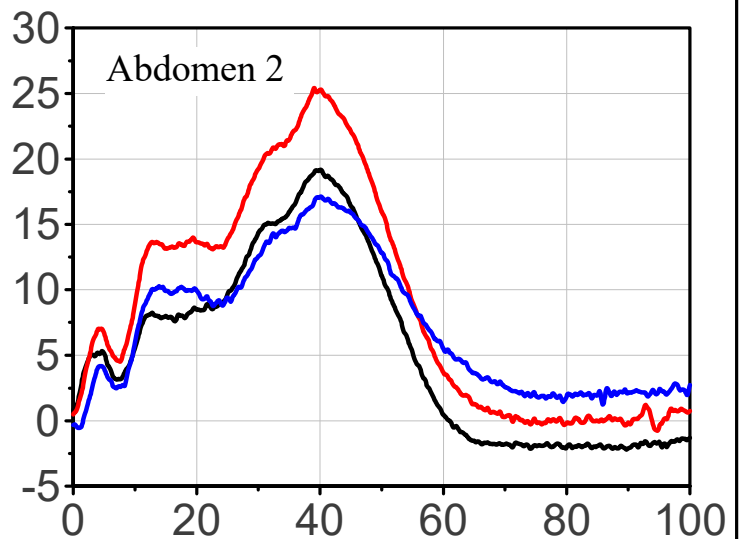
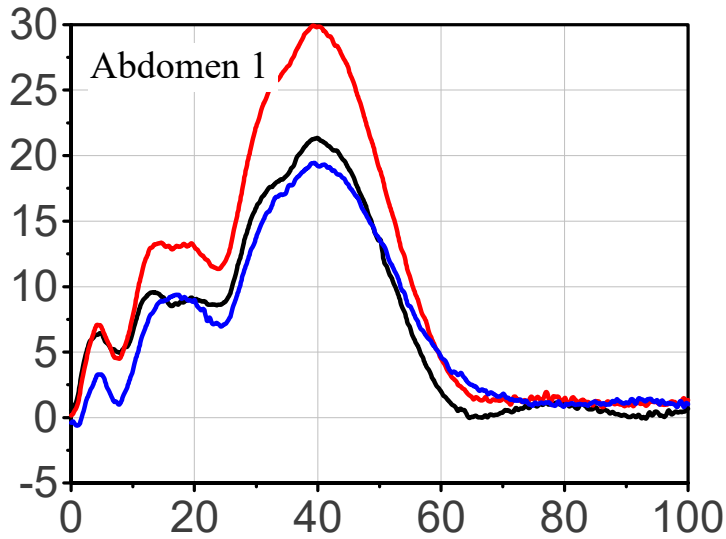
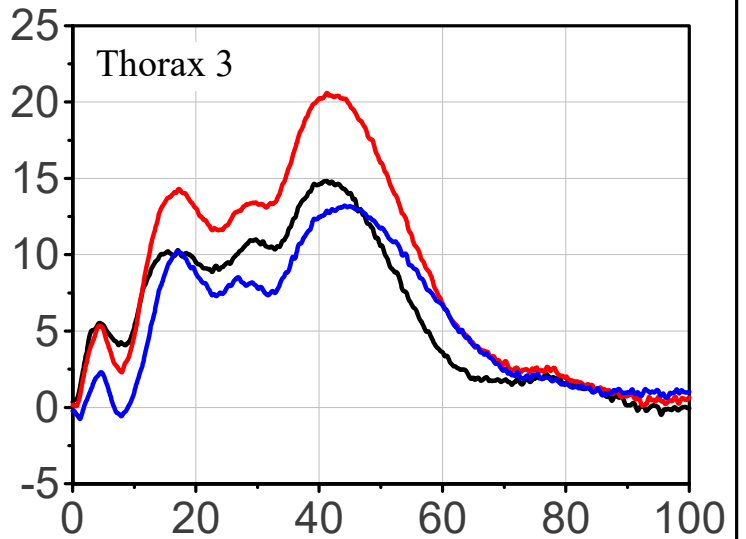
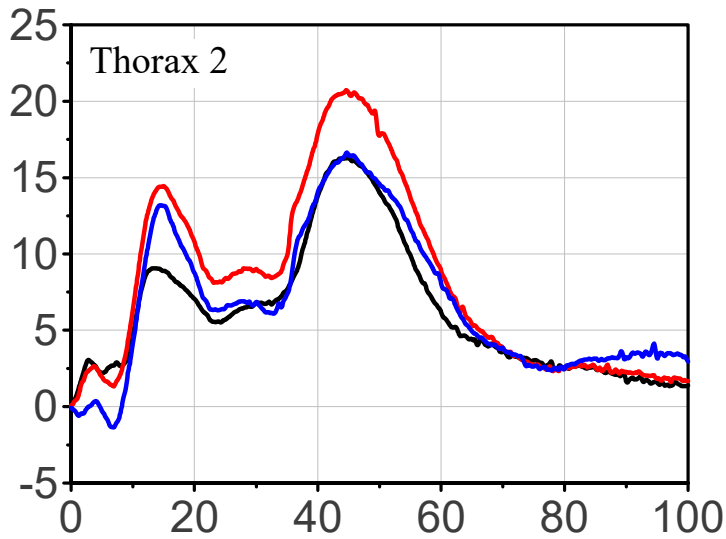
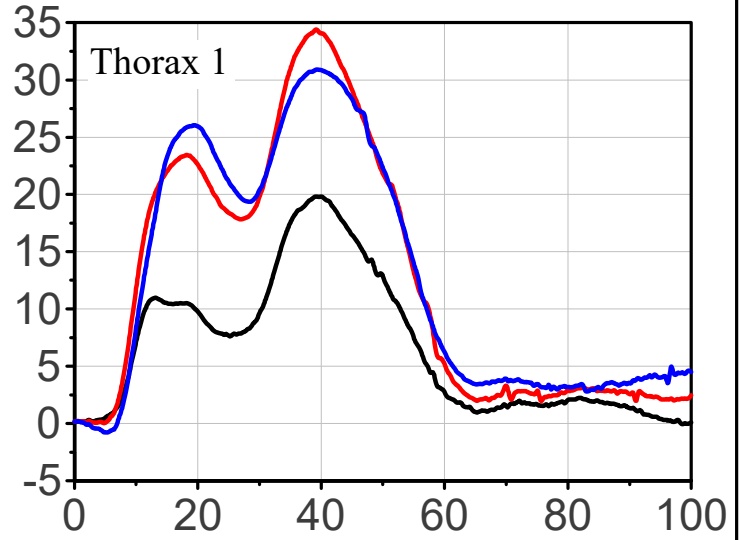
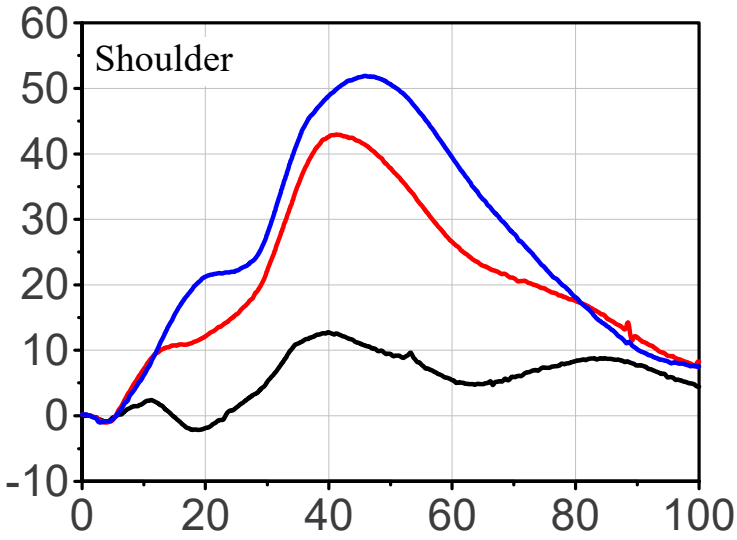
Abdomen Rib 1 Displacement



Abdomen Rib 2 Displacement

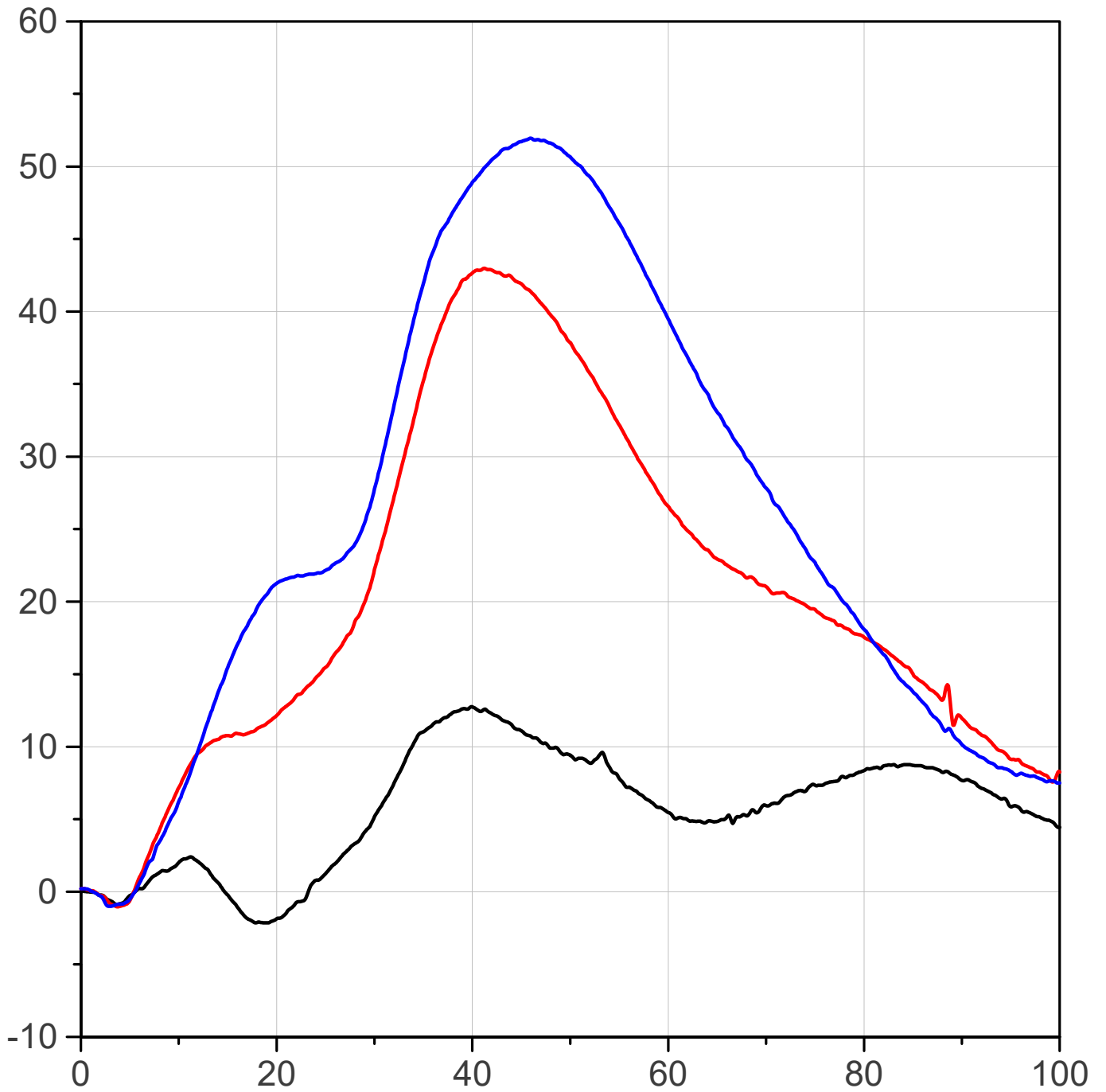


Rib Length Change (mm) vs. Time (ms)



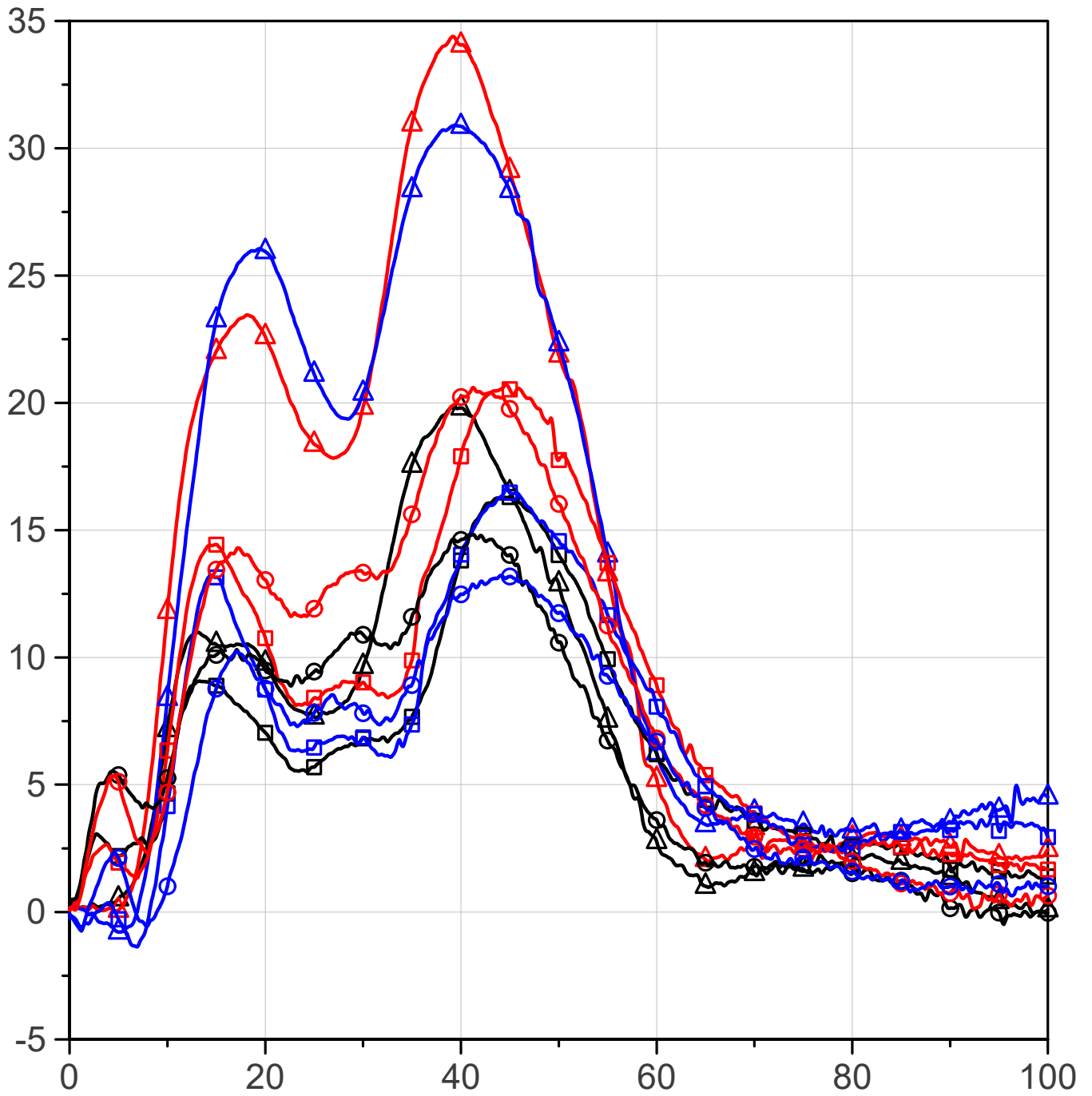
Rear LED Middle LED Front LED

Shoulder Rib Length Change (mm) vs. Time (ms)



 Rear LED Middle LED Front LED

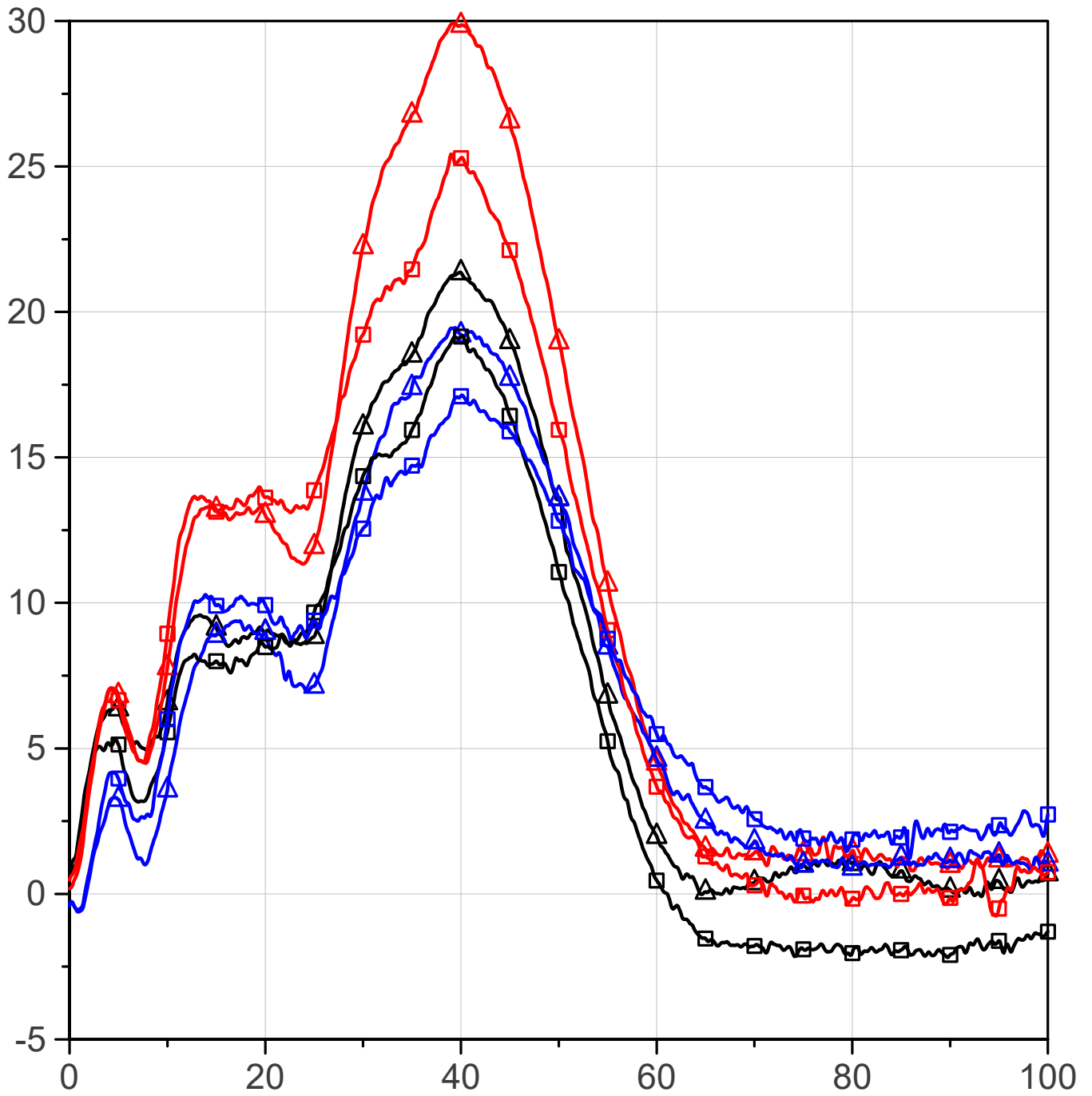
Thorax Rib Length Change (mm) vs. Time (ms)



Rear LED Middle LED Front LED

- △ Thorax Rib 1
- Thorax Rib 2
- Thorax Rib 3

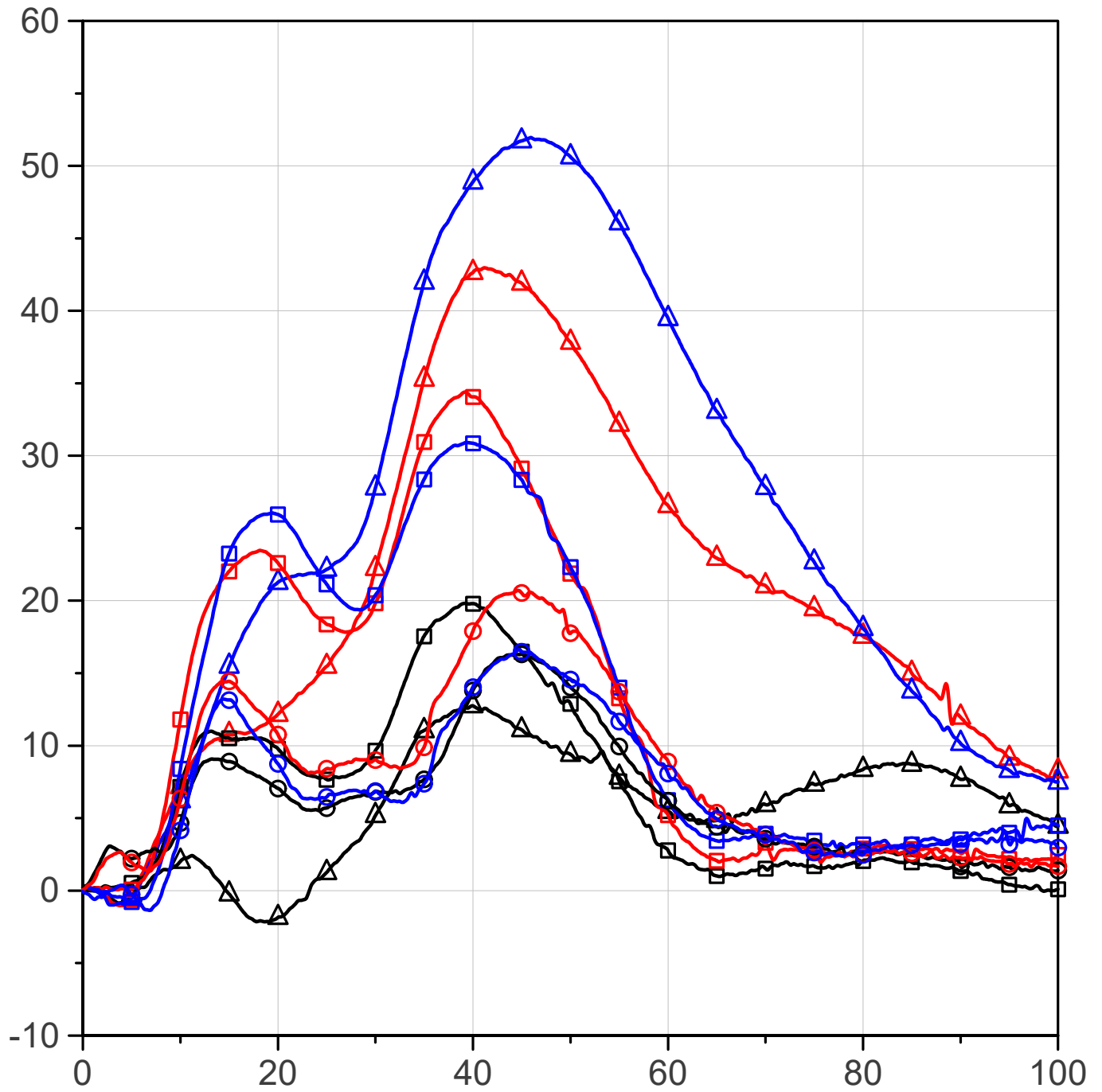
Abdomen Rib Length Change (mm) vs. Time (ms)



Rear LED Middle LED Front LED

△ Abdomen Rib 1
□ Abdomen Rib 2

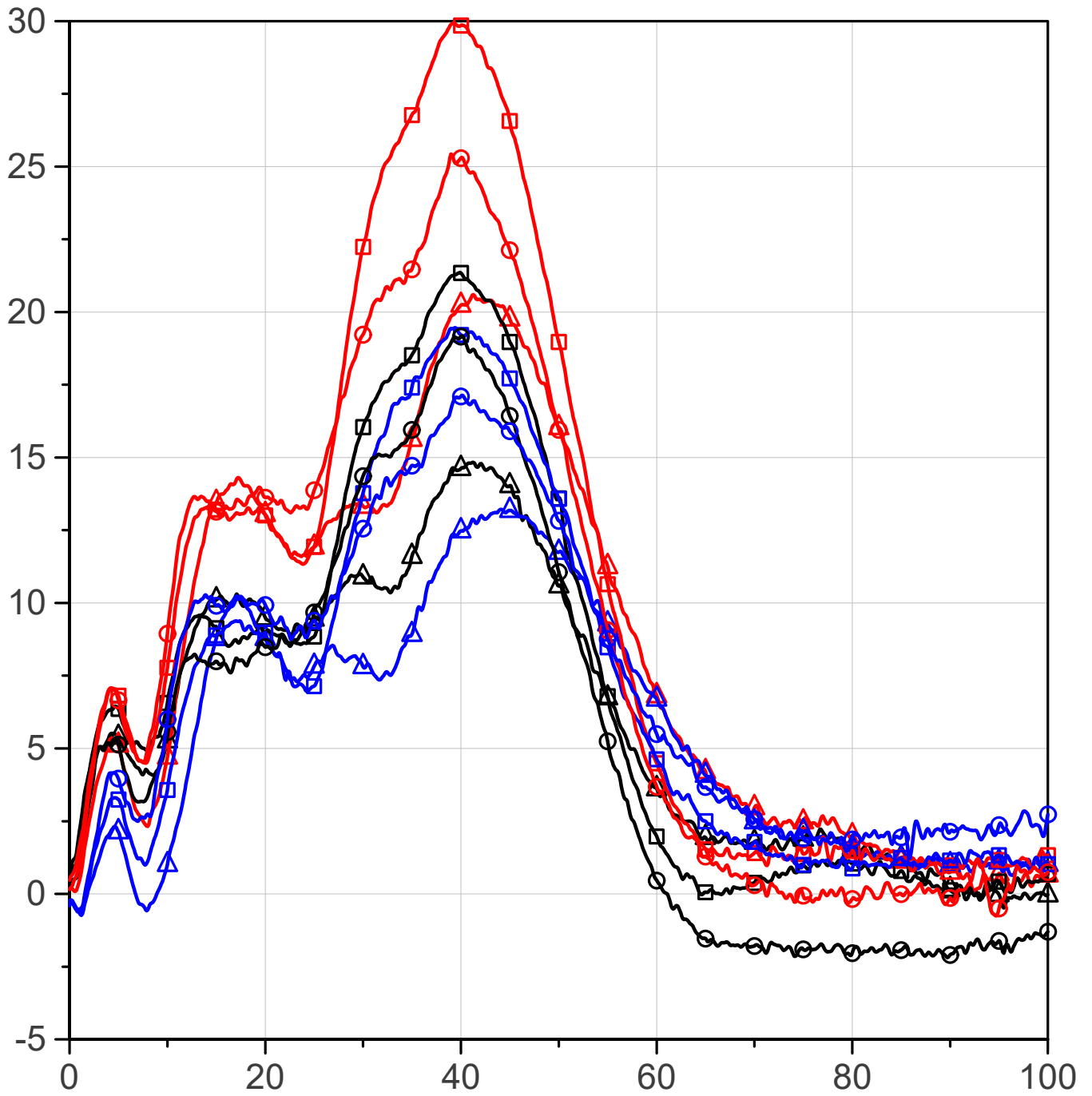
Upper Rib group Length Change (mm) vs. Time (ms)



Rear LED Middle LED Front LED

- △ Shoulder Rib
- Thorax Rib 1
- Thorax Rib 2

Lower Rib Group Length Change (mm) vs. Time (ms)

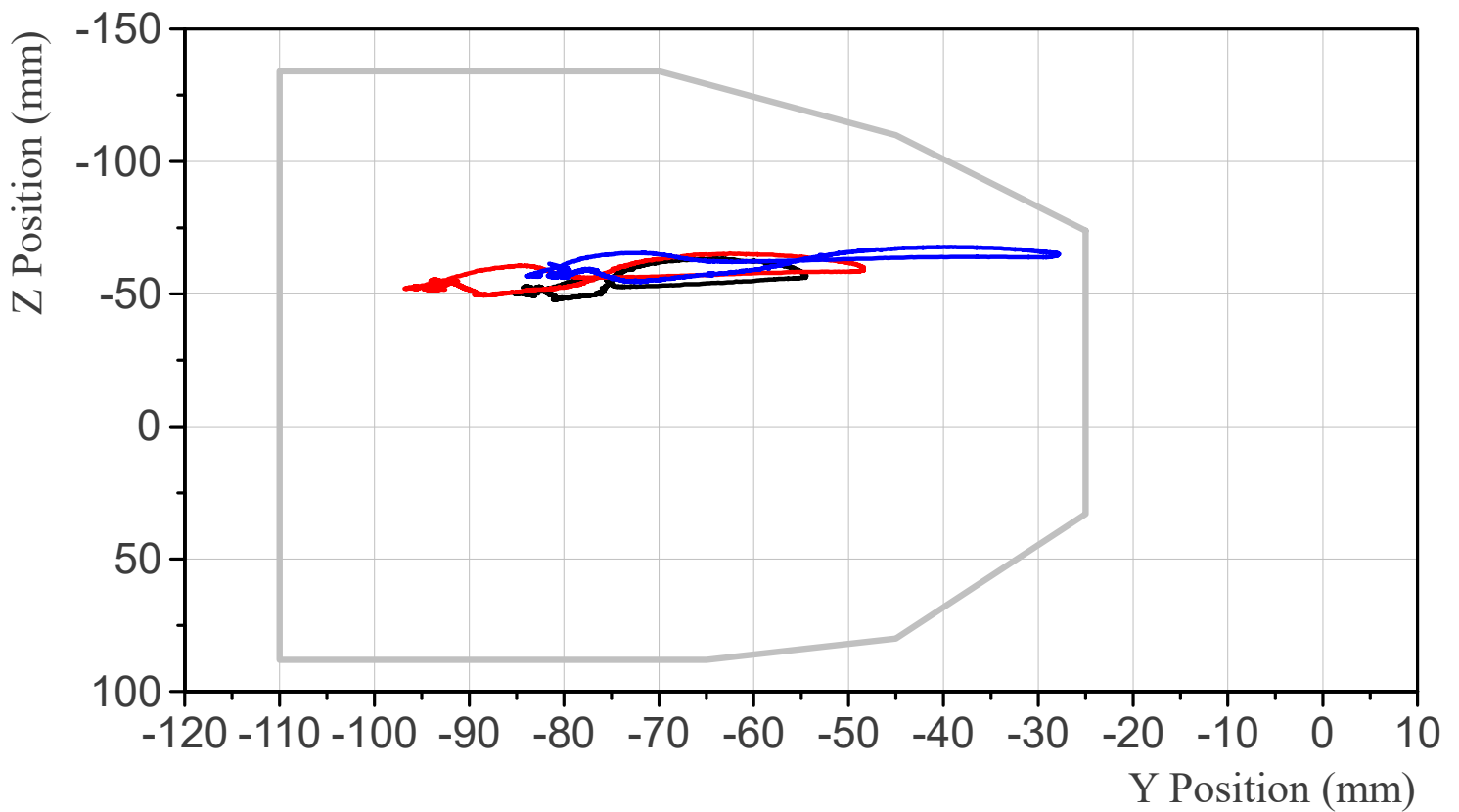
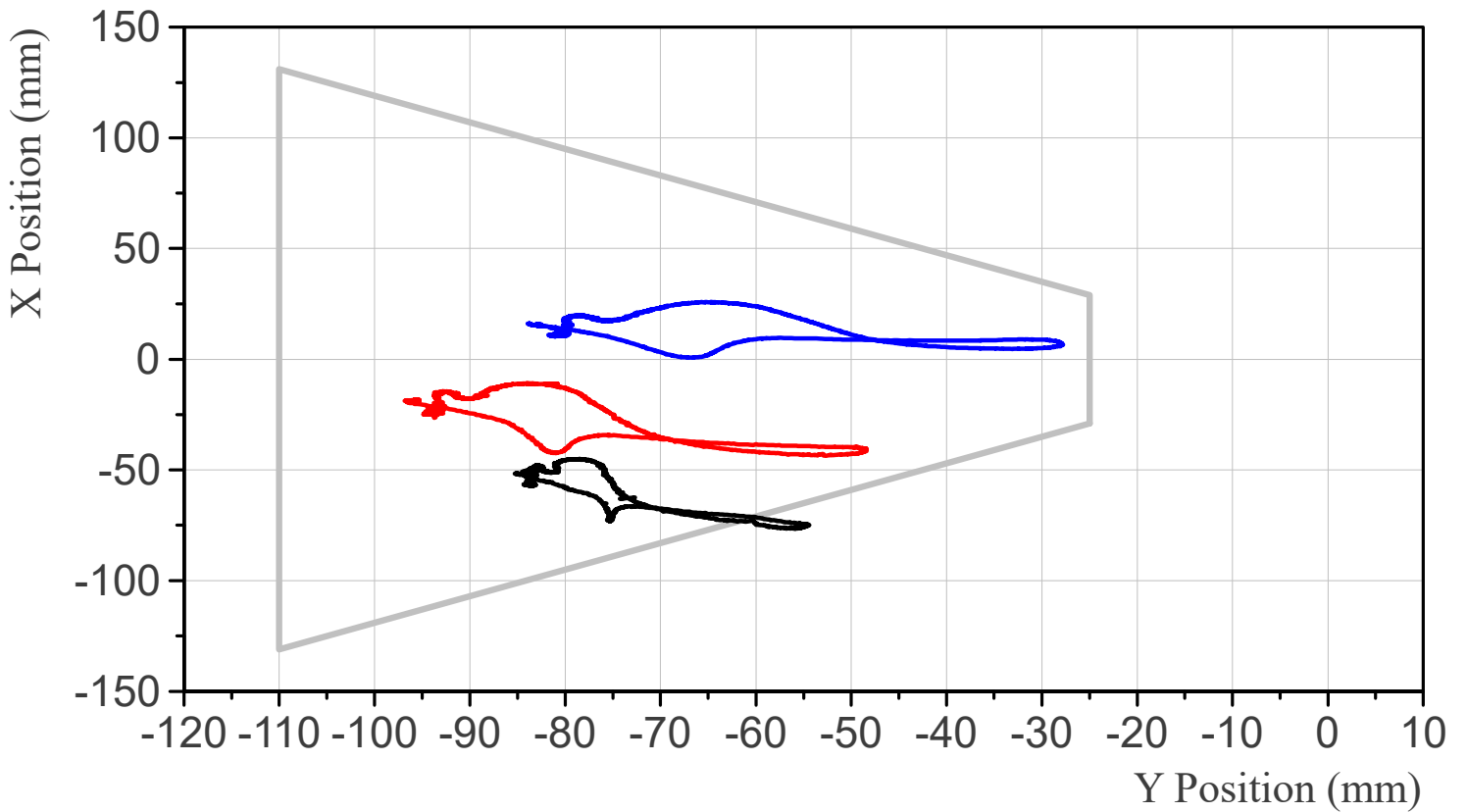


Rear LED Middle LED Front LED

- △ Thorax Rib 3
- Abdomen Rib 1
- Abdomen Rib 2

RibEye Measurement Range Plot

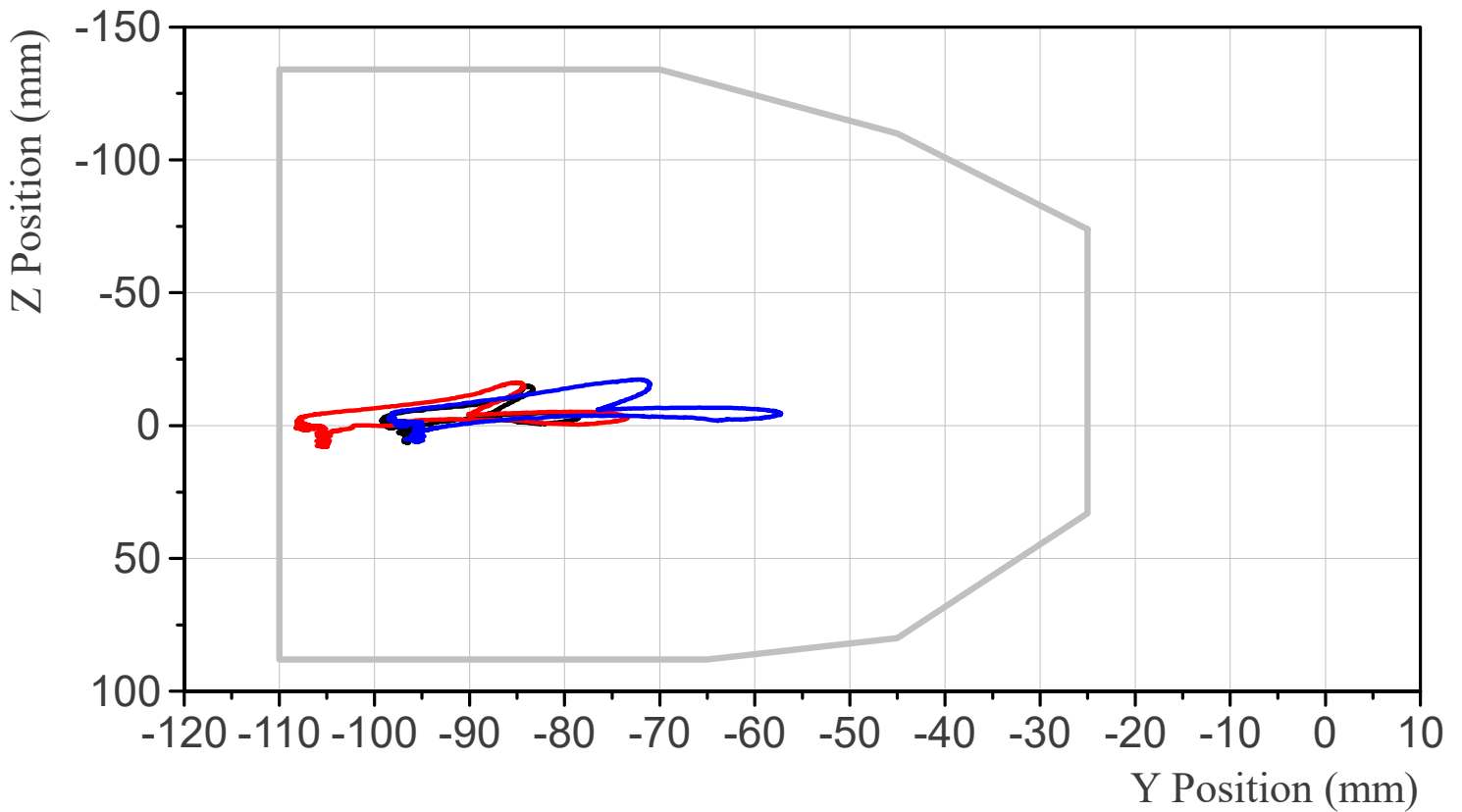
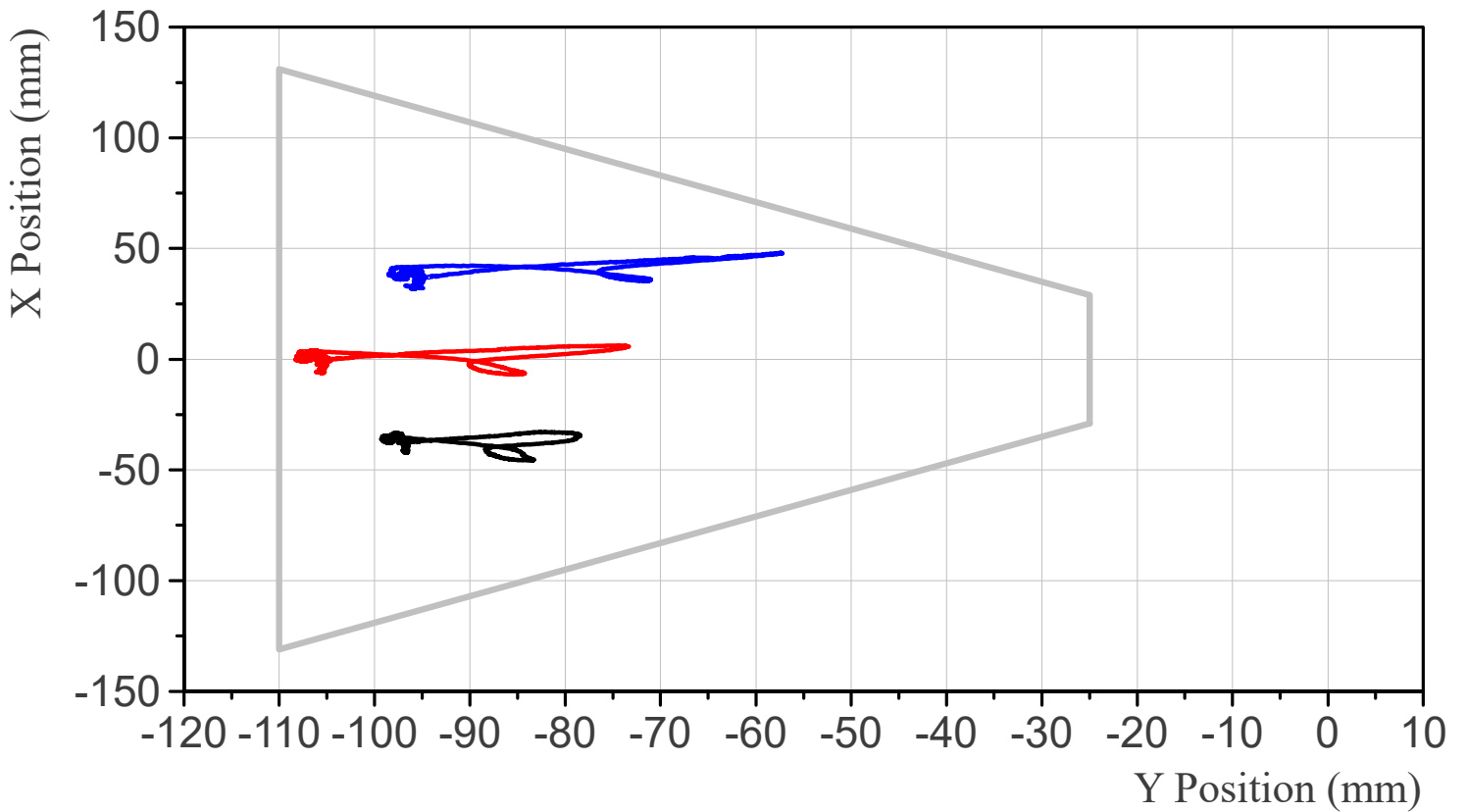
Shoulder Rib Absolute Position, Relative to Thorax Rib 1 Origin



Rear LED Middle LED Front LED

RibEye Measurement Range Plot

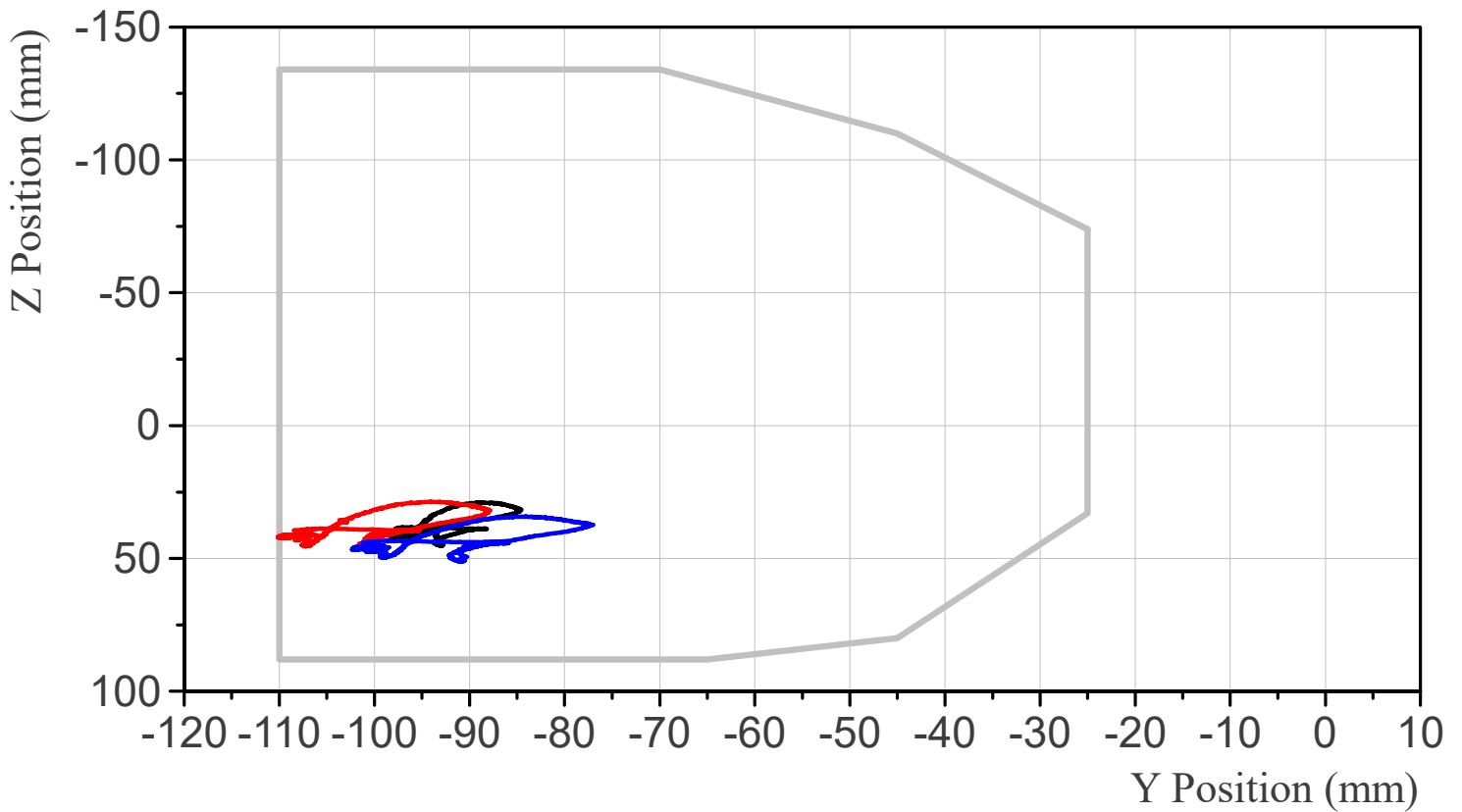
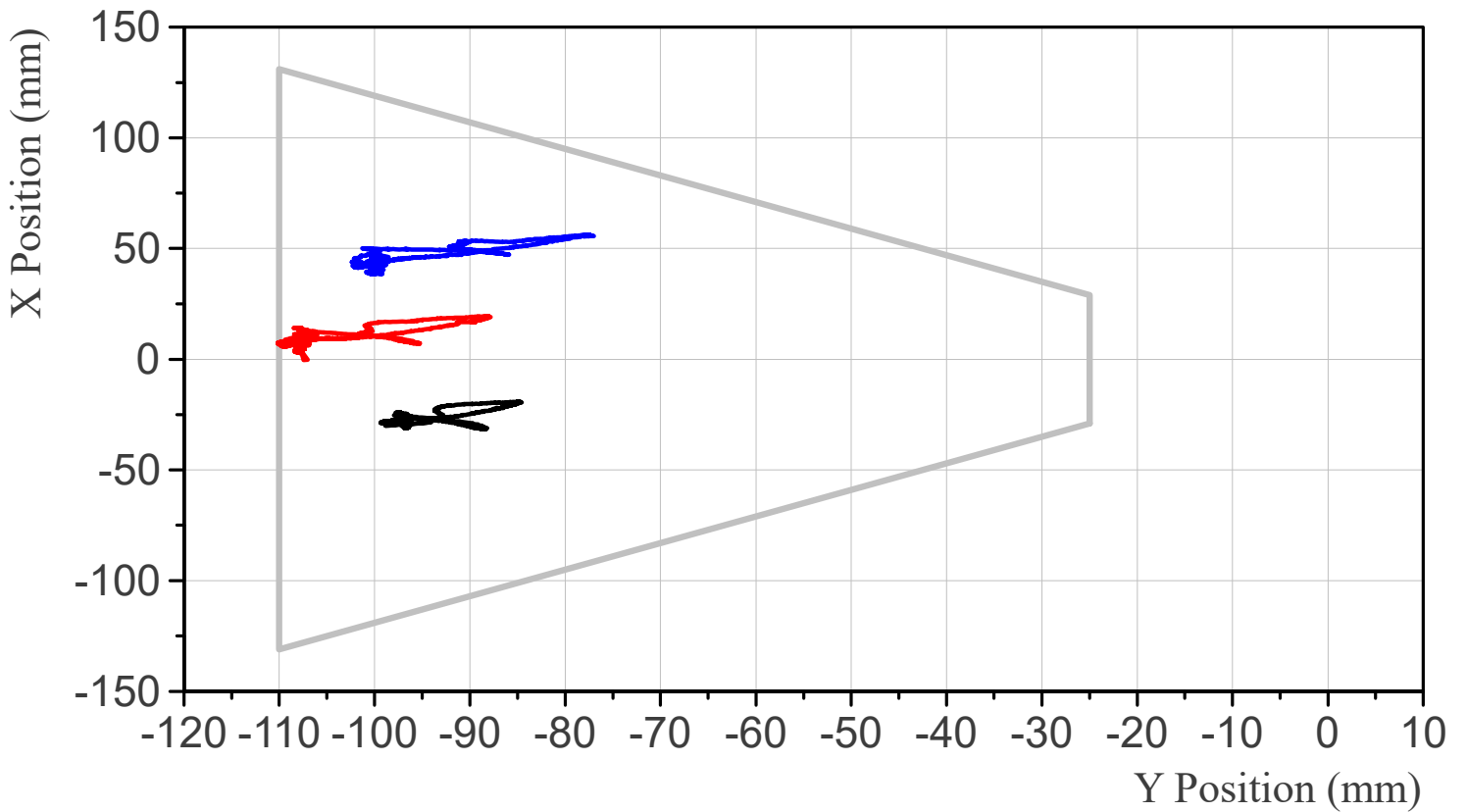
Thorax Rib 1 Absolute Position, Relative to Thorax Rib 1 Origin



Rear LED Middle LED Front LED

RibEye Measurement Range Plot

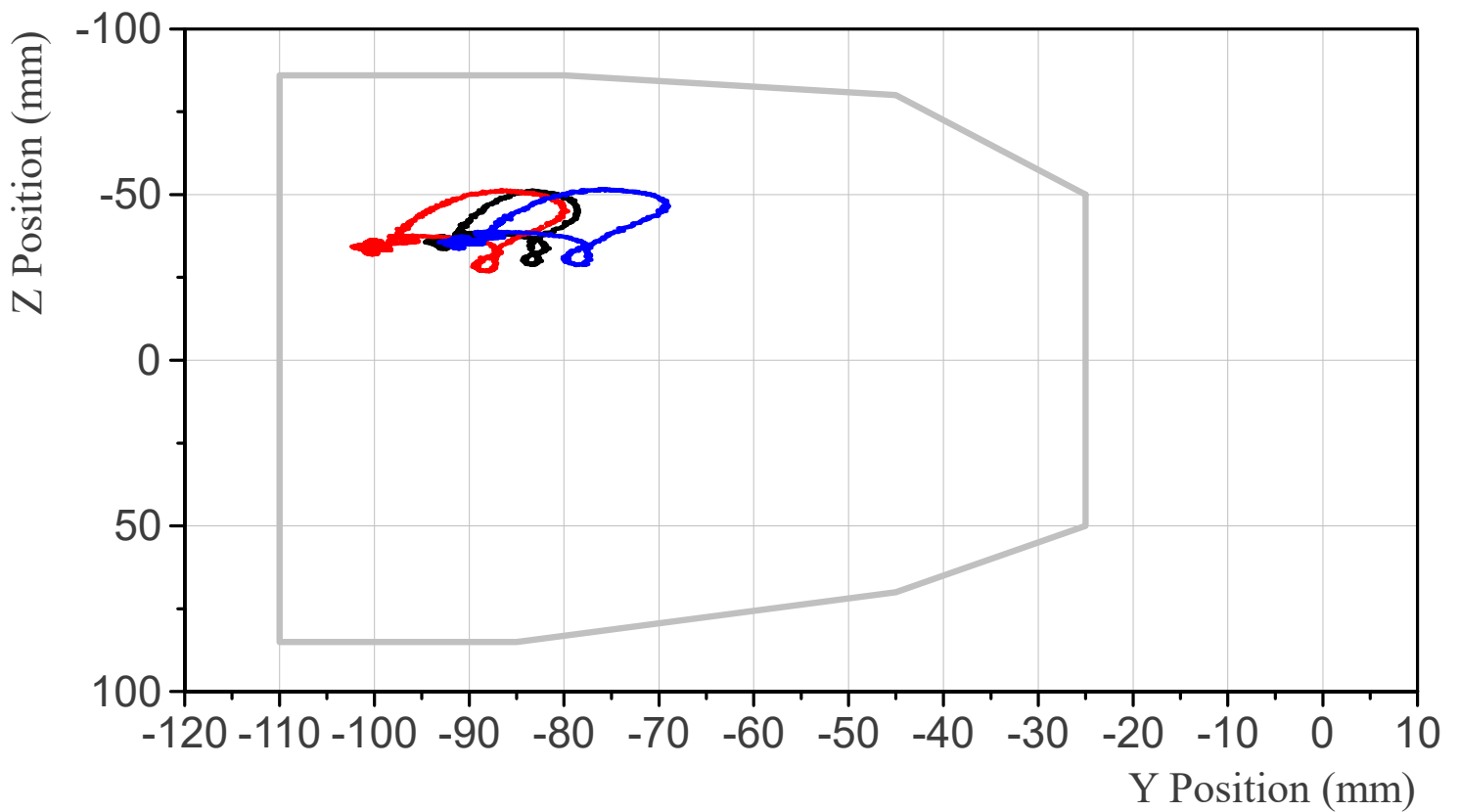
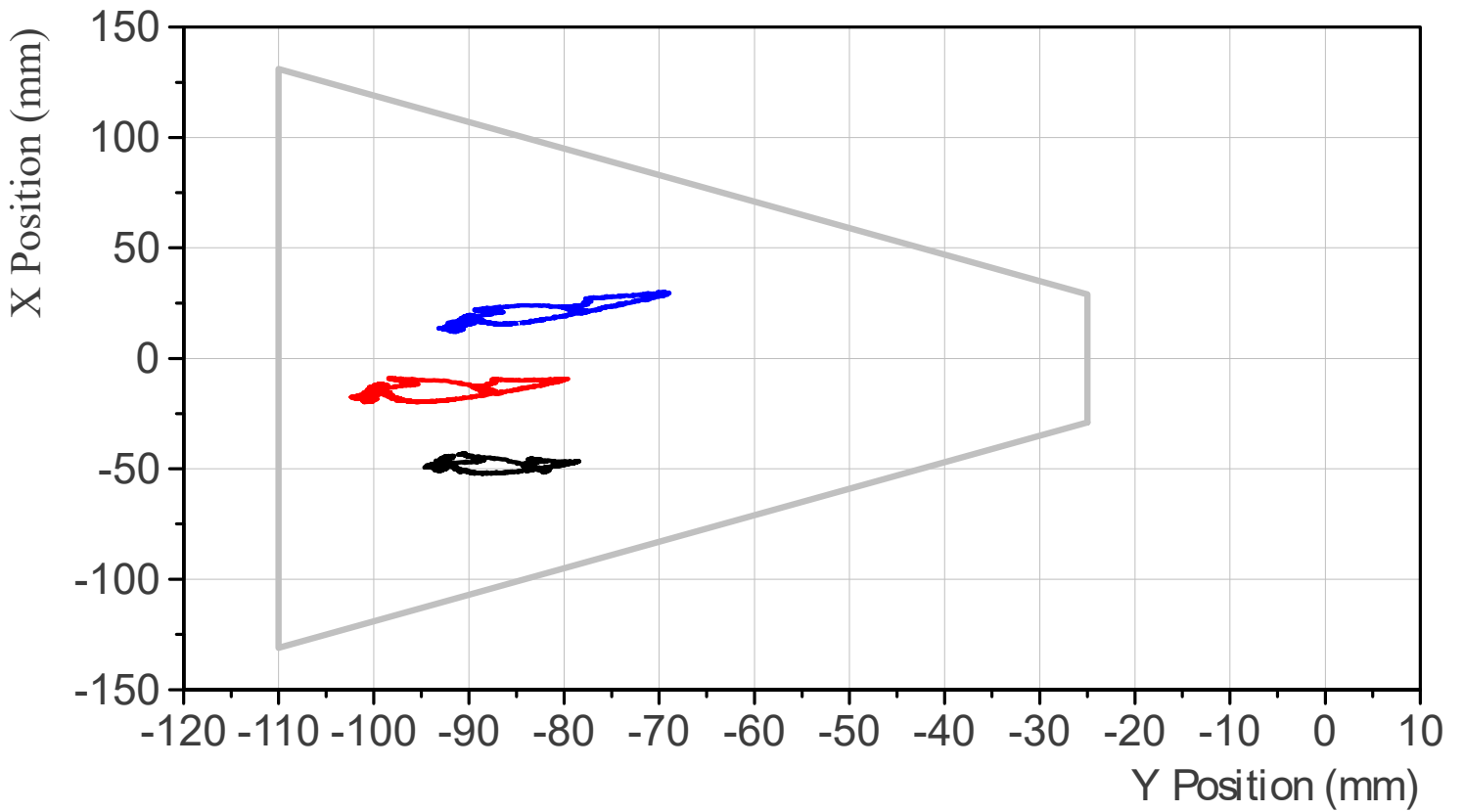
Thorax Rib 2 Absolute Position, Relative to Thorax Rib 1 Origin



Rear LED Middle LED Front LED

RibEye Measurement Range Plot

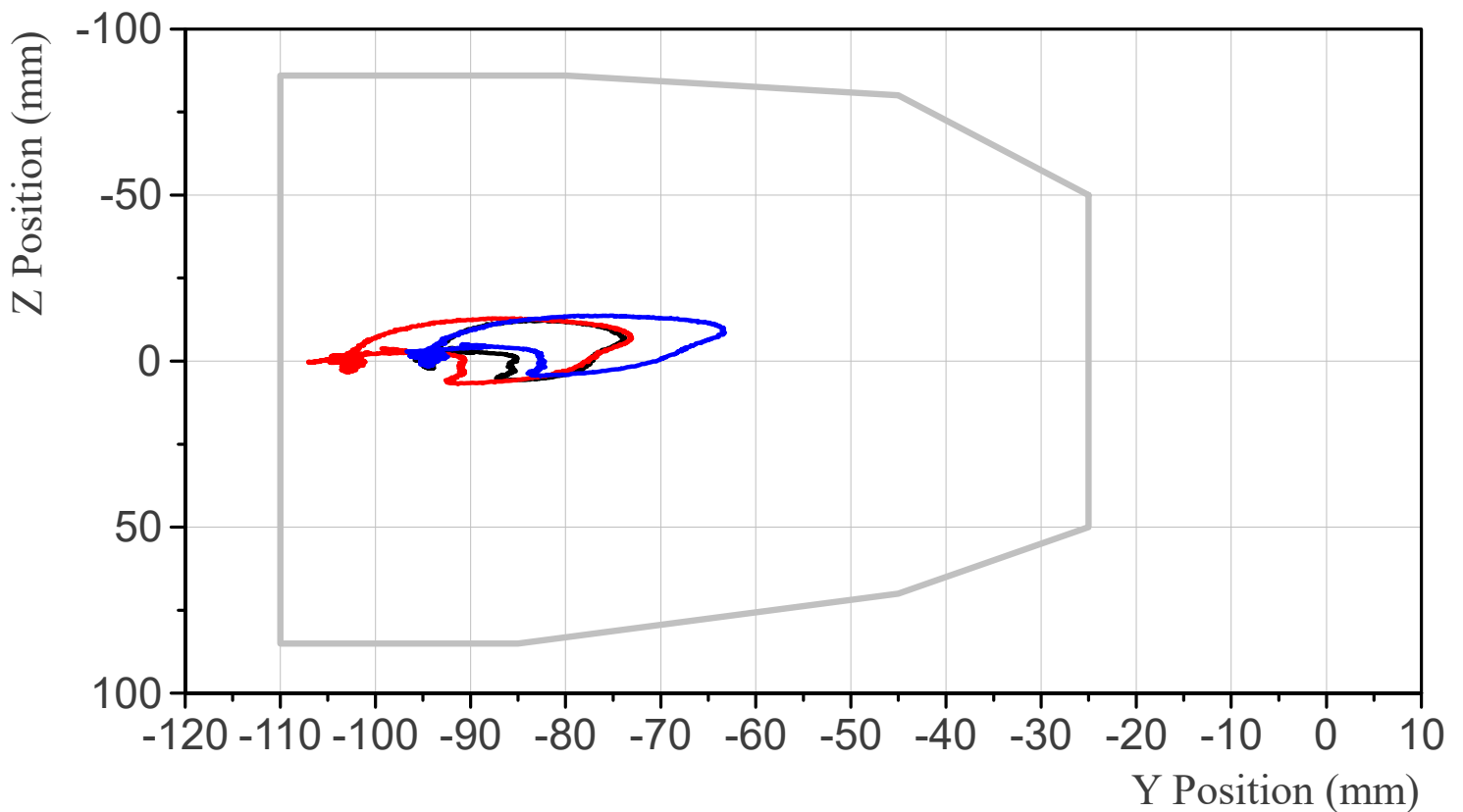
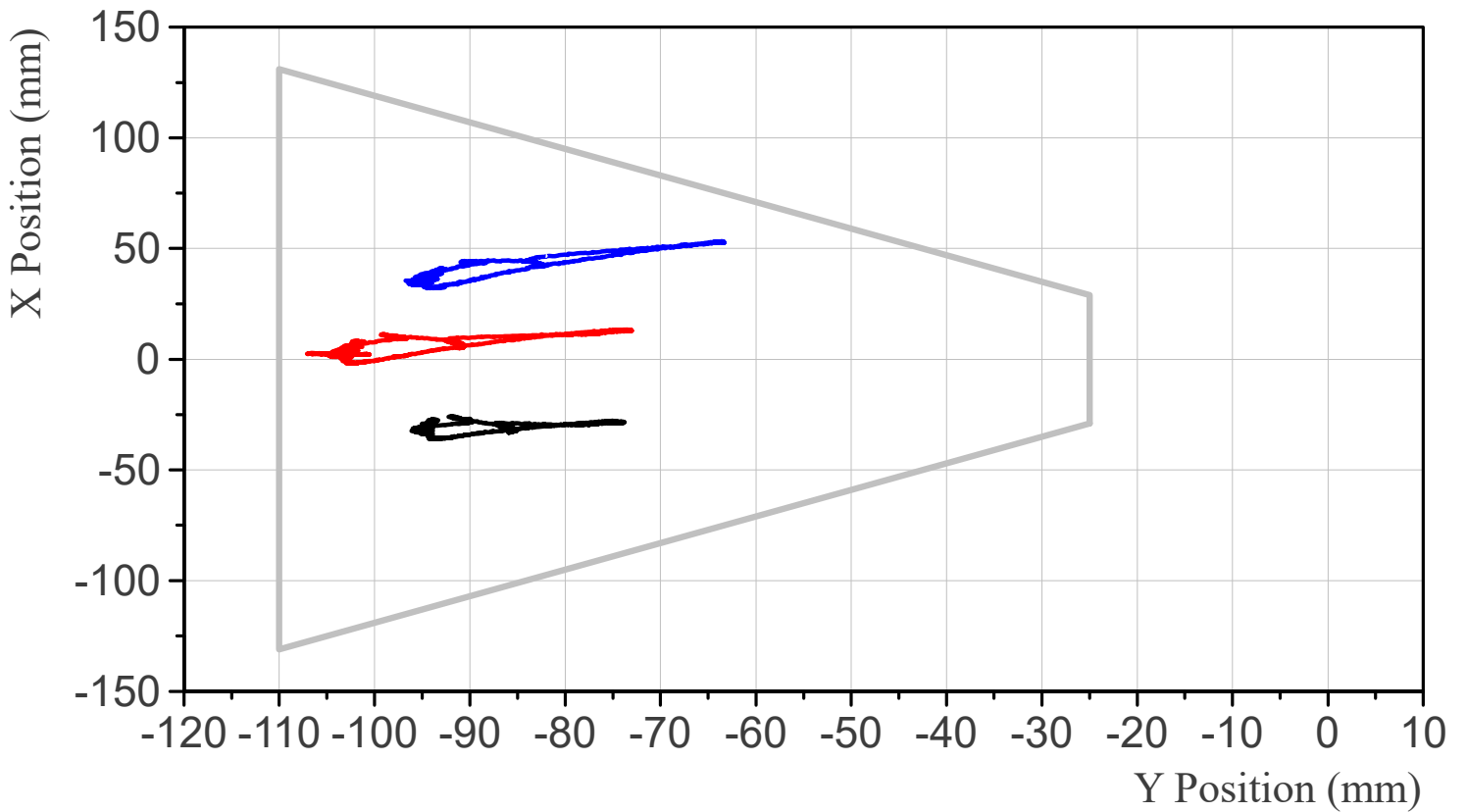
Thorax Rib 3, Absolute Position, Relative to Abdomen Rib 1 Origin



Rear LED Middle LED Front LED

RibEye Measurement Range Plot

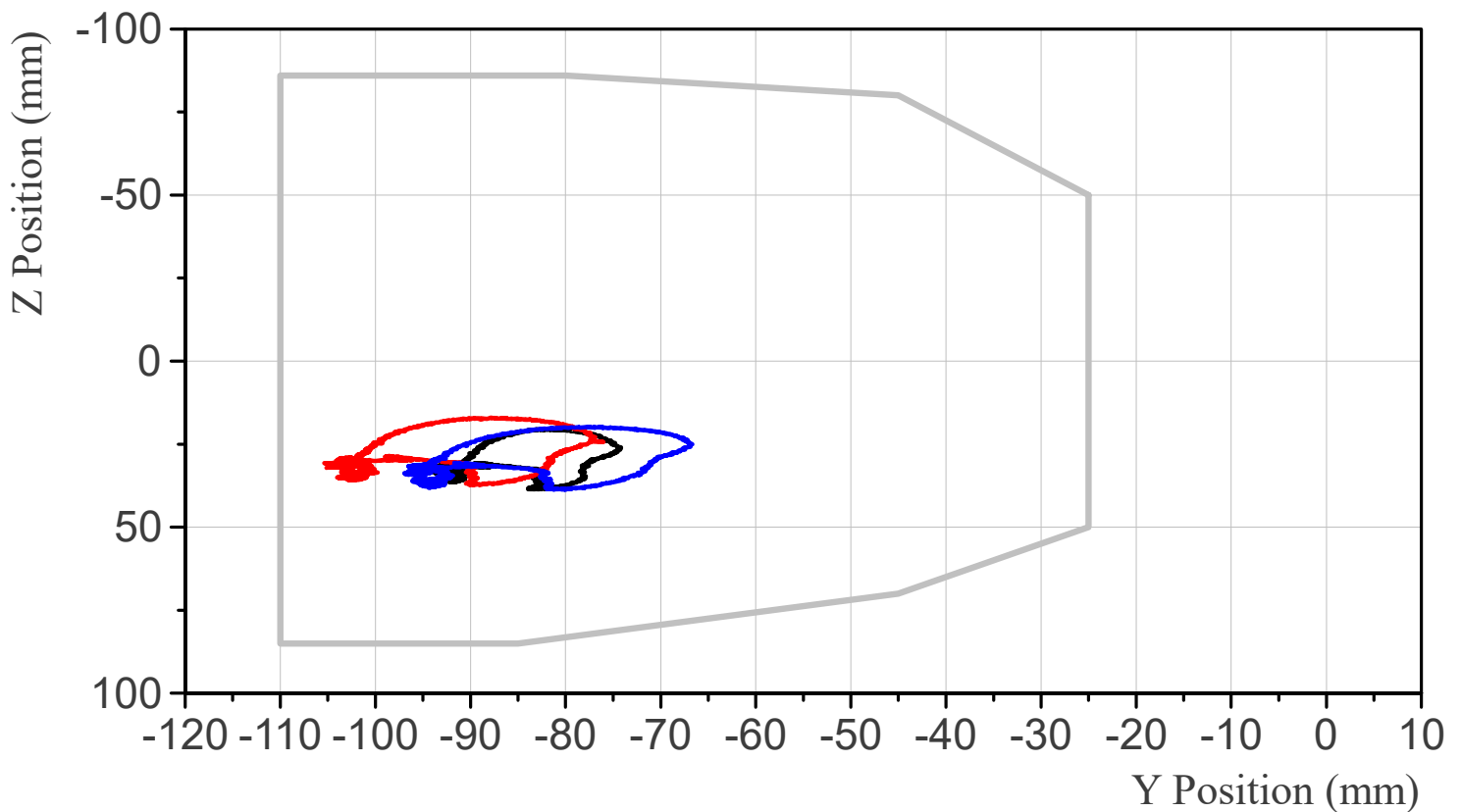
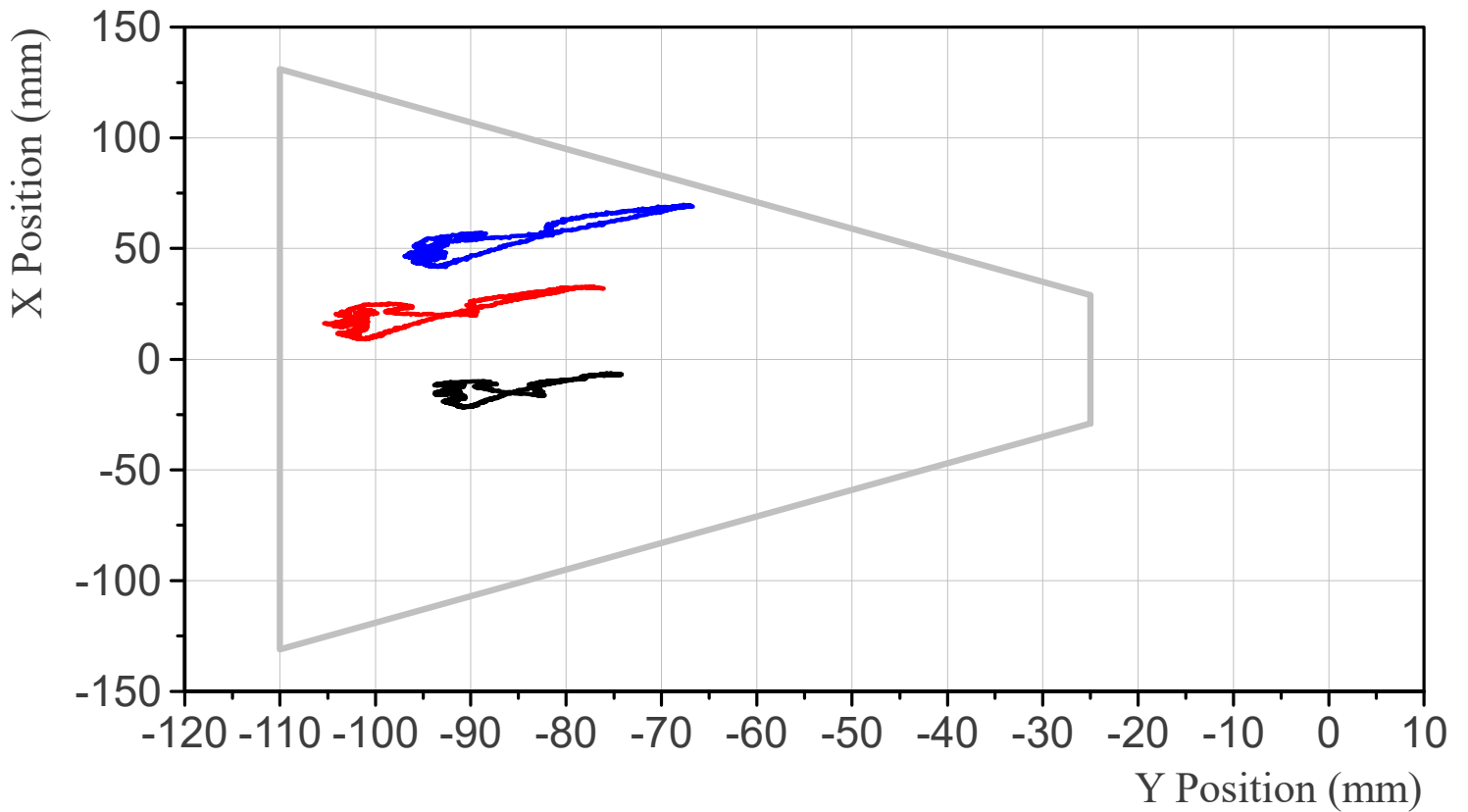
Abdomen Rib 1 Absolute Position, Relative to Abdomen Rib 1 Origin



Rear LED Middle LED Front LED

RibEye Measurement Range Plot

Abdomen Rib 2 Absolute Position, Relative to Abdomen Rib 1 Origin



Rear LED Middle LED Front LED