E-scooter Driving Postures and Velocities Retrieved from Volunteer Tests using Motion Capturing and Traffic Observations

Christoph Leo, Martin Schachner, Desiree Kofler, Corina Klug

Abstract The number of injured e-scooter riders has drastically increased during the last years. Knowledge of the injury mechanisms is still limited. The aim of this study was to determine typical driving postures and velocity profiles for e-scooter riders to be used in simulations with Human Body Models.

Volunteer tests were carried out with 16 males and 15 females. First, the volunteers drove with the e-scooters along a predefined route to derive average driving speeds using a camera-based traffic observation system. Furthermore, a 3D motion-capturing system was used to measure the driving poses of the volunteers in a lab environment.

At the outdoor route, average driving speeds of up to 25 km/h for males and 22.4 km/h for females were observed. Nine different characteristic poses were identified and quantitatively characterised. The most common position for both sexes was the right foot positioned in front while the left foot is behind and slightly bent. High variation between volunteers and between female and male volunteers have been observed.

For future investigations with Human Body Models, representative boundary conditions and initial postures have been derived within the current study.

Keywords Driving postures, driving velocities, e-scooter, volunteer tests.

I. INTRODUCTION

The popularity of electric scooters (e-scooters) as a mode of transportation has increased significantly in recent years. E-scooters are portable, environmentally friendly, and cost-effective, making them an attractive option for short-distance travel [1-3]. However, as their usage has grown, so has the concern for e-scooter safety. Accidents related to e-scooters have become increasingly common, resulting in injuries [3-9]. Therefore, it is essential to examine the safety implications of e-scooters and identify measures that can reduce the risk of accidents and injuries.

There are various safety concerns associated with e-scooter usage, primarily due to their design and operating characteristics. For example, e-scooters are relatively small, with a low centre of gravity, which make them more prone to tipping over than other modes of transportation [5]. They also have small wheels, which can cause instability on uneven or slippery surfaces. Additionally, e-scooters are often used in areas with high pedestrian traffic, which increases the risk of collisions between e-scooter riders and pedestrians [10].

Another significant safety concern associated with e-scooters is the behaviour of the riders. Many e-scooter riders do not wear helmets or other protective gear [4], [8-9], increasing the risk of head injuries and other severe injuries in the event of an accident. Additionally, riders may be inexperienced, unaware of traffic laws and regulations, or engage in risky behaviour, such as speeding, using their smartphone, riding after consuming alcohol or drugs, which increases the risk of accidents [1].

To accurately simulate the response of HBMs in accidents, HBMs require input data that represent the rider's driving pose as well as the driving velocity. The results of the HBM simulations can then be used to improve the safety of e-scooter riders.

The aim of this study was to determine typical driving postures and velocity profiles for e-scooter riders to be used in simulations with detailed finite element (FE) Human Body Models.

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II. METHODS

A group of 31 volunteers composed of 16 male and 15 female individuals, covering an age range from 18 to 44 and 18 to 54 years, respectively, were acquired for the e-scooter driving tests. Compliance with all standards for volunteer testing was assured via the approval of the ethics committee of the Medical University of Graz, Austria, (No. EK 34-349 es21/22 1153-2022).

All volunteers were briefed in detail about the test setup, procedure and the measured data, as well as the privilege to abort the test process anytime without any reason. Good health status and the mental and physical capability to drive an e-scooter were confirmed by each volunteer. Before the test, the volunteers completed a questionnaire about their experience with e-scooter and anatomical measurements as height, weight and extremities length were documented. All data collected were pseudo-anonymised and datasets suffixed only with *M* or *F* indicating a male or female volunteer.

Two different types of e-scooters, DocGreen EWA 6000 and iSinWheel S9 Pro were prepared for the driving tests. The differences between those two models are limited to variations in handlebar height, footboard width and top speed, whereby DocGreen allows a maximal velocity of 20km/h and iSinWheel 25km/h.

The volunteers were asked to perform two tasks, namely focusing on the driving velocity and on the driving posture.

In the first task, the volunteer followed a predefined course on the university campus intending to get comfortable with driving the e-scooter. The route was defined such that it passes the traffic observation system described in [11]. The system was extended to detect and track e-scooters. This enabled the speed evaluation of the volunteers for a sub-area of the route. The specified route, as well as the subarea in which the speed was measured, are shown in Figure 1. For safety reasons, the volunteers always wore a bicycle helmet when handling the e-scooter.

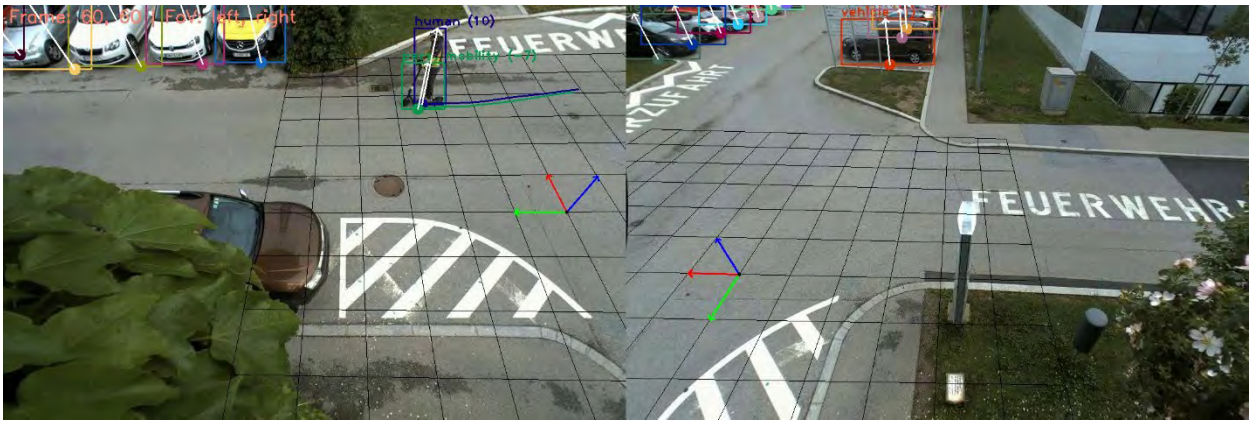

Fig. 1. Left and right field of view of the installed observation system, which is capable of detecting and tracking humans in the recorded video sequences. Coloured bounding boxes and trajectories correspond to the object's ID. The white coloured orientation vector estimated the volunteer's foot point, which was used for trajectory reconstruction. The left image shows the projected trajectory onto ground plane, defined by the extrinsic camera calibration. The coordinate system, which has been aligned with a road network model is illustrated via arrows pointing along the major axes (red: X-axis, green: Y -axis, blue: Z-axis)

The identified area [11] for which the trajectory reconstruction works sufficiently accurate (less than 0.5 m deviation) has been used as a boundary for the trajectories. The boundaries are outlined in Figure 2.

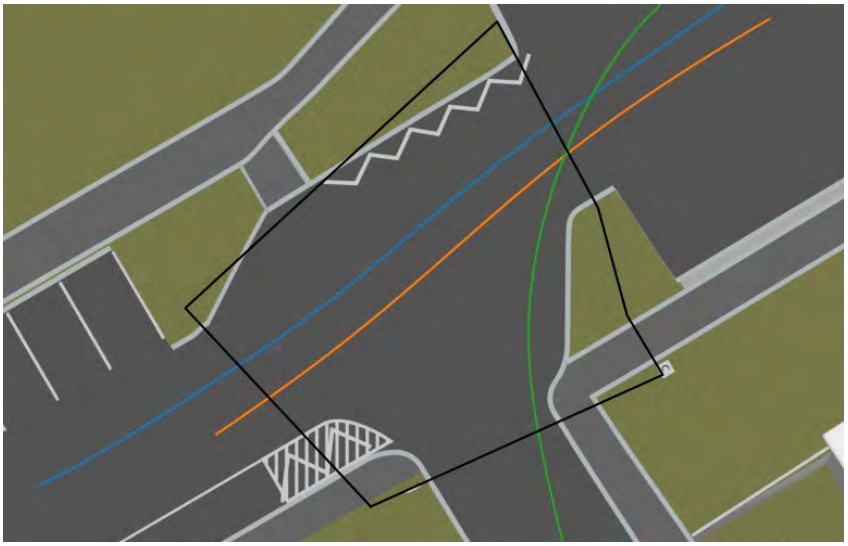

Fig. 2. Road network model and the reconstructed trajectory of the volunteer. The black bounding box shows the considered, accurate area.

The second task took place in a laboratory with motion-capturing equipment. The motion of special targets is captured by 10 fix installed infrared cameras of the types Maqus M3 and M5 with a framerate of up to 650 fps and a 3D resolution of 0.07 mm and processed with the software Qualisys. Each volunteer, dressed in tight-fitting, non-reflecting and short-sleeved clothing, was equipped with reflecting markers. The markers were positioned on landmarks according to the guide by [12] and visually documented, see Figure 3. Due to four targets placed on the head, a standard bicycle helmet could not be used. Therefore, all volunteers wore an airbag helmet from Hövding Sverige AB, which was positioned around the neck. The single target, which indicates the neck of the volunteer, was located on the rear cover of the airbag helmet. With a sum of 50 markers distributed over the volunteer's body, each volunteer followed a predefined course in the capturing area twice with both e-scooters.

Fig. 3. Volunteer wearing test clothing and instrumented with 50 markers.

As the angles of the ankle, knee, hip, shoulder and elbow characterise the volunteer's pose, those angles were extracted for each recorded volunteer pose. To do so, the centre point of a joint was calculated as the midpoint of the two markers, which located the joint. For example, the centre of the knee joint was defined by the midpoint of the marker on the medial condyle of the tibia and the marker on the fibular head. With the centre of each joint defined and additional nodes for the head and back, the pose could be visualised as shown in Figure 4. The angles of each joint of interest were derived in reference to a coordinate system with axes in global directions and originating in the corresponding joint.

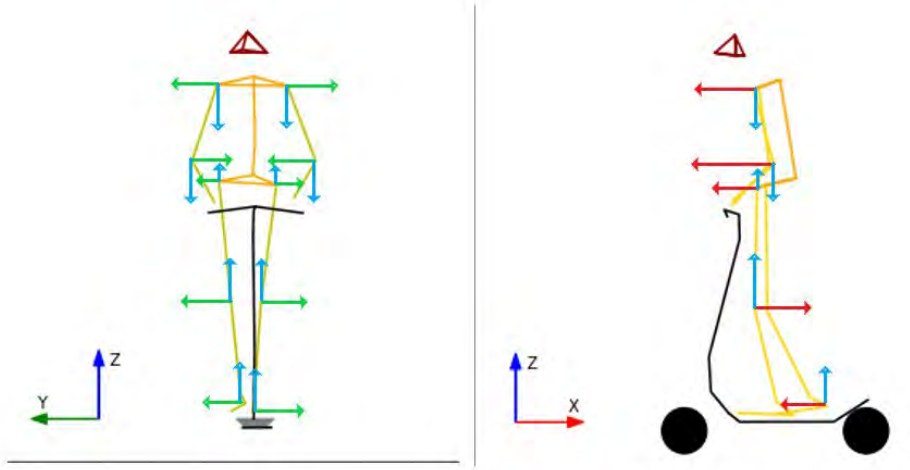

Fig. 4. Definition of coordinate systems for the angle calculation in each joint of interest.

Furthermore, the recorded postures were evaluated, focusing on the leg posture. A detailed description of the defined driving postures is given in the result section. Through clustering of the labelled volunteer postures, the final overall postures were identified and ranked accordingly to their frequency of occurrence.

III. RESULTS

A. Anatomical Dimensions of the Volunteers and Analysis of the Questionnaire

In Figure 5 the age, weight and height of all volunteers is displayed according to their gender. Also displayed are the corresponding values of the VIVA+ 50F and 50M models [13]. This is because these models should be used in further investigations using FE Simulations. For the age of the volunteers' it can be seen that the average female volunteer as well as the average male volunteer was 30 YO. This is a lot younger than the VIVA+ models, which are corresponding to the average 50 YO female and male. Analysing the weight of the volunteers it can be seen that the average weight of 66.2 kg for female volunteers is a little too high compared to the VIVA+ 50F model (62.7 kg). Also, for male volunteers it can be seen that the average weight of 81.4 kg is slightly higher than that of the VIVA+ 50M model (76.8 kg). Comparing the average height of the female volunteers with the VIVA+ 50F model it can be seen that the volunteers are taller than the VIVA+ model (1.690 m compared to 1.616 m). Also, the average male volunteer (1.867 m) is taller than the VIVA+ 50M model (1.753 m). The average values of the VIVA+ models are based on the study of [14].

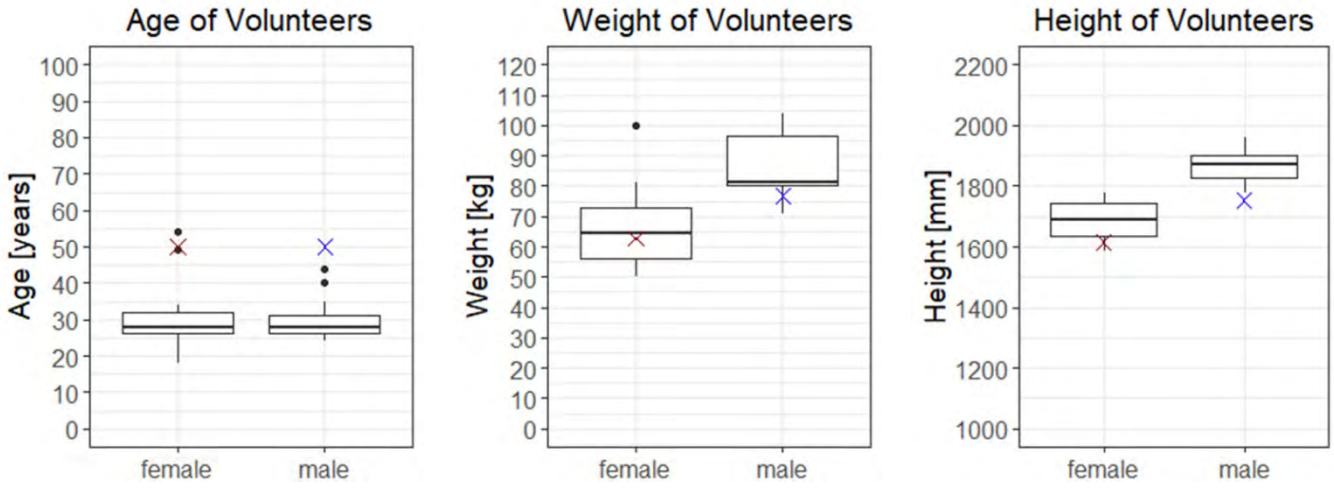

Fig. 5. Age, Weight and Height of the volunteers according gender. The red cross displays the equivalent value of the VIVA+ 50F and the blue cross displays the equivalent value of the VIVA+ 50M model.

The remaining anatomical dimensions of the volunteers which were collected, are shown in Figure A1 of the Appendix A. A detailed list with the anatomical dimensions of each volunteer is also given in the Appendix A.

The results of the questionnaire which the volunteers had to fill in is shown also in the Appendix A. Most of the volunteers have stated that they had never used an e-scooter before. Those who had used an e-scooter before have stated that they only use it occasionally. Nevertheless, the latter subjects have indicated that they have practice in using e-scooters. The volunteers have also stated that they tend not to use personal protective equipment when using e-scooters. In contrast, most of the people indicated that they own a bicycle helmet and use it regularly when riding their bicycle.

B. Driving velocities from traffic observation

The results of the traffic observation, which was used to derive the driving speed of the volunteers, is displayed in Figure 6. Unfortunately, the driving speed could not be determined for all volunteers. Since the traffic observation camera is located at a public point on the university campus, there was sometimes a conflict with other road users. Moreover, on one day of the test series a university event took place, which is why the test track was blocked for some test persons. A detailed list of the average driving speed for each volunteer, where the driving speed could be measured, is given in the Appendix A.

It was observed that male volunteers tended to drive faster than female volunteers. The average driving speed for male volunteers for the DocGreen Scooter was 19 km/h and 25 km/h for the iSinWheel Scooter. For female volunteers, on the other hand, an average driving speed of 18.3 km/h for the DocGreen Scooter and 22.4 km/h for the iSinWheel Scooter was observed.

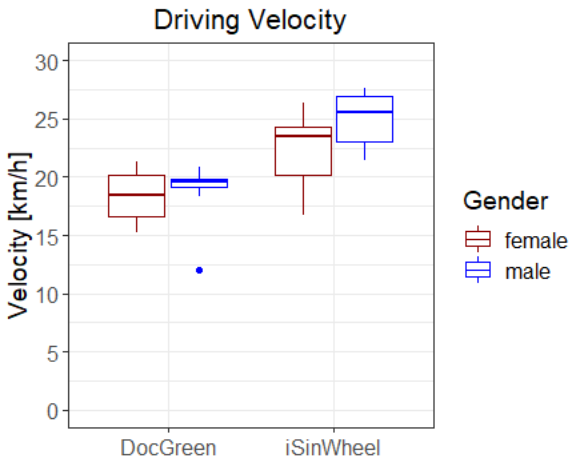

Fig. 6. Driving velocity of the volunteers according to gender and the driven scooter model.

C. Driving Postures from Motion Capturing

In a first step the x, y and z position of each of the 50 marker for all volunteers have been analysed. Therefore, a frame of the recording by the Qualisys system was selected on which all markers were captured by the cameras. These points were then transformed from the global coordinate system defined by the 3D motion capturing program to the centre of the scooter handlebar, where also a marker was placed and which represents the origin. This was done by calculating the distances of the individual infrared markers between the global coordinate system and the origin. By connecting the marker positions, a stick figure could then be obtained for each volunteer and scooter. The result of this can be seen in the Appendix B.

By analysing the videos of the volunteer tests as well as the stick figures it can be seen, that the foot position differs the most between the volunteers. The position of the upper extremities has not differed much, because of the fairly similar construction and handlebar height of the two e-scooter models, why the positions are clustered based on the position of the lower extremities. By analysing the videos and the motion capturing results, the following nine driving postures have been identified:

Posture 1: The feet of the volunteers were side by side (parallel). The driving posture was assigned when one foot was no more than a quarter of the foot's length in front of the other.

Posture 2: The left foot was more than a quarter of the foot's length in front of the right foot. The right foot was

parallel to the scooter footboard centreline (within 10° rotation) behind the left foot. Both feet were standing on the scooter footboard.
Posture 3: The left foot was more than a quarter of the foot's length in front of the right foot. The right foot was parallel to the scooter footboard centreline (within 10° rotation) behind the left foot. The right foot was also raised and only the tips of the toes stood up on the footboard.
Posture 4: The left foot was more than a quarter of the foot's length in front of the right foot. The right foot was rotated to the scooter footboard centreline (more 10° rotation) behind the left foot. Both feet were standing on the scooter footboard.
Posture 5: The left foot was more than a quarter of the foot's length in front of the right foot. The right foot was rotated to the scooter footboard centreline (more 10° rotation) behind the left foot. The right foot was also raised and only the tips of the toes stand up on the footboard.
Posture 6: The right foot was more than a quarter of the foot's length in front of the left foot. The left foot was parallel to the scooter footboard centreline (within 10° rotation) behind the right foot. Both feet were standing on the scooter footboard.
Posture 7: The right foot was more than a quarter of the foot's length in front of the left foot. The left foot was parallel to the scooter footboard centreline (within 10° rotation) behind the right foot. The left foot was also raised and only the tips of the toes stood up on the footboard.
Posture 8: The right foot was more than a quarter of the foot's length in front of the left food. The left foot was rotated to the scooter footboard centreline (more 10° rotation) behind the right foot. Both feet were standing on the scooter footboard.
Posture 9: The right foot was more than a quarter of the foot's length in front of the left foot. The left foot was rotated to the scooter footboard centreline (more 10° rotation) behind the right foot. The left foot was also raised and only the tips of the toes stood up on the footboard.

A summary of all driving postures of the volunteers depending on the driven scooter and the gender is given in Table I and Figure 7. For the most driving postures it seems that the used scooter did not have any influence on the adopted posture. Most male and female volunteers preferred driving Posture 8 followed by driving Posture 4 for males and 7 for females. Pictures of all driving postures can be seen in the Appendix B. The calculated mean values of the joint angles for males and females and each driving posture can be seen in Table II**.** To calculate these joint angles, the centre point of a joint was calculated as the midpoint of the two markers, which located the joint. By connecting these centre points, made it possible to calculate the joint angles in x, y and z direction according to the coordinate systems seen in Figure 4. For the analysis of the average joint angles per driving posture, the values observed for the two scooters have been merged. This was done because no major difference in the scooter models was seen. The detailed results for each volunteer and scooter are given in Appendix C.

TABLE I
SUMMARY OF THE DEFINED DRIVING POSTURES FOR MALES AND FEMALES FOR THE TWO DIFFERENT SCOOTER MODELS.

	Position of the feet	Female			Male		
		DocGreen	iSinWheel	∑	DocGreen	iSinWheel	∑
Pos. 1	Side by Side	1	-	1	-	1	1
Pos. 2	Left foot front, parallel, even	1	1	2	3	2	5
Pos. 3	Left foot front, parallel, back foot elevated	1	-	1	1	-	1
Pos. 4	Left foot front, angulated, even	1	1	2	4	4	8
Pos. 5	Left foot front, angulated, back foot elevated	-	-	-	-	2	2
Pos. 6	Right foot front, parallel, even	1	1	2	1	1	2
Pos. 7	Right foot front, parallel, back foot elevated	3	2	5	-	1	1
Pos. 8	Right foot front, angulated, even	5	8	13	6	4	10
Pos. 9	Right foot front, angulated, back foot elevated	2	2	4	1	1	2

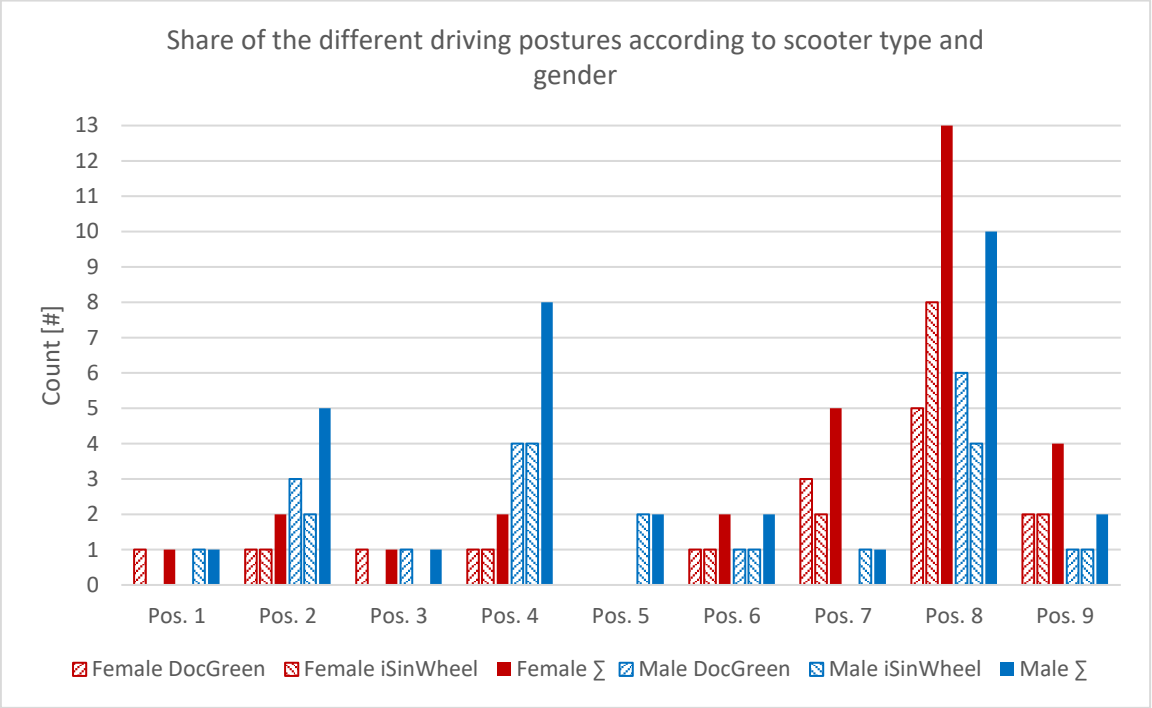

Fig. 7. Share of the different driving postures according to scooter type and gender.

TABLE II

CALCULATED MEAN JOINT ANGLES FOR ALL NINE DEFINED DRIVING POSTURES FOR FEMALE AND MALE VOLUNTEERS.

Driving Posture	Gender	Left Elbow X [deg]	Left Elbow Y [deg]	Left Elbow Z [deg]	Right Elbow X [deg]	Right Elbow Y [deg]	Right Elbow Z [deg]	Left shoulder X [deg]	Left shoulder Y [deg]	Left shoulder Z [deg]	Right shoulder X [deg]	Right shoulder Y [deg]	Right shoulder Z [deg]	Left Knee X [deg]	Left Knee Y [deg]	Left Knee Z [deg]	Right Knee X [deg]	Right Knee Y [deg]	Right Knee Z [deg]	Left Hip X [deg]	Left Hip Y [deg]	Left Hip Z [deg]	Right Hip X [deg]	Right Hip Y [deg]	Right Hip Z [deg]	Left Foot X [deg]	Left Foot Y [deg]	Left Foot Z [deg]	Right Foot X [deg]	Right Foot Y [deg]	Right Foot Z [deg]	Right Foot Mz [deg]	Left Foot Mz [deg]
1	Male	47.0	72.7	48.1	39.5	77.3	53.4	87.8	75.3	14.8	81.8	71.5	20.3	60.2	87.7	150.1	74.9	83.5	163.5	94.4	92.7	174.9	94.5	92.3	175.0	11.3	99.3	96.3	11.4	78.7	88.4	11.3	9.3
	Female	19.5	90.9	70.6	33.1	65.3	69.4	84.8	82.2	9.4	82.0	67.3	24.2	78.8	89.5	168.8	78.5	87.0	168.1	97.6	96.7	169.8	87.5	97.4	172.2	11.0	79.2	88.1	12.9	102.7	87.5	12.7	10.8
2	Male	47.8	73.6	47.1	50.6	75.7	43.4	89.1	74.5	17.5	85.7	76.1	16.6	75.9	90.0	165.5	73.0	83.3	161.2	93.3	98.1	170.8	85.2	97.7	170.4	12.7	96.7	87.5	18.9	71.5	91.9	18.5	12.3
	Female	26.4	85.0	64.4	27.8	70.7	73.7	81.0	76.5	18.9	76.9	67.2	26.7	81.4	89.7	171.4	78.6	81.4	165.0	94.4	101.0	167.3	84.2	99.2	168.5	4.7	94.6	89.2	5.9	84.2	90.3	5.9	4.6
3	Male	20.6	76.6	74.7	28.7	74.1	66.8	89.0	80.1	9.9	91.3	72.0	18.0	72.9	82.5	161.2	37.0	78.1	124.4	107.3	98.2	160.7	95.6	94.6	172.8	5.4	84.8	88.4	39.4	74.2	125.0	19.4	5.2
	Female	22.1	92.1	68.0	40.6	109.3	55.9	82.3	108.2	19.9	79.9	101.9	15.7	85.7	92.3	175.1	49.8	98.7	138.5	93.9	82.9	171.9	84.3	86.5	173.3	12.3	102.1	92.2	34.4	92.8	124.2	3.4	12.1
4	Male	47.9	74.4	47.3	45.4	80.2	46.9	84.5	76.3	16.1	79.5	77.8	17.3	80.5	88.4	169.7	77.3	76.1	160.2	92.7	96.4	171.3	84.0	97.9	169.7	14.4	99.4	87.7	51.3	38.9	89.3	51.2	13.6
	Female	22.0	82.1	69.8	30.5	73.4	65.8	91.3	77.9	12.9	77.9	76.0	19.0	83.8	86.6	172.4	78.2	77.8	162.9	89.0	98.2	171.7	80.4	99.2	166.7	1.8	88.8	89.8	50.8	39.3	87.6	50.8	1.3
5	Male	40.2	82.1	51.3	39.5	80.6	52.3	81.1	82.1	12.2	81.5	76.7	17.1	76.5	85.5	165.7	45.1	77.9	132.4	96.8	97.7	166.6	91.4	90.6	173.6	10.2	94.4	85.5	41.8	62.5	117.4	31.0	9.1
	Female	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	Male	30.8	82.3	60.7	29.8	72.0	71.2	107.1	78.1	22.0	100.4	79.9	14.7	69.1	82.4	157.6	81.8	84.8	169.8	87.2	97.1	171.7	93.6	95.4	172.2	14.1	76.2	92.2	4.3	85.8	89.7	4.3	13.9
	Female	27.6	73.4	69.4	29.0	76.8	65.1	80.4	73.8	19.2	78.4	67.9	25.8	76.2	86.5	165.7	79.1	89.6	169.1	77.9	98.8	164.9	92.9	97.6	171.9	6.1	85.1	93.1	7.6	97.3	91.8	7.3	5.0
7	Male	54.8	75.8	38.8	53.8	80.2	37.9	83.6	80.0	12.0	83.3	75.3	16.2	55.4	78.3	142.9	79.1	84.7	167.8	98.2	90.0	171.8	99.2	99.0	167.0	29.0	76.0	114.9	16.4	73.7	88.3	16.3	15.4
	Female	30.3	80.1	62.7	25.7	79.0	69.0	92.4	78.1	15.3	96.1	75.4	20.7	51.0	78.5	138.2	78.7	86.2	168.0	90.7	92.6	175.3	87.9	99.0	170.3	42.8	89.2	131.4	6.6	83.5	91.1	6.5	11.1
8	Male	44.9	72.6	51.2	42.9	79.7	49.5	79.1	80.6	15.2	82.4	72.5	20.0	74.2	78.5	160.1	82.6	89.2	171.1	83.8	98.4	169.0	88.7	98.6	170.8	48.5	41.6	90.1	9.7	94.8	88.6	9.1	48.5
	Female	29.7	74.4	67.2	30.8	76.9	64.2	80.6	78.2	17.3	80.3	68.2	24.3	73.0	79.6	159.4	81.2	85.7	169.7	81.9	98.9	167.5	89.9	96.3	172.9	37.5	53.1	92.3	7.2	89.8	90.1	6.5	37.1
9	Male	54.2	77.9	38.5	54.0	75.7	40.6	86.2	77.5	15.8	82.9	73.8	18.0	64.4	72.3	147.1	79.5	88.9	169.5	90.7	91.0	178.6	92.1	97.1	171.6	52.0	51.9	113.7	4.6	94.5	89.7	4.5	41.2
	Female	33.8	76.6	67.5	31.4	74.5	67.3	84.0	76.3	16.0	83.2	72.0	20.5	51.3	75.1	135.8	84.0	83.8	170.4	90.9	88.6	175.6	85.4	100.8	167.8	51.9	68.9	130.9	4.0	92.0	91.4	3.0	27.1

IV. DISCUSSION

The identified driving velocities and driving postures are an important step for further investigations with Human Body Models. However, the current study still underlies several limitations. A rather small testing group was included in this study with 16 male and 15 female volunteers. By including more volunteers and also younger people and children, maybe also other driving postures would have been observed. The e-scooter models used in this study are very similar in terms of dimensions. Unfortunately, it was not possible to include a rental scooter, since they are not available in the city of Graz, Austria. Rental scooters are usually somewhat larger and more robustly built than scooters for private usage. This may also influence the driving posture as well as the driving velocity. The traffic observation camera was installed on the campus of the university. There is no public transport and vehicles drive at low velocities. This leads to a rather idealised view and the measured speeds deviate from the actual speeds in road traffic. As the laboratory area in which the motion capturing system is installed is rather small, only a short driving distance (approx. 10 m) could be covered. This leads to the fact, that driving off with the e-scooter may influence the driving pose. For this reason, a longer distance should be chosen for future tests. This would also allow influences such as braking on the pose to be investigated. Because of the rather short test course in the laboratory no meaningful speed could be determined in the laboratory tests. As a result, it was also not possible to determine driving poses as a function of speed. However, a qualitative comparison of the determined poses with the recorded videos of the traffic observation showed that the driving poses of the outdoor tests and the laboratory tests are similar. In the future, it would be useful to use videos from traffic observation cameras in road traffic to investigate the influence of emergency braking and evasive manoeuvres on the driving pose. These investigations cannot be carried out under laboratory conditions.

A. Analysis of the Questionnaire

The volunteers indicated that they would rather not wear a bicycle helmet if they were using an e-scooter. This is also in line with the literature, where helmet waring rates of e-scooter drivers is rather low [4], [8-9]. This leads to the fact, that head injuries can often be observed in e-scooter accidents [4-9]. For this reason, it would make sense to think about a helmet wearing obligation for the use of e-scooters.

The average age of the volunteers was 30 years, which agrees quite well with other studies. They have shown that younger people are more likely to use e-scooters [4-9].

B. Driving Velocities from Traffic Observation

At the traffic observation and the calculated driving velocities it was shown that male volunteers tend to travel at higher velocities compared to female volunteers for both scooter models. Moreover, it was shown that both men and women, make use of the maximum driving speed of the scooter models under the idealised driving conditions at the campus. The reason for speeds above the actual design speed (limited to 20km/h for DocGreen and 25km/h for iSinWheel by the e-scooter company) of the e-scooters, can be on the one hand explained by the slope of the road, but also on the re-projection accuracy, which depends on the location of the detected e-scooters on the road network, as denoted in [11]..

Comparing these driving velocities with the driving velocities determined by the traffic safety board (KFV) in Austria [15], they are slightly higher. The KFV indicates that females travel at a mean velocity of 14.5 km/h and males travel at a mean velocity of 15.3 km/h. This study also shows that travel speeds depend on the infrastructure used. E-scooter drivers travel at higher mean velocities when using the bicycle path (16.6 km/h) compared to when using the roadway (15.0 km/h) or the pavement (10.3 km/h). The university campus at the time of the recording was not very busy and therefore might have been the reason for the higher speeds of the volunteers compared to the other study recorded in normal traffic. For future investigations, the traffic observation should be done in real traffic situations in order to obtain a more meaningful result.

C. Driving Postures from Motion Capturing

In total, nine different driving postures have been identified. As it was seen, most of the volunteers assumed driving Posture 8 when riding an e-scooter. The right foot was in front of the footboard while the left foot was

slightly bent and behind the right foot. It is striking, that the mirrored version of this position, with the left foot in front and the right foot slightly angled behind the left foot, is already the second most common position among the male volunteers, while this position was only taken by two volunteers among the female volunteers. Position 7, right foot in front, left foot parallel behind and slightly raised, turned out to be the second most common position for the female volunteers. Position 7, however, was taken by only one rider among the male volunteers. It is therefore striking, that, although the majority of both sexes clearly used the most frequent driving position, there is no commonality between the sexes in the second and third most frequent positions. This might be because of the limited number of volunteers included in this study. By including more volunteers, it might be possible to see a clearer trend in terms of driving postures. However, it has also been shown, that even with 31 volunteers, the driving postures can vary greatly, which means that it cannot be ruled out that there are other positions which did not occur in this series of tests. The influence of the different poses on the accident and injury events will be evaluated with the help of Human Body Models in future research.

As can also be seen in Figure 8 is, that the e-scooter type does not seem to have any influence on the choice of driving posture for most positions. This might be because the e-scooter models used in this study are very similar in terms of dimensions. For future investigations also rental scooters should be included as they are usually somewhat larger and more robustly built than scooters for private use.

V. CONCLUSION

The popularity of e-scooters as a mode of transportation has increased significantly in recent years. However, safety concerns associated with e-scooter usage need to be addressed to ensure that their usage does not result in accidents and injuries. This study is intended to lay the foundation for further investigations with Human Body Models. At the outdoor route, an average driving speed of up to 25 km/h for males and 22.4 km/h for females was observed. By analysing the data of the motion capturing, nine different characteristic poses were identified and defined. The most common position for both sexes was the following: The right foot is positioned in front while the left foot is slightly bent and behind the right foot. Moreover, it was also shown that the driving postures varied between the volunteers and sexes. The generated driving postures can be applied to position the Human Body Models which can be used for injury assessment with different boundary conditions for single accidents and accidents with other road users. The results of these investigations can then be used to make recommendations to increase the safety of e-scooter riders. One of these recommendations could be to make the wearing of helmets obligatory or to reduce the speed of the e-scooters.

VI. ACKNOWLEDGEMENT

This study has received funding by the Science and University Funding Program of the Provincial Government of Styria, Austria.

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VIII. Appendix A: Results of the volunteer questionnaire, anatomical dimensions of the volunteers and driving speeds

TABLE A I
RESULTS OF THE QUESTIONNAIRE FILLED IN BY THE VOLUNTEERS

			Female		Male	
			Number	Percentage	Number	Percentage
General information before the volunteer tests	Do you have experience in the field of vehicle safety?	yes	8	26%	15	48%
		no	7	23%	1	3%
	How would you describe your current state?	calm	13	42%	15	48%
		excited	2	6%	1	3%
		nervous	0	0%	0	0%
Data on experience with e-scooters	Have you ever used an e-scooter?	yes	5	16%	7	23%
		no	10	32%	9	29%
	If yes, how often do you use the e-scooter?	occasionally	5	42%	7	58%
		weekly	0	0%	0	0%
		daily	0	0%	0	0%
	For what purpose do you use the e-scooter?	Free time	5	42%	7	58%
		Commute	0	0%	0	0%
	How do you rate your driving safety with regard to e-scooters?	unsafe	2	17%	1	8%
		practised	3	25%	4	33%
		safe	0	0%	2	17%
	Do you use personal protective equipment when using e-scooters (helmet, protectors)?	no	4	33%	3	25%
		yes, helmet	1	8%	4	33%
		yes, protectors	0	0%	0	0%
	Have you ever had an accident with an e-scooter?	no	5	42%	7	58%
		yes, single accident	0	0%	0	0%
		yes, accident with other road user	0	0%	0	0%

Information on the volunteer test	How did you feel during the driving manoeuvres?	calm	13	42%	14	45%
		excited	2	6%	2	6%
		nervous	0	0%	0	0%
	Do you have a preferred leg position on the e-scooter?	yes, always the same foot in front	11	35%	12	39%
		yes, prefer a certain foot in front	4	13%	2	6%
		no, change often	0	0%	1	3%
General information on road traffic behaviour	How do you cover most of your journeys on the road (e.g. to work)?	Car	3	7%	5	11%
		On Foot	3	7%	4	9%
		Bicycle	11	24%	13	28%
		E-scooter	0	0%	0	0%
		Public transport	3	7%	3	7%
		P2W	0	0%	1	2%
	Have you ever been involved in an accident?	yes	5	16%	7	23%
		no	10	32%	9	29%
	Do you own a bicycle helmet?	yes	11	35%	12	39%
		no	4	13%	4	13%
	If you own a bicycle helmet, do you use it regularly?	no	1	3%	1	3%
		yes, always	9	29%	8	26%
		yes, only in road traffic	0	0%	0	0%
		yes, only when doing sports	1	3%	3	10%

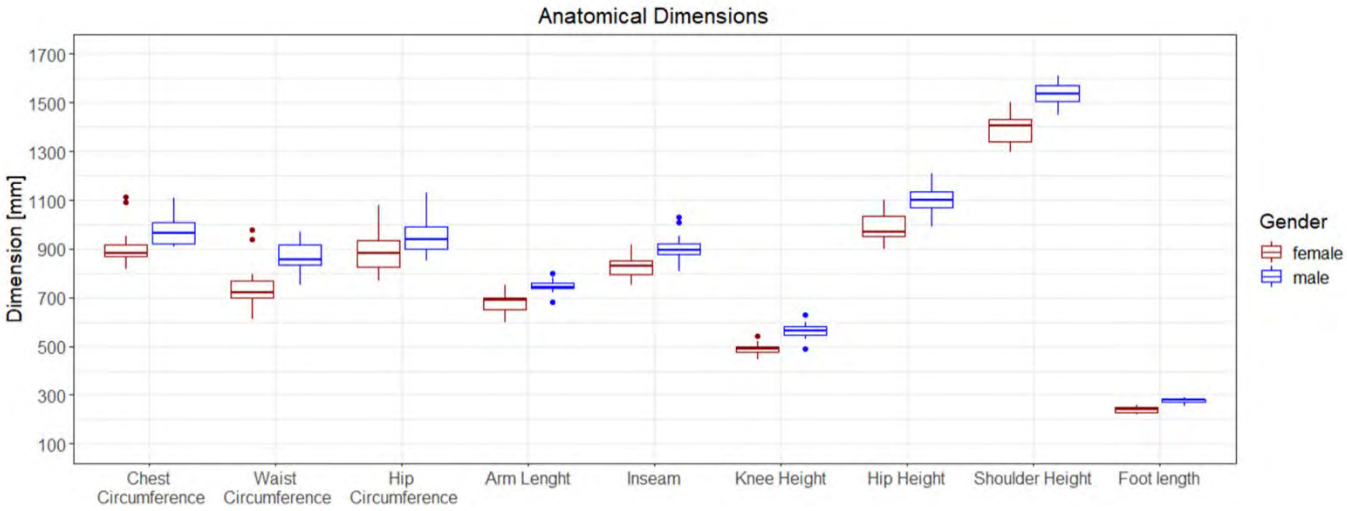


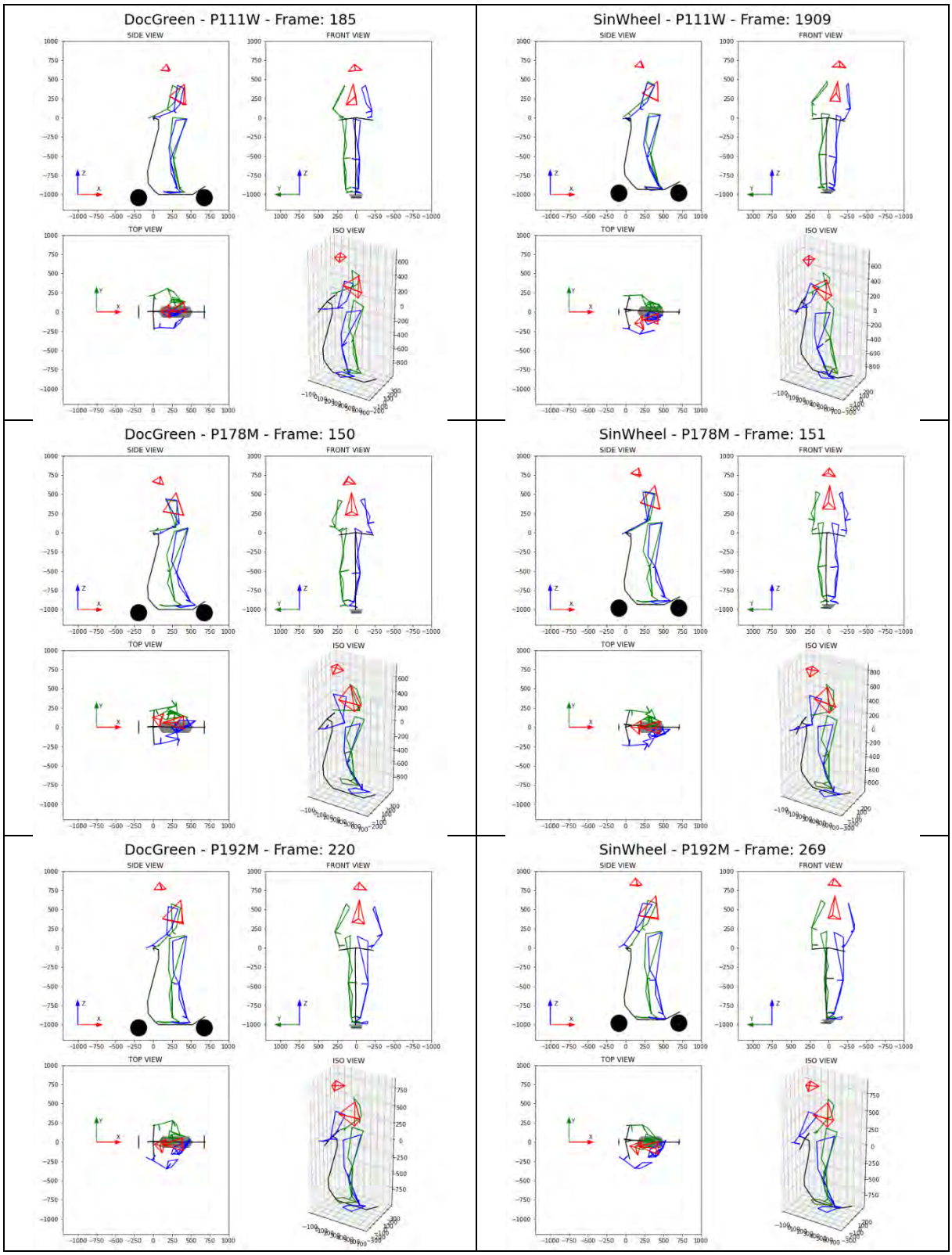
Fig. A1. Anatomical dimensions of the volunteers according to gender.

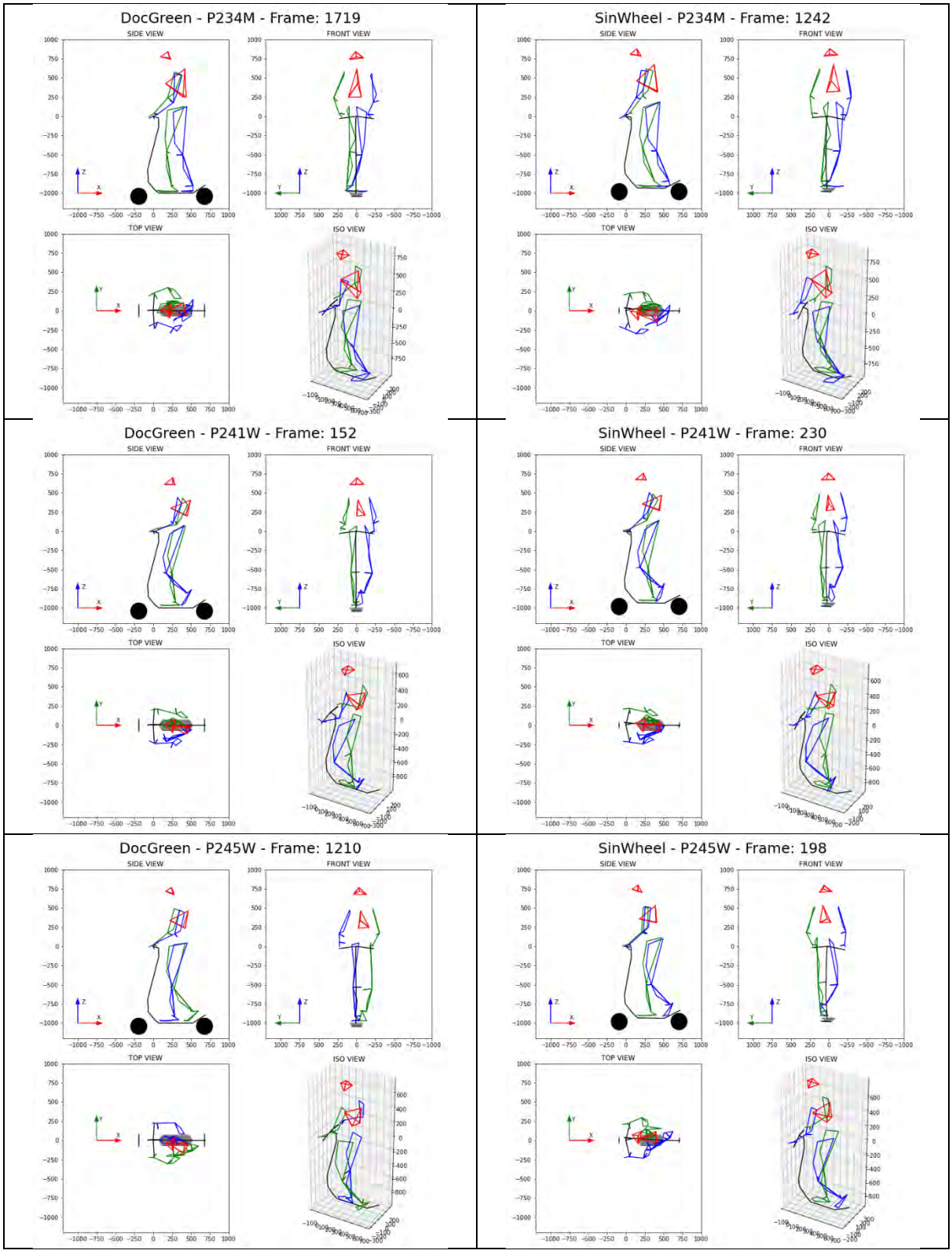
TABLE A II

ANATOMICAL DIMENSIONS AND DRIVING VELOCITY OF EACH VOLUNTEER.

Volunteer Number	Gender	Age	Weight [kg]	Height [mm]	Chest Circumference [mm]	Waist Circumference [mm]	Hip Circumference [mm]	Arm Length [mm]	Inseam [mm]	Knee Height [mm]	Hip Height [mm]	Shoulder Height [mm]	Foot Length [mm]	DocGreen [km/h]	iSinWheel [km/h]
P543W	female	28	81.3	1585	1090	940	1080	600	750	445	900	1295	230	-	-
P302W	female	33	73.3	1755	900	760	940	690	870	540	1080	1440	250	-	-
P391W	female	18	74.6	1690	950	795	930	700	830	475	1015	1405	250	-	-
P326W	female	54	100	1770	1115	980	1075	750	820	500	1100	1500	250	16.3	16.7
P411W	female	25	62.2	1680	870	705	850	700	790	475	955	1380	240	17.7	23.1
P178M	male	40	79.1	1820	960	800	870	750	880	555	1080	1510	270	20.6	26.5
P525W	female	34	56.9	1630	870	710	800	630	810	470	920	1320	230	20.1	20.4
P801M	male	24	96.5	1925	970	915	990	780	1010	570	1210	1590	260	-	-
P481W	female	24	50.3	1650	815	610	770	620	915	480	960	1340	220	15.7	19.2
P660M	male	26	81.3	1780	1000	850	905	745	880	550	1030	1470	255	20.8	25.2
P768M	male	30	80.8	1900	940	860	930	760	870	490	1100	1530	275	-	-
P298W	female	27	51.4	1630	835	685	820	670	780	490	950	1340	225	-	-
P678W	female	49	64.5	1720	930	780	890	690	830	510	1040	1430	240	15.2	24.5
P265M	male	35	97.3	1910	990	900	970	740	860	600	1090	1530	270	19.2	27.2
P234M	male	27	101.1	1880	1040	930	1000	730	920	560	1130	1580	290	-	-
P111W	female	31	55.2	1710	820	680	830	680	830	500	1000	1410	230	20.2	23.5
P447M	male	24	103.7	1840	1060	960	1130	740	840	540	1070	1530	280	19.7	-
P780M	male	34	70.8	1790	920	750	850	740	890	540	990	1450	280	19.3	27.6
P261M	male	26	76.5	1860	910	850	950	750	1030	580	1150	1570	270	19.8	21.9
P440M	male	30	81.5	1900	920	970	1010	800	950	570	1110	1560	290	18.3	25.5
P512M	male	28	83.8	1850	980	800	900	760	810	600	1100	1540	280	18.7	22.4
P852W	female	28	55.4	1610	870	690	800	650	800	480	950	1340	240	19.1	24.2
P241W	female	22	64.4	1730	870	720	890	710	860	490	1040	1420	260	17.6	23.9
P192M	male	28	93.3	1900	1050	935	970	730	930	560	1160	1570	290	12.0	21.4
P746M	male	27	79.4	1830	920	860	1000	680	910	580	1060	1490	260	19.6	25.5
P591W	female	28	67.6	1780	880	710	870	690	850	500	970	1430	260	20.1	24.9
P522M	male	29	80.8	1920	910	810	900	740	900	570	1100	1580	280	-	-
P702W	female	29	63.3	1640	900	740	880	650	780	460	940	1350	250	21.3	26.3
P245W	female	28	72.5	1780	880	760	950	700	850	520	1030	1480	250	-	19.9
P895M	male	44	81	1810	960	840	900	720	880	530	990	1490	280	20.1	-
P745M	male	26	97.7	1960	1110	850	930	800	920	630	1170	1610	280	19.7	27.0

IX. APPENDIX B: ILLUSTRATION OF THE DRIVING POSE OF EACH VOLUNTEER AND THE MEAN DRIVING POSES

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SinWheel - P234M - Frame: 1242
DocGreen - P241W - Frame: 152
SinWheel - P241W - Frame: 230
DocGreen - P245W - Frame: 1210
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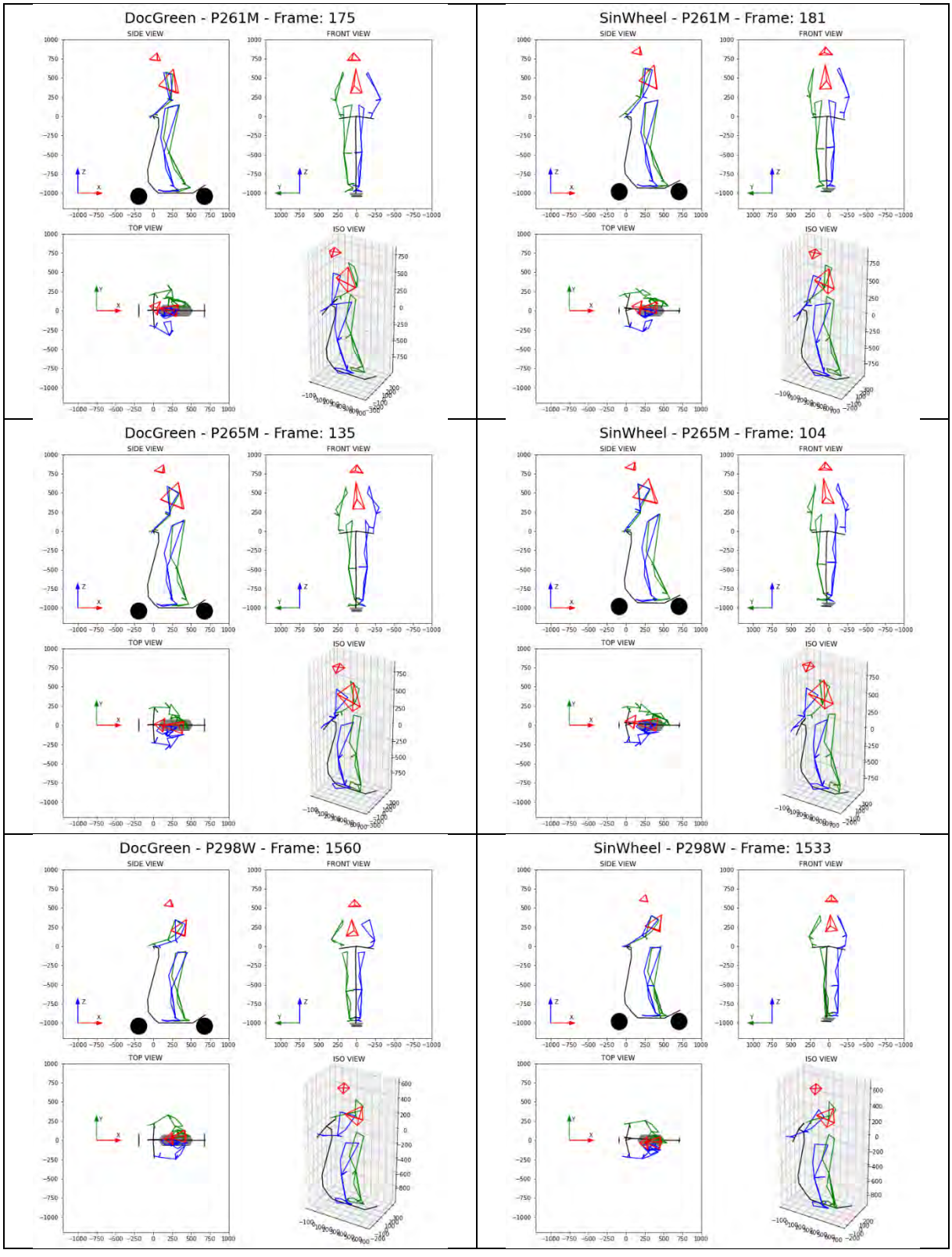
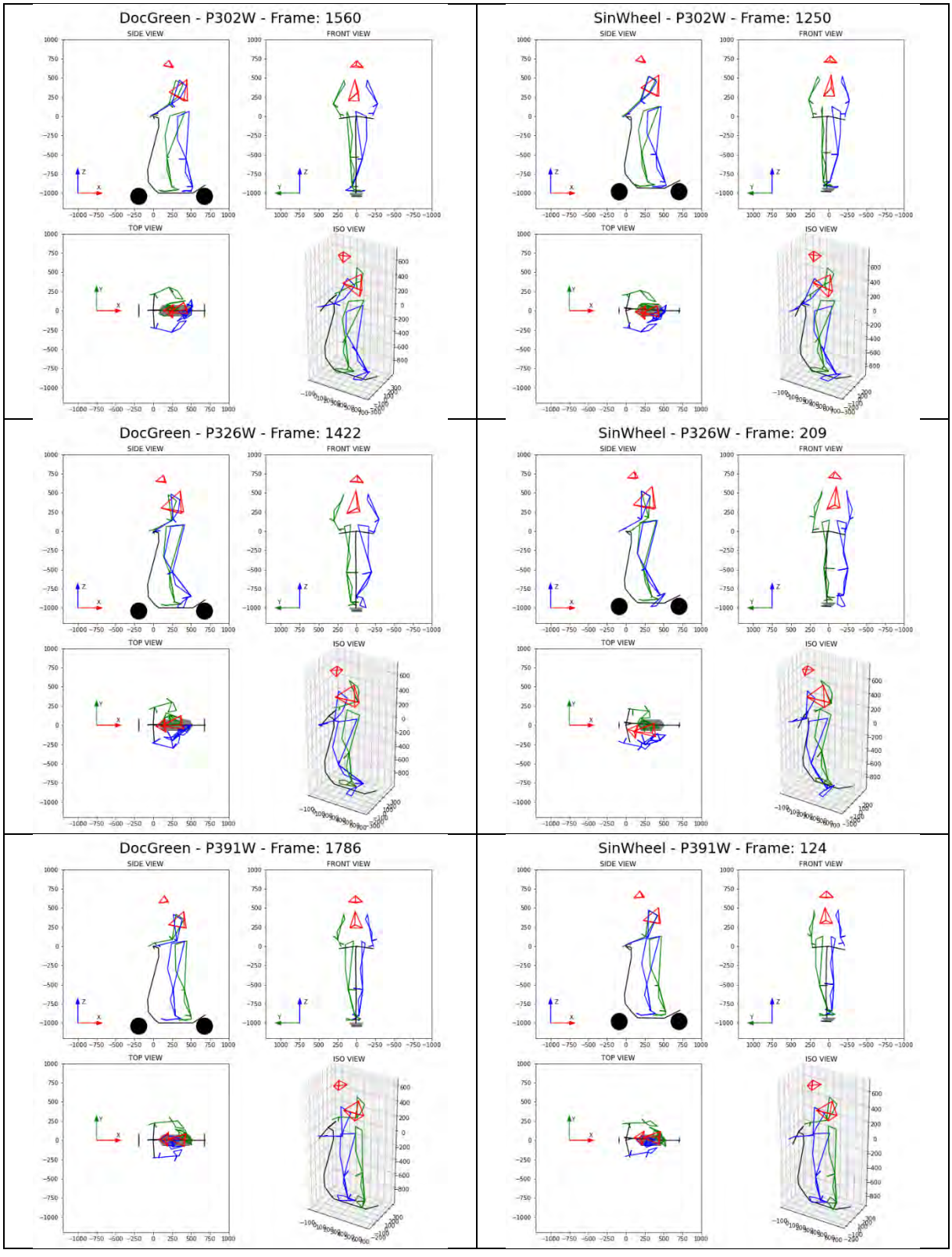
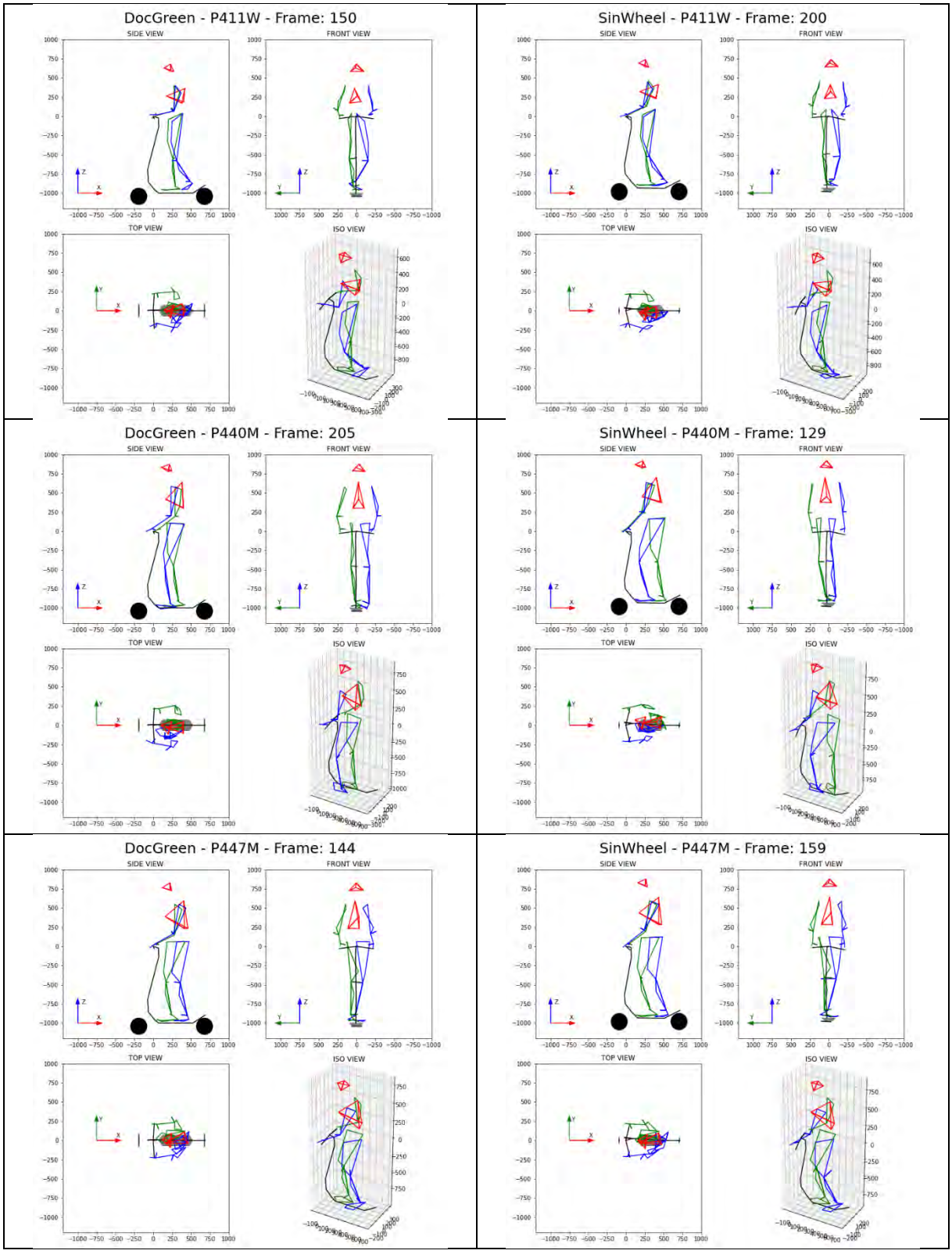
FRONT VIEW
TOP VIEW
ISO VIEW


DocGreen - P261M - Frame: 175
SIDE VIEW
FRONT VIEW
TOP VIEW
ISO VIEW
SinWheel - P261M - Frame: 181
SIDE VIEW
FRONT VIEW
TOP VIEW
ISO VIEW
DocGreen - P265M - Frame: 135
SIDE VIEW
FRONT VIEW
TOP VIEW
ISO VIEW
SinWheel - P265M - Frame: 104
SIDE VIEW
FRONT VIEW
TOP VIEW
ISO VIEW
DocGreen - P298W - Frame: 1560
SIDE VIEW
FRONT VIEW
TOP VIEW
ISO VIEW
SinWheel - P298W - Frame: 1533
SIDE VIEW
FRONT VIEW
TOP VIEW
ISO VIEW


DocGreen - P302W - Frame: 1560
SinWheel - P302W - Frame: 1250
DocGreen - P326W - Frame: 1422
SinWheel - P326W - Frame: 209
DocGreen - P391W - Frame: 1786
SinWheel - P391W - Frame: 124
SIDE VIEW
FRONT VIEW
TOP VIEW
ISO VIEW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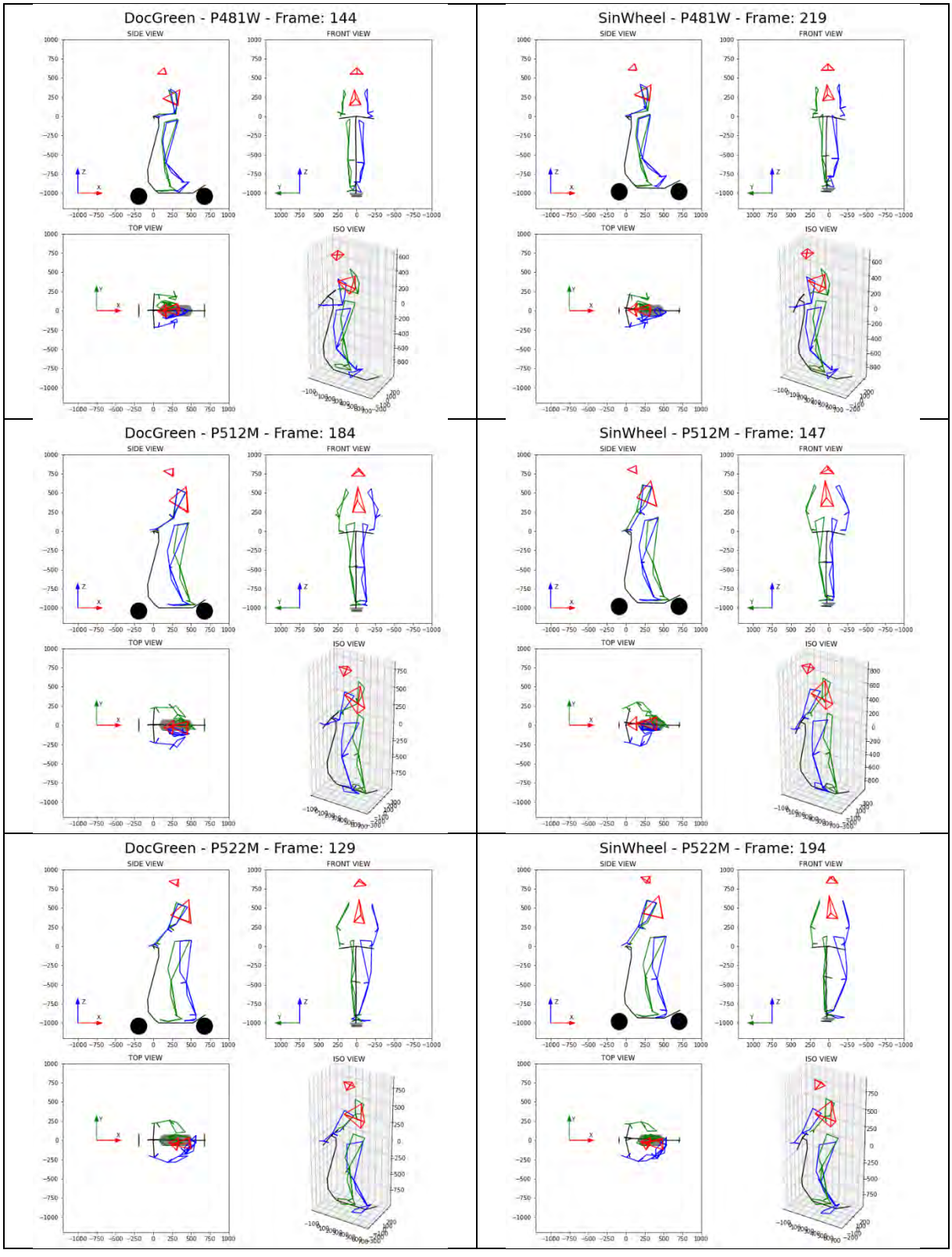
SinWheel - P411W - Frame: 200
DocGreen - P440M - Frame: 205
SinWheel - P440M - Frame: 129
DocGreen - P447M - Frame: 144
SinWheel - P447M - Frame: 159
SIDE VIEW
FRONT VIEW
TOP VIEW
ISO VIEW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SIDE VIEW
FRONT VIEW
TOP VIEW
ISO VIEW
SinWheel - P481W - Frame: 219
SIDE VIEW
FRONT VIEW
TOP VIEW
ISO VIEW
DocGreen - P512M - Frame: 184
SIDE VIEW
FRONT VIEW
TOP VIEW
ISO VIEW
SinWheel - P512M - Frame: 147
SIDE VIEW
FRONT VIEW
TOP VIEW
ISO VIEW
DocGreen - P522M - Frame: 129
SIDE VIEW
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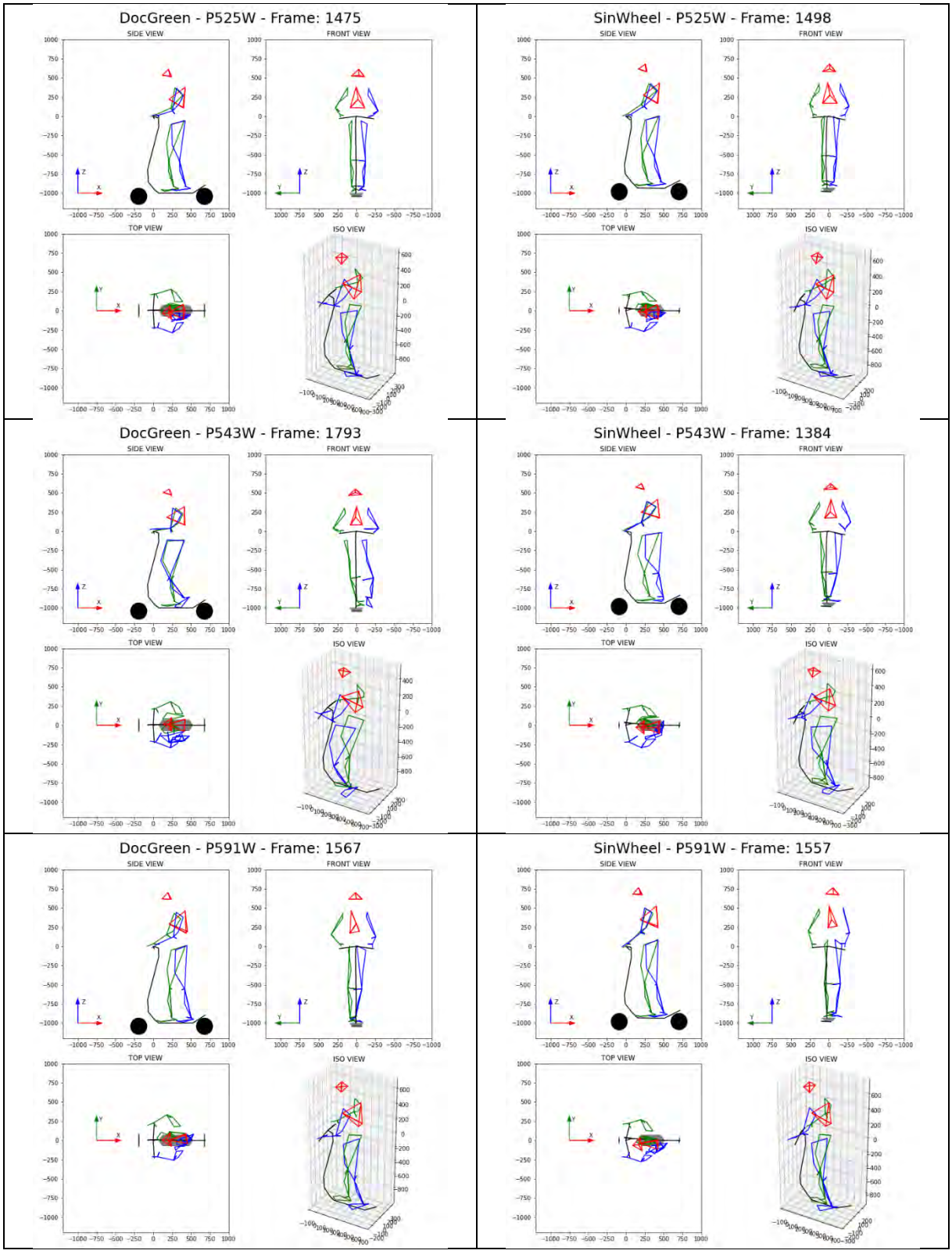
TOP VIEW
ISO VIEW
SinWheel - P522M - Frame: 194
SIDE VIEW
FRONT VIEW
TOP VIEW
ISO VIEW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SinWheel - P525W - Frame: 1498
DocGreen - P543W - Frame: 1793
SinWheel - P543W - Frame: 1384
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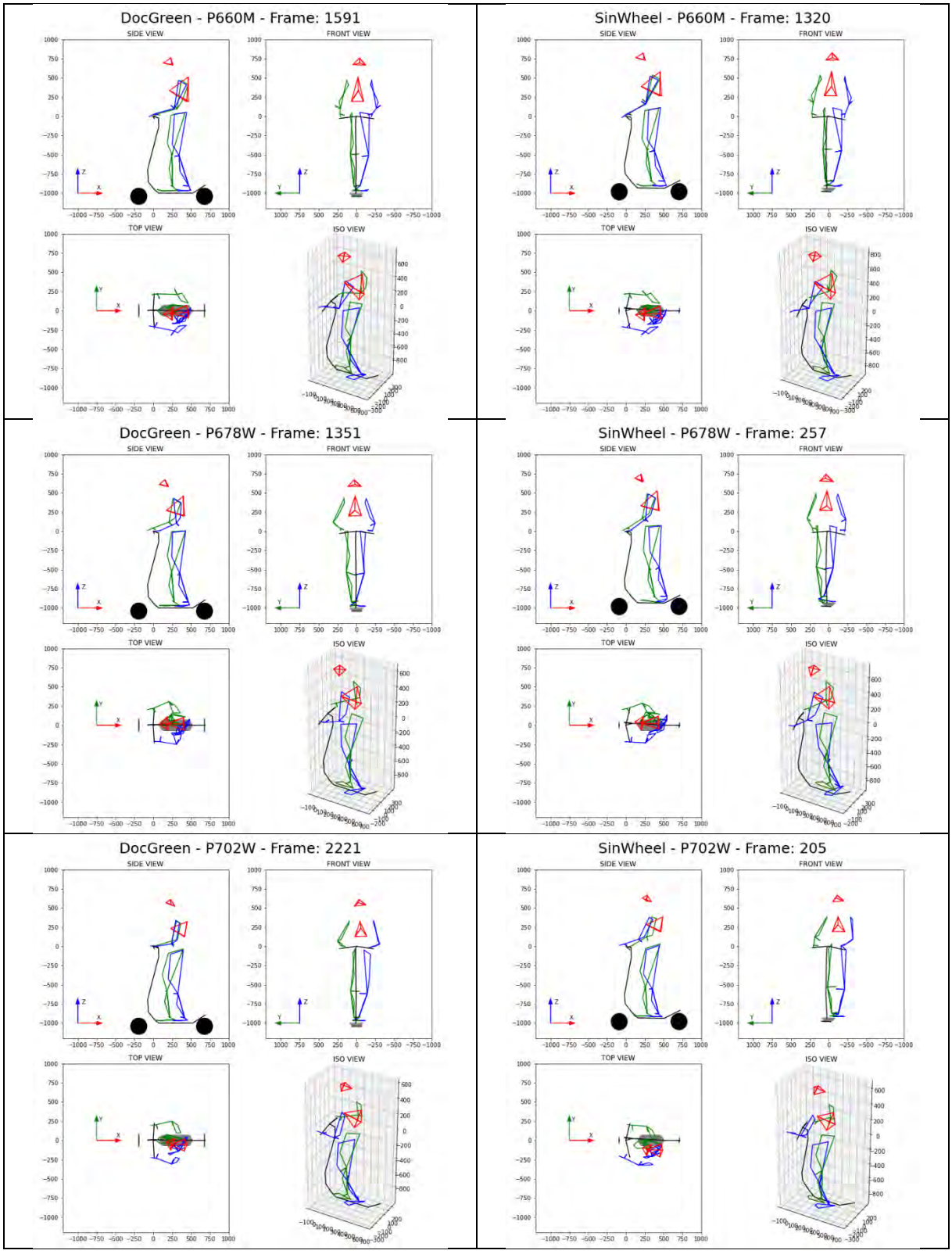
FRONT VIEW
TOP VIEW
ISO VIEW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SinWheel - P660M - Frame: 1320
DocGreen - P678W - Frame: 1351
SinWheel - P678W - Frame: 257
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SinWheel - P702W - Frame: 205
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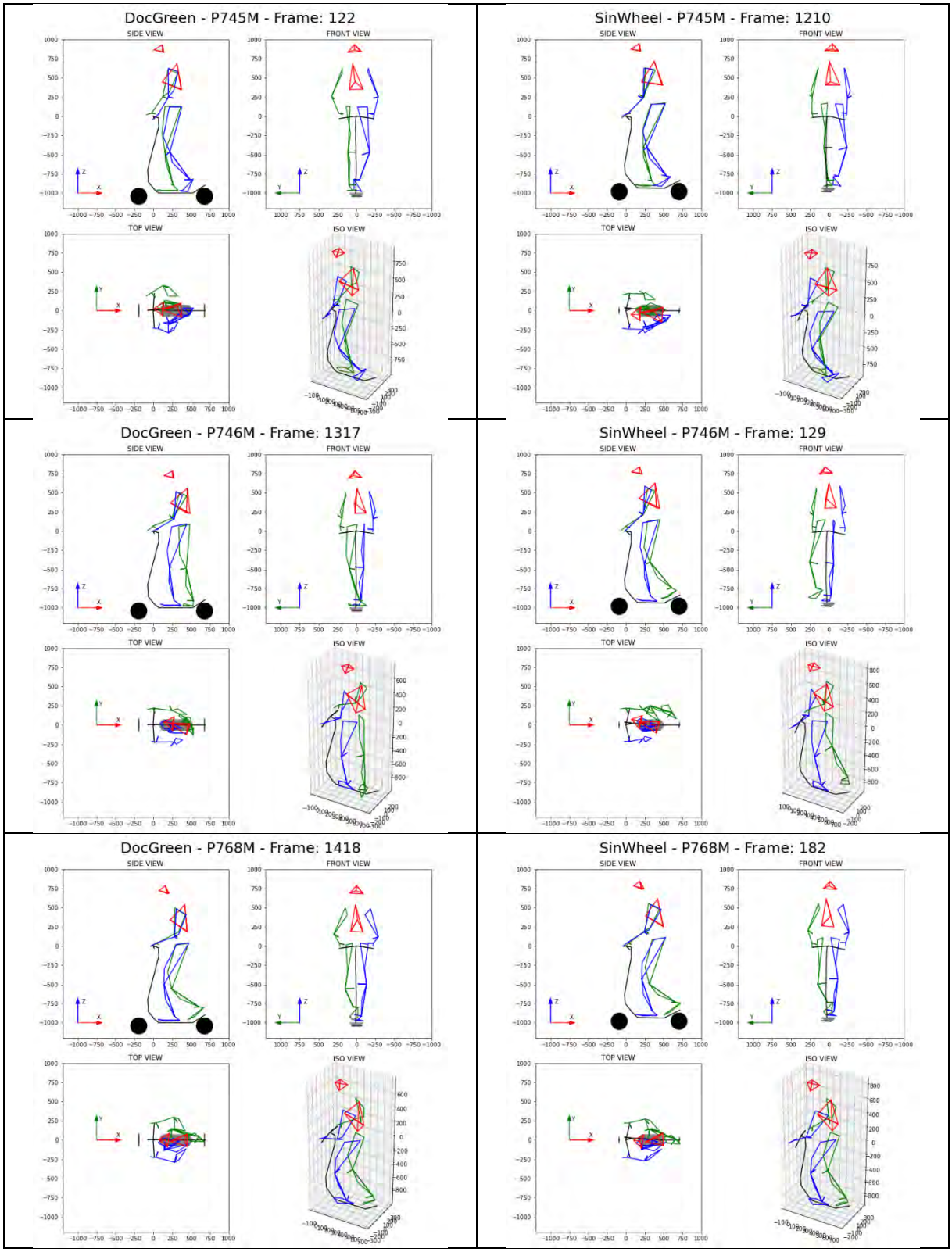
FRONT VIEW
TOP VIEW
ISO VIEW


DocGreen - P745M - Frame: 122
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FRONT VIEW
TOP VIEW
ISO VIEW
SinWheel - P745M - Frame: 1210
SIDE VIEW
FRONT VIEW
TOP VIEW
ISO VIEW
DocGreen - P746M - Frame: 1317
SIDE VIEW
FRONT VIEW
TOP VIEW
ISO VIEW
SinWheel - P746M - Frame: 129
SIDE VIEW
FRONT VIEW
TOP VIEW
ISO VIEW
DocGreen - P768M - Frame: 1418
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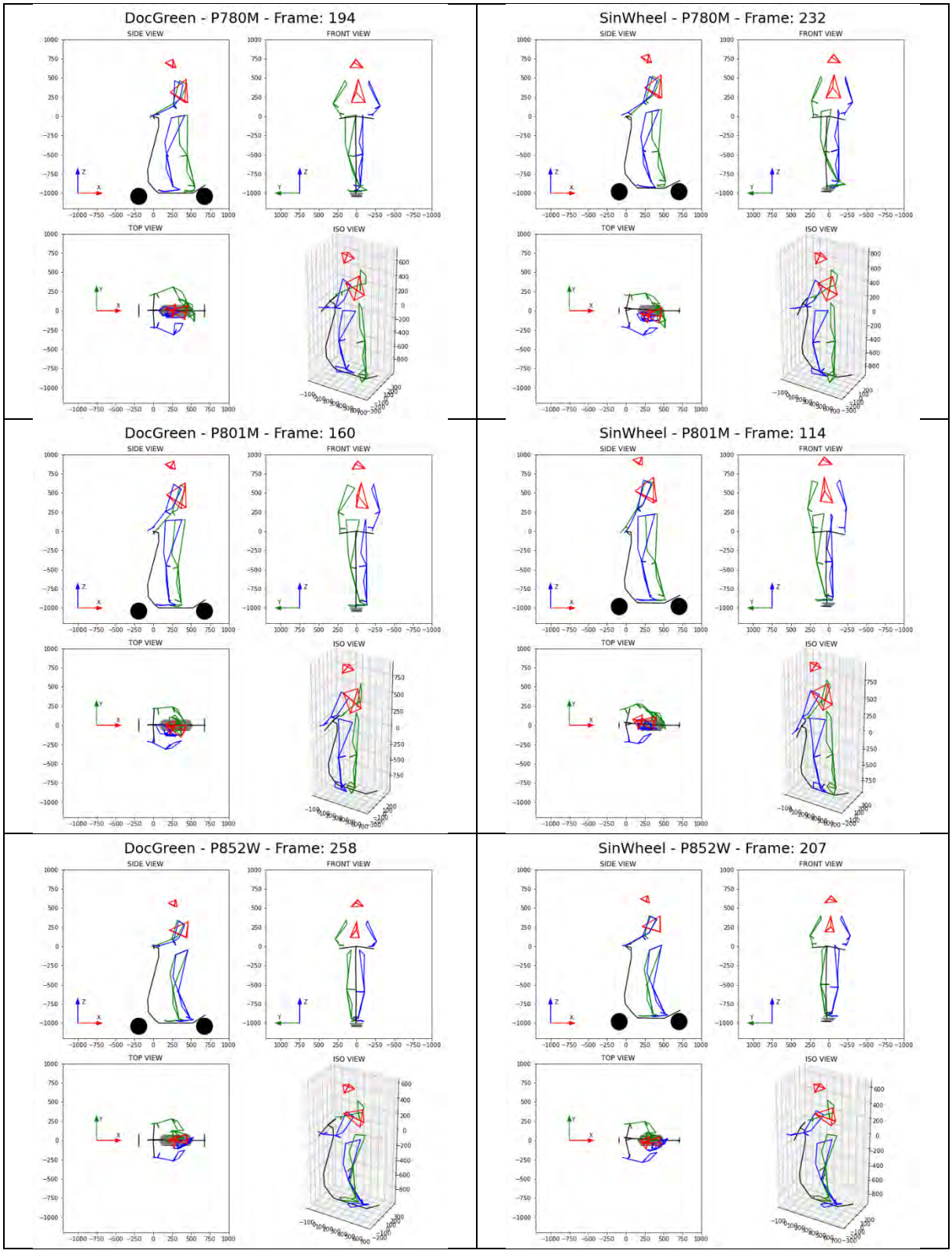
FRONT VIEW
TOP VIEW
ISO VIEW
SinWheel - P768M - Frame: 182
SIDE VIEW
FRONT VIEW
TOP VIEW
ISO VIEW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SinWheel - P780M - Frame: 232
SIDE VIEW
FRONT VIEW
TOP VIEW
ISO VIEW
DocGreen - P801M - Frame: 160
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FRONT VIEW
TOP VIEW
ISO VIEW
SinWheel - P801M - Frame: 114
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FRONT VIEW
TOP VIEW
ISO VIEW
DocGreen - P852W - Frame: 258
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ISO VIEW
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SIDE VIEW
FRONT VIEW
TOP VIEW
ISO VIEW

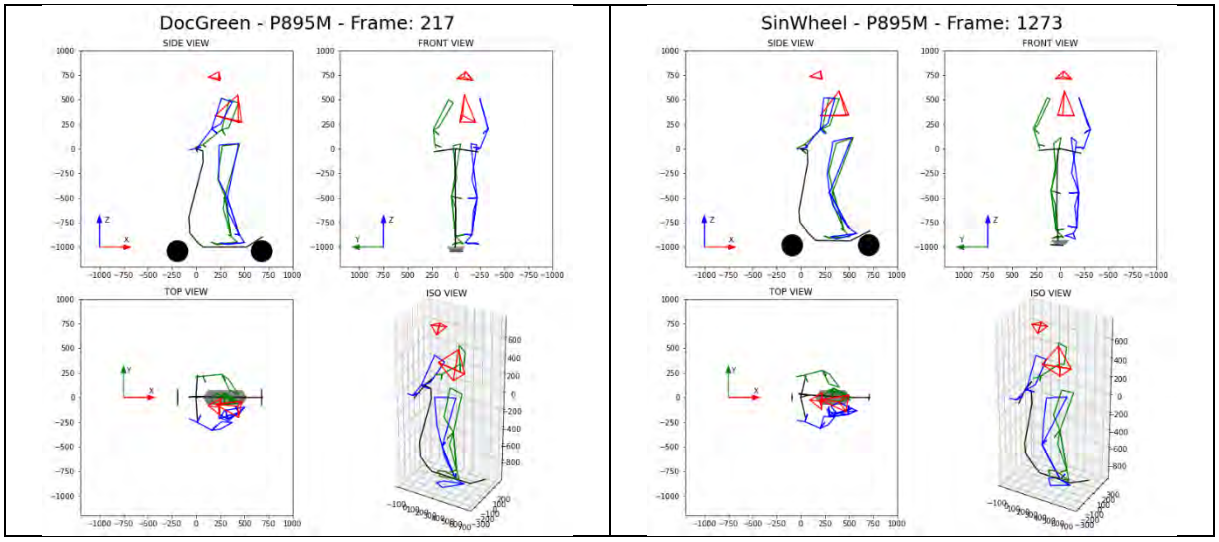
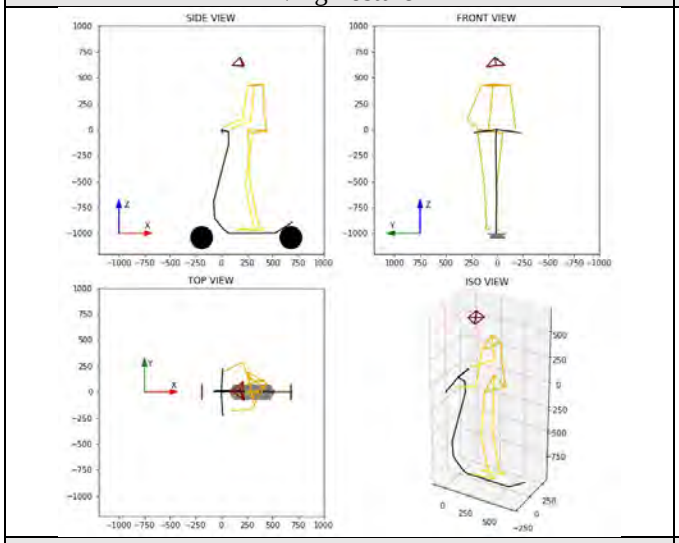
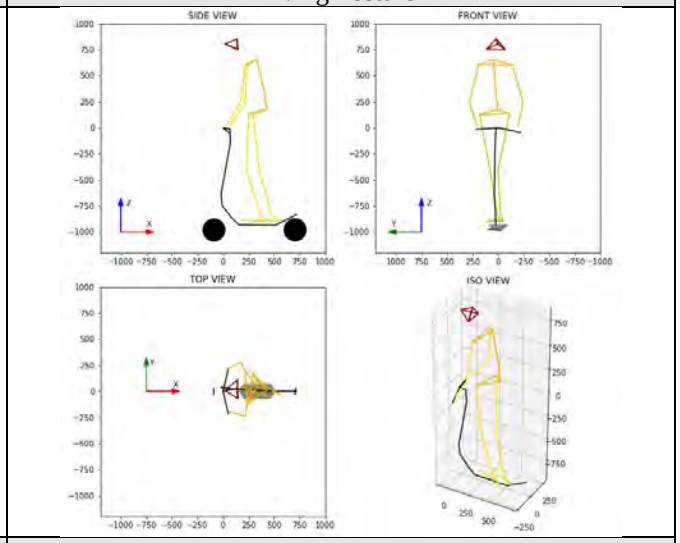
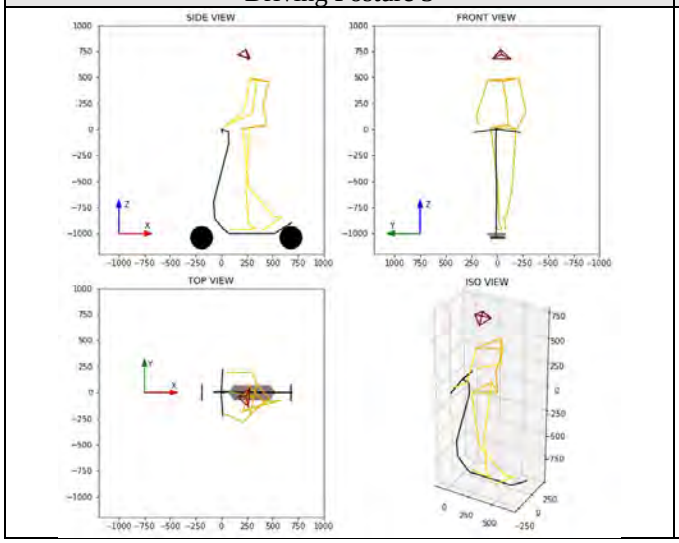
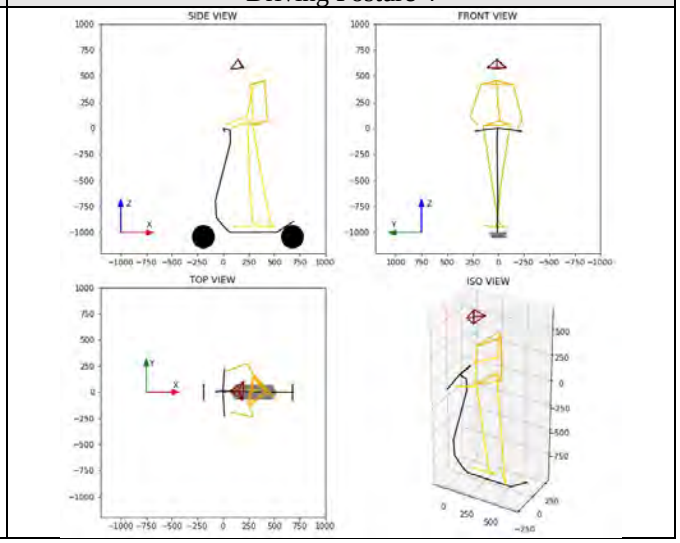


Fig. B1. Stick figure of each volunteer on the DocGreen and iSinWheel scooter.

Driving Posture 1	Driving Posture 2
	
Driving Posture 3	**Driving Posture 4**
	

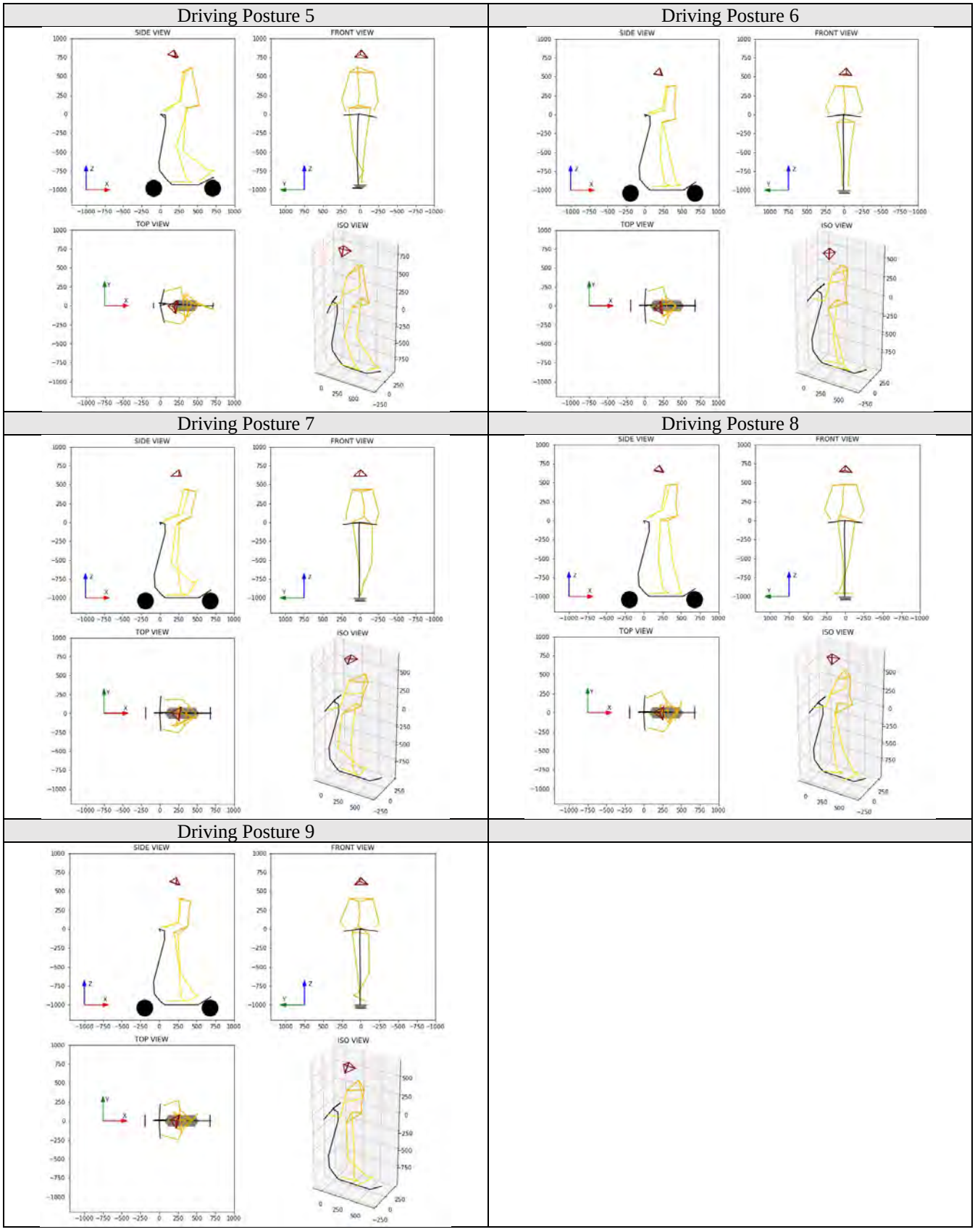


Fig. B2. Stick figure of the calculated mean joint angles for all nine defined driving postures for female and male volunteers.

X. APPENDIX C: DETAILED RESULTS OF THE INDIVIDUAL DRIVING POSTURES

TABLE C I

DRIVING POSTURE 1 FOR DIFFERENT SCOOTER TYPES AND SEXES.

Driving Posture 1

female

Proband	Scooter	Left Elbow X [deg]	Left Elbow Y [deg]	Left Elbow Z [deg]	Right Elbow X [deg]	Right Elbow Y [deg]	Right Elbow Z [deg]	Left shoulder X [deg]	Left shoulder Y [deg]	Left shoulder Z [deg]	Right shoulder X [deg]	Right shoulder Y [deg]	Right shoulder Z [deg]	Left Knee X [deg]	Left Knee Y [deg]	Left Knee Z [deg]	Right Knee X [deg]	Right Knee Y [deg]	Right Knee Z [deg]	Left Foot X [deg]	Left Foot Y [deg]	Left Foot Z [deg]	Right Foot X [deg]	Right Foot Y [deg]	Right Foot Z [deg]	Left Hip X [deg]	Left Hip Y [deg]	Left Hip Z [deg]	Right Hip X [deg]	Right Hip Y [deg]	Right Hip Z [deg]	Right Foot Mz [deg]	Left Foot Mz [deg]
P111W	DocGreen	19.5	90.9	70.6	33.1	65.3	69.4	84.8	82.2	9.4	82.0	67.3	24.2	78.8	89.5	168.8	78.5	87.0	168.1	11.0	79.2	88.1	12.9	102.7	87.5	97.6	96.7	169.8	87.5	97.4	172.2	12.7	10.8

male

Proband	Scooter	Left Elbow X [deg]	Left Elbow Y [deg]	Left Elbow Z [deg]	Right Elbow X [deg]	Right Elbow Y [deg]	Right Elbow Z [deg]	Left shoulder X [deg]	Left shoulder Y [deg]	Left shoulder Z [deg]	Right shoulder X [deg]	Right shoulder Y [deg]	Right shoulder Z [deg]	Left Knee X [deg]	Left Knee Y [deg]	Left Knee Z [deg]	Right Knee X [deg]	Right Knee Y [deg]	Right Knee Z [deg]	Left Foot X [deg]	Left Foot Y [deg]	Left Foot Z [deg]	Right Foot X [deg]	Right Foot Y [deg]	Right Foot Z [deg]	Left Hip X [deg]	Left Hip Y [deg]	Left Hip Z [deg]	Right Hip X [deg]	Right Hip Y [deg]	Right Hip Z [deg]	Right Foot Mz [deg]	Left Foot Mz [deg]
P895M	SinWheel	47.0	72.7	48.1	39.5	77.3	53.4	87.8	75.3	14.8	81.8	71.5	20.3	60.2	87.7	150.1	74.9	83.5	163.5	11.3	99.3	96.3	11.4	78.7	88.4	94.4	92.7	174.9	94.5	92.3	175.0	11.3	9.3

TABLE C II

DRIVING POSTURE 2 FOR DIFFERENT SCOOTER TYPES AND SEXES.

Driving Posture 2

female

Proband	Scooter	Left Elbow X [deg]	Left Elbow Y [deg]	Left Elbow Z [deg]	Right Elbow X [deg]	Right Elbow Y [deg]	Right Elbow Z [deg]	Left shoulder X [deg]	Left shoulder Y [deg]	Left shoulder Z [deg]	Right shoulder X [deg]	Right shoulder Y [deg]	Right shoulder Z [deg]	Left Knee X [deg]	Left Knee Y [deg]	Left Knee Z [deg]	Right Knee X [deg]	Right Knee Y [deg]	Right Knee Z [deg]	Left Foot X [deg]	Left Foot Y [deg]	Left Foot Z [deg]	Right Foot X [deg]	Right Foot Y [deg]	Right Foot Z [deg]	Left Hip X [deg]	Left Hip Y [deg]	Left Hip Z [deg]	Right Hip X [deg]	Right Hip Y [deg]	Right Hip Z [deg]	Right Foot Mz [deg]	Left Foot Mz [deg]
P298W	DocGreen	18.4	83.9	72.7	31.8	60.5	79.1	93.1	81.6	9.0	76.0	65.6	28.6	82.9	89.8	172.9	76.2	84.8	165.2	3.0	92.7	88.8	2.2	87.9	90.4	99.1	100.5	166.0	87.0	101.5	168.1	2.1	2.7
P298W	SinWheel	34.3	86.1	56.0	23.8	80.8	68.2	68.8	71.4	28.8	77.7	68.8	24.8	79.8	89.6	169.8	80.9	78.0	164.8	6.4	96.4	89.5	9.6	80.4	90.1	89.7	101.5	168.5	81.3	96.8	168.9	9.6	6.4
mean		**26.4**	**85.0**	**64.4**	**27.8**	**70.7**	**73.7**	**81.0**	**76.5**	**18.9**	**76.9**	**67.2**	**26.7**	**81.4**	**89.7**	**171.4**	**78.6**	**81.4**	**165.0**	**4.7**	**94.6**	**89.2**	**5.9**	**84.2**	**90.3**	**94.4**	**101.0**	**167.3**	**84.2**	**99.2**	**168.5**	**5.9**	**4.6**

male

Proband	Scooter	Left Elbow X [deg]	Left Elbow Y [deg]	Left Elbow Z [deg]	Right Elbow X [deg]	Right Elbow Y [deg]	Right Elbow Z [deg]	Left shoulder X [deg]	Left shoulder Y [deg]	Left shoulder Z [deg]	Right shoulder X [deg]	Right shoulder Y [deg]	Right shoulder Z [deg]	Left Knee X [deg]	Left Knee Y [deg]	Left Knee Z [deg]	Right Knee X [deg]	Right Knee Y [deg]	Right Knee Z [deg]	Left Foot X [deg]	Left Foot Y [deg]	Left Foot Z [deg]	Right Foot X [deg]	Right Foot Y [deg]	Right Foot Z [deg]	Left Hip X [deg]	Left Hip Y [deg]	Left Hip Z [deg]	Right Hip X [deg]	Right Hip Y [deg]	Right Hip Z [deg]	Right Foot Mz [deg]	Left Foot Mz [deg]
P261M	DocGreen	45.2	68.4	52.7	51.4	68.1	46.6	104.5	69.7	25.3	97.6	71.6	20.0	76.5	86.3	166.0	63.3	84.7	152.7	7.7	82.6	87.9	16.5	75.6	97.9	91.2	97.6	172.3	89.4	95.8	174.1	14.6	7.4
P440M	DocGreen	45.4	70.5	51.1	37.5	81.7	53.8	85.2	75.8	15.0	92.6	80.1	10.2	81.5	88.9	171.4	82.5	83.0	169.7	18.1	107.0	84.0	13.3	76.7	90.3	97.3	94.3	171.6	81.6	94.3	170.5	13.3	17.1
P512M	DocGreen	44.6	72.5	50.6	48.2	79.5	43.7	79.0	76.9	17.2	76.7	73.1	21.8	70.2	94.7	159.6	75.7	81.9	163.5	11.0	101.0	90.1	21.6	68.4	89.9	95.2	100.4	168.4	87.3	100.5	169.2	21.6	11.0
P261M	SinWheel	48.1	76.7	45.0	56.1	75.3	37.8	88.8	75.2	14.9	79.1	79.9	14.9	79.4	87.0	168.9	68.6	86.2	158.2	7.4	83.5	86.4	14.3	75.7	90.0	90.0	96.4	173.6	84.3	97.2	170.9	14.3	6.5
P512M	SinWheel	55.9	79.7	36.1	59.7	73.9	35.1	88.0	74.8	15.3	82.6	76.0	16.0	72.0	93.1	161.7	74.7	80.9	162.1	19.4	109.4	89.3	28.9	61.1	91.3	92.6	101.8	167.9	83.6	100.7	167.5	28.9	19.4
mean		**47.8**	**73.6**	**47.1**	**50.6**	**75.7**	**43.4**	**89.1**	**74.5**	**17.5**	**85.7**	**76.1**	**16.6**	**75.9**	**90.0**	**165.5**	**73.0**	**83.3**	**161.2**	**12.7**	**96.7**	**87.5**	**18.9**	**71.5**	**91.9**	**93.3**	**98.1**	**170.8**	**85.2**	**97.7**	**170.4**	**18.5**	**12.3**

TABLE C III

DRIVING POSTURE 3 FOR DIFFERENT SCOOTER TYPES AND SEXES.

Driving Posture 3

female

Proband	Scooter	Left Elbow X [deg]	Left Elbow Y [deg]	Left Elbow Z [deg]	Right Elbow X [deg]	Right Elbow Y [deg]	Right Elbow Z [deg]	Left shoulder X [deg]	Left shoulder Y [deg]	Left shoulder Z [deg]	Right shoulder X [deg]	Right shoulder Y [deg]	Right shoulder Z [deg]	Left Knee X [deg]	Left Knee Y [deg]	Left Knee Z [deg]	Right Knee X [deg]	Right Knee Y [deg]	Right Knee Z [deg]	Left Foot X [deg]	Left Foot Y [deg]	Left Foot Z [deg]	Right Foot X [deg]	Right Foot Y [deg]	Right Foot Z [deg]	Left Hip X [deg]	Left Hip Y [deg]	Left Hip Z [deg]	Right Hip X [deg]	Right Hip Y [deg]	Right Hip Z [deg]	Right Foot Mz [deg]	Left Foot Mz [deg]
P245W	DocGreen	22.1	92.1	68.0	40.6	109.3	55.9	82.3	108.2	19.9	79.9	101.9	15.7	85.7	92.3	175.1	49.8	98.7	138.5	12.3	102.1	92.2	34.4	92.8	124.2	93.9	82.9	171.9	84.3	86.5	173.3	3.4	12.1

male

Proband	Scooter	Left Elbow X [deg]	Left Elbow Y [deg]	Left Elbow Z [deg]	Right Elbow X [deg]	Right Elbow Y [deg]	Right Elbow Z [deg]	Left shoulder X [deg]	Left shoulder Y [deg]	Left shoulder Z [deg]	Right shoulder X [deg]	Right shoulder Y [deg]	Right shoulder Z [deg]	Left Knee X [deg]	Left Knee Y [deg]	Left Knee Z [deg]	Right Knee X [deg]	Right Knee Y [deg]	Right Knee Z [deg]	Left Foot X [deg]	Left Foot Y [deg]	Left Foot Z [deg]	Right Foot X [deg]	Right Foot Y [deg]	Right Foot Z [deg]	Left Hip X [deg]	Left Hip Y [deg]	Left Hip Z [deg]	Right Hip X [deg]	Right Hip Y [deg]	Right Hip Z [deg]	Right Foot Mz [deg]	Left Foot Mz [deg]
P768M	DocGreen	20.6	76.6	74.7	28.7	74.1	66.8	89.0	80.1	9.9	91.3	72.0	18.0	72.9	82.5	161.2	37.0	78.1	124.4	5.4	84.8	88.4	39.4	74.2	125.0	107.3	98.2	160.7	95.6	94.6	172.8	19.4	5.2

TABLE C IV

DRIVING POSTURE 4 FOR DIFFERENT SCOOTER TYPES AND SEXES.

Driving Posture 4

female

Proband	Scooter	Left Elbow X [deg]	Left Elbow Y [deg]	Left Elbow Z [deg]	Right Elbow X [deg]	Right Elbow Y [deg]	Right Elbow Z [deg]	Left shoulder X [deg]	Left shoulder Y [deg]	Left shoulder Z [deg]	Right shoulder X [deg]	Right shoulder Y [deg]	Right shoulder Z [deg]	Left Knee X [deg]	Left Knee Y [deg]	Left Knee Z [deg]	Right Knee X [deg]	Right Knee Y [deg]	Right Knee Z [deg]	Left Foot X [deg]	Left Foot Y [deg]	Left Foot Z [deg]	Right Foot X [deg]	Right Foot Y [deg]	Right Foot Z [deg]	Left Hip X [deg]	Left Hip Y [deg]	Left Hip Z [deg]	Right Hip X [deg]	Right Hip Y [deg]	Right Hip Z [deg]	Right Foot Mz [deg]	Left Foot Mz [deg]
P391W	DocGreen	21.6	79.9	71.1	27.2	71.0	71.4	95.5	75.4	15.7	78.5	71.6	21.9	85.4	84.5	172.8	78.9	80.4	165.3	0.7	90.1	90.7	49.1	41.0	87.6	88.2	98.8	171.0	80.1	98.7	166.7	49.0	0.1
P391W	SinWheel	22.4	84.3	68.5	33.8	75.7	60.1	87.0	80.4	10.0	77.3	80.3	16.1	82.1	88.6	172.0	77.4	75.2	160.4	2.8	87.5	88.9	52.5	37.6	87.6	89.7	97.6	172.4	80.7	99.6	166.6	52.5	2.5
mean		**22.0**	**82.1**	**69.8**	**30.5**	**73.4**	**65.8**	**91.3**	**77.9**	**12.9**	**77.9**	**76.0**	**19.0**	**83.8**	**86.6**	**172.4**	**78.2**	**77.8**	**162.9**	**1.8**	**88.8**	**89.8**	**50.8**	**39.3**	**87.6**	**89.0**	**98.2**	**171.7**	**80.4**	**99.2**	**166.7**	**50.8**	**1.3**

male

Proband	Scooter	Left Elbow X [deg]	Left Elbow Y [deg]	Left Elbow Z [deg]	Right Elbow X [deg]	Right Elbow Y [deg]	Right Elbow Z [deg]	Left shoulder X [deg]	Left shoulder Y [deg]	Left shoulder Z [deg]	Right shoulder X [deg]	Right shoulder Y [deg]	Right shoulder Z [deg]	Left Knee X [deg]	Left Knee Y [deg]	Left Knee Z [deg]	Right Knee X [deg]	Right Knee Y [deg]	Right Knee Z [deg]	Left Foot X [deg]	Left Foot Y [deg]	Left Foot Z [deg]	Right Foot X [deg]	Right Foot Y [deg]	Right Foot Z [deg]	Left Hip X [deg]	Left Hip Y [deg]	Left Hip Z [deg]	Right Hip X [deg]	Right Hip Y [deg]	Right Hip Z [deg]	Right Foot Mz [deg]	Left Foot Mz [deg]
P265M	DocGreen	54.0	69.4	43.2	53.7	78.0	38.9	91.2	71.2	18.8	87.1	71.6	18.6	82.5	83.9	170.3	75.7	81.9	163.5	10.1	79.9	89.2	32.2	57.8	89.6	96.4	98.1	169.6	85.1	98.7	170.0	32.2	10.1
P746M	DocGreen	37.8	75.9	55.8	31.1	83.3	59.8	82.8	77.5	14.5	70.1	77.3	23.9	83.1	86.2	172.1	78.0	74.2	159.9	13.4	103.0	86.7	63.6	27.1	84.0	92.2	96.4	173.2	83.8	96.6	170.9	63.5	13.0
P780M	DocGreen	30.0	69.3	69.3	30.9	72.4	65.5	90.6	71.5	18.5	79.0	69.5	23.5	80.3	86.6	169.7	76.4	72.0	157.2	3.3	93.2	90.8	64.1	25.9	89.9	96.1	97.0	170.7	81.8	98.5	168.1	64.1	3.2
P801M	DocGreen	48.4	71.2	47.6	44.6	85.3	45.8	78.0	82.1	14.4	76.2	77.3	18.9	86.9	90.7	176.8	85.8	76.5	165.8	28.0	118.0	89.1	57.0	33.0	90.6	86.5	92.7	175.6	89.5	98.5	171.5	57.0	28.0
P265M	SinWheel	61.5	76.4	32.2	62.1	80.0	30.0	89.9	70.3	19.7	88.1	78.3	11.8	79.8	84.4	168.3	66.5	80.8	154.6	6.7	83.3	89.7	34.0	56.0	89.7	93.3	98.7	170.7	85.4	97.8	170.9	34.0	6.7
P440M	SinWheel	54.2	85.0	36.3	45.6	79.9	46.2	81.8	79.7	13.2	81.1	86.3	9.6	75.7	93.3	165.3	82.0	78.8	166.2	20.6	110.3	87.0	42.5	47.6	88.1	101.8	97.1	166.2	80.3	96.7	168.2	42.4	20.4
P780M	SinWheel	37.2	68.7	61.1	39.5	86.8	50.7	79.6	79.4	15.0	77.8	76.4	18.5	77.0	90.6	167.0	77.5	66.6	153.1	9.5	94.3	81.5	67.4	22.9	93.4	92.5	96.7	172.8	85.1	97.5	171.0	67.3	4.3
P801M	SinWheel	59.8	79.1	32.5	55.5	76.2	38.0	81.9	78.3	14.3	76.8	85.9	13.8	78.3	91.5	168.2	76.6	77.6	161.5	23.4	113.2	87.5	49.3	40.7	88.7	82.6	94.8	171.2	80.6	98.8	167.1	49.3	23.2
mean		**47.9**	**74.4**	**47.3**	**45.4**	**80.2**	**46.9**	**84.5**	**76.3**	**16.1**	**79.5**	**77.8**	**17.3**	**80.5**	**88.4**	**169.7**	**77.3**	**76.1**	**160.2**	**14.4**	**99.4**	**87.7**	**51.3**	**38.9**	**89.3**	**92.7**	**96.4**	**171.3**	**84.0**	**97.9**	**169.7**	**51.2**	**13.6**

TABLE C V

DRIVING POSTURE 5 FOR DIFFERENT SCOOTER TYPES AND SEXES.

Driving Posture 5

female

n.A.

male

Proband	Scooter	Left Elbow X [deg]	Left Elbow Y [deg]	Left Elbow Z [deg]	Right Elbow X [deg]	Right Elbow Y [deg]	Right Elbow Z [deg]	Left shoulder X [deg]	Left shoulder Y [deg]	Left shoulder Z [deg]	Right shoulder X [deg]	Right shoulder Y [deg]	Right shoulder Z [deg]	Left Knee X [deg]	Left Knee Y [deg]	Left Knee Z [deg]	Right Knee X [deg]	Right Knee Y [deg]	Right Knee Z [deg]	Left Foot X [deg]	Left Foot Y [deg]	Left Foot Z [deg]	Right Foot X [deg]	Right Foot Y [deg]	Right Foot Z [deg]	Left Hip X [deg]	Left Hip Y [deg]	Left Hip Z [deg]	Right Hip X [deg]	Right Hip Y [deg]	Right Hip Z [deg]	Right Foot Mz [deg]	Left Foot Mz [deg]
P746M	SinWheel	50.2	85.0	40.2	42.4	82.6	48.6	82.7	81.0	11.7	76.1	79.7	17.4	80.3	86.2	169.6	50.6	81.2	139.3	14.9	103.4	83.7	43.8	53.8	111.3	86.7	97.4	171.9	88.6	84.9	174.7	39.3	13.5
P768M	SinWheel	30.1	79.1	62.4	36.5	78.5	55.9	79.4	83.1	12.7	86.8	73.6	16.7	72.6	84.8	161.8	39.5	74.6	125.4	5.4	85.4	87.2	39.8	71.2	123.5	106.8	98.0	161.3	94.1	96.3	172.5	22.7	4.6
mean		**40.2**	**82.1**	**51.3**	**39.5**	**80.6**	**52.3**	**81.1**	**82.1**	**12.2**	**81.5**	**76.7**	**17.1**	**76.5**	**85.5**	**165.7**	**45.1**	**77.9**	**132.4**	**10.2**	**94.4**	**85.5**	**41.8**	**62.5**	**117.4**	**96.8**	**97.7**	**166.6**	**91.4**	**90.6**	**173.6**	**31.0**	**9.1**

TABLE C VI

DRIVING POSTURE 6 FOR DIFFERENT SCOOTER TYPES AND SEXES.

Driving Posture 6

female

Proband	Scooter	Left Elbow X [deg]	Left Elbow Y [deg]	Left Elbow Z [deg]	Right Elbow X [deg]	Right Elbow Y [deg]	Right Elbow Z [deg]	Left shoulder X [deg]	Left shoulder Y [deg]	Left shoulder Z [deg]	Right shoulder X [deg]	Right shoulder Y [deg]	Right shoulder Z [deg]	Left Knee X [deg]	Left Knee Y [deg]	Left Knee Z [deg]	Right Knee X [deg]	Right Knee Y [deg]	Right Knee Z [deg]	Left Foot X [deg]	Left Foot Y [deg]	Left Foot Z [deg]	Right Foot X [deg]	Right Foot Y [deg]	Right Foot Z [deg]	Left Hip X [deg]	Left Hip Y [deg]	Left Hip Z [deg]	Right Hip X [deg]	Right Hip Y [deg]	Right Hip Z [deg]	Right Foot Mz [deg]	Left Foot Mz [deg]
P525W	DocGreen	22.9	71.9	76.4	24.9	74.7	70.8	82.9	73.1	18.4	82.6	64.6	26.6	76.7	87.5	166.5	80.0	88.4	169.9	4.4	87.4	93.5	7.2	96.6	92.7	78.1	97.9	165.7	92.0	98.2	171.6	6.6	2.6
P525W	SinWheel	32.2	74.9	62.3	33.1	78.8	59.3	77.8	74.5	20.0	74.1	71.2	25.0	75.6	85.4	164.8	78.2	90.8	168.2	7.7	82.7	92.6	7.9	97.9	90.8	77.6	99.7	164.1	93.8	96.9	172.1	7.9	7.3
mean		**27.6**	**73.4**	**69.4**	**29.0**	**76.8**	**65.1**	**80.4**	**73.8**	**19.2**	**78.4**	**67.9**	**25.8**	**76.2**	**86.5**	**165.7**	**79.1**	**89.6**	**169.1**	**6.1**	**85.1**	**93.1**	**7.6**	**97.3**	**91.8**	**77.9**	**98.8**	**164.9**	**92.9**	**97.6**	**171.9**	**7.3**	**5.0**

male

Proband	Scooter	Left Elbow X [deg]	Left Elbow Y [deg]	Left Elbow Z [deg]	Right Elbow X [deg]	Right Elbow Y [deg]	Right Elbow Z [deg]	Left shoulder X [deg]	Left shoulder Y [deg]	Left shoulder Z [deg]	Right shoulder X [deg]	Right shoulder Y [deg]	Right shoulder Z [deg]	Left Knee X [deg]	Left Knee Y [deg]	Left Knee Z [deg]	Right Knee X [deg]	Right Knee Y [deg]	Right Knee Z [deg]	Left Foot X [deg]	Left Foot Y [deg]	Left Foot Z [deg]	Right Foot X [deg]	Right Foot Y [deg]	Right Foot Z [deg]	Left Hip X [deg]	Left Hip Y [deg]	Left Hip Z [deg]	Right Hip X [deg]	Right Hip Y [deg]	Right Hip Z [deg]	Right Foot Mz [deg]	Left Foot Mz [deg]
P178M	DocGreen	28.6	86.0	61.8	28.0	63.3	82.2	117.7	77.4	30.9	104.3	78.5	18.5	65.6	80.2	153.5	78.8	86.4	168.2	14.4	75.9	92.7	4.2	85.8	89.4	90.5	98.2	171.8	98.4	94.8	170.3	4.2	14.1
P178M	SinWheel	33.0	78.5	59.6	31.5	80.7	60.2	96.4	78.8	13.0	96.4	81.2	10.9	72.6	84.6	161.7	84.7	83.1	171.3	13.7	76.4	91.6	4.3	85.7	89.9	83.9	96.0	171.5	88.8	95.9	174.0	4.3	13.6
mean		**30.8**	**82.3**	**60.7**	**29.8**	**72.0**	**71.2**	**107.1**	**78.1**	**22.0**	**100.4**	**79.9**	**14.7**	**69.1**	**82.4**	**157.6**	**81.8**	**84.8**	**169.8**	**14.1**	**76.2**	**92.2**	**4.3**	**85.8**	**89.7**	**87.2**	**97.1**	**171.7**	**93.6**	**95.4**	**172.2**	**4.3**	**13.9**

TABLE C VII

DRIVING POSTURE 7 FOR DIFFERENT SCOOTER TYPES AND SEXES.

Driving Posture 7

female

Proband	Scooter	Left Elbow X [deg]	Left Elbow Y [deg]	Left Elbow Z [deg]	Right Elbow X [deg]	Right Elbow Y [deg]	Right Elbow Z [deg]	Left shoulder X [deg]	Left shoulder Y [deg]	Left shoulder Z [deg]	Right shoulder X [deg]	Right shoulder Y [deg]	Right shoulder Z [deg]	Left Knee X [deg]	Left Knee Y [deg]	Left Knee Z [deg]	Right Knee X [deg]	Right Knee Y [deg]	Right Knee Z [deg]	Left Foot X [deg]	Left Foot Y [deg]	Left Foot Z [deg]	Right Foot X [deg]	Right Foot Y [deg]	Right Foot Z [deg]	Left Hip X [deg]	Left Hip Y [deg]	Left Hip Z [deg]	Right Hip X [deg]	Right Hip Y [deg]	Right Hip Z [deg]	Right Foot Mz [deg]	Left Foot Mz [deg]
P241W	DocGreen	32.6	79.9	59.3	16.9	89.6	73.1	77.8	75.3	19.3	75.4	76.5	20.1	44.2	75.5	130.6	83.6	87.4	173.1	57.5	100.1	145.6	8.2	81.8	90.0	97.4	91.0	172.6	92.7	98.4	171.1	8.2	18.2
P326W	DocGreen	33.3	76.1	60.4	43.6	60.9	60.8	96.9	71.3	20.0	92.6	65.0	25.1	57.0	70.7	140.4	81.8	85.8	170.8	44.3	79.9	132.5	4.9	85.3	91.4	91.0	92.1	177.6	85.3	100.1	168.9	4.7	13.8
P481W	DocGreen	16.3	89.7	73.7	11.0	80.1	85.2	99.9	82.5	12.5	105.0	80.2	18.0	49.1	81.8	138.0	78.7	86.6	168.2	29.2	89.9	119.2	5.4	85.0	92.1	90.7	94.1	175.8	89.8	97.6	172.4	5.0	0.2
P326W	SinWheel	40.6	67.0	58.6	43.2	79.0	48.9	86.2	80.3	10.4	101.4	69.3	23.9	59.5	84.5	148.9	75.1	86.8	164.8	43.5	79.2	131.5	6.7	83.3	90.7	89.2	94.2	175.7	85.2	99.3	169.5	6.7	14.5
P481W	SinWheel	28.6	87.9	61.4	13.7	85.6	77.0	101.0	81.2	14.2	106.1	86.2	16.6	45.0	80.0	133.3	74.3	84.3	163.3	39.3	96.8	128.4	7.8	82.3	91.3	85.2	91.8	174.9	86.4	99.5	169.8	7.7	8.7
mean		**30.3**	**80.1**	**62.7**	**25.7**	**79.0**	**69.0**	**92.4**	**78.1**	**15.3**	**96.1**	**75.4**	**20.7**	**51.0**	**78.5**	**138.2**	**78.7**	**86.2**	**168.0**	**42.8**	**89.2**	**131.4**	**6.6**	**83.5**	**91.1**	**90.7**	**92.6**	**175.3**	**87.9**	**99.0**	**170.3**	**6.5**	**11.1**

male

Proband	Scooter	Left Elbow X [deg]	Left Elbow Y [deg]	Left Elbow Z [deg]	Right Elbow X [deg]	Right Elbow Y [deg]	Right Elbow Z [deg]	Left shoulder X [deg]	Left shoulder Y [deg]	Left shoulder Z [deg]	Right shoulder X [deg]	Right shoulder Y [deg]	Right shoulder Z [deg]	Left Knee X [deg]	Left Knee Y [deg]	Left Knee Z [deg]	Right Knee X [deg]	Right Knee Y [deg]	Right Knee Z [deg]	Left Foot X [deg]	Left Foot Y [deg]	Left Foot Z [deg]	Right Foot X [deg]	Right Foot Y [deg]	Right Foot Z [deg]	Left Hip X [deg]	Left Hip Y [deg]	Left Hip Z [deg]	Right Hip X [deg]	Right Hip Y [deg]	Right Hip Z [deg]	Right Foot Mz [deg]	Left Foot Mz [deg]
P745M	SinWheel	54.8	75.8	38.8	53.8	80.2	37.9	83.6	80	12	83.3	75.3	16.2	55.4	78.3	142.9	79.1	84.7	167.8	29	76	114.9	16.4	73.7	88.3	98.2	90	171.8	99.2	99	167	16.3	15.4

TABLE C VIII

DRIVING POSTURE 8 FOR DIFFERENT SCOOTER TYPES AND SEXES.

Driving Posture 8

female

Proband	Scooter	Left Elbow X [deg]	Left Elbow Y [deg]	Left Elbow Z [deg]	Right Elbow X [deg]	Right Elbow Y [deg]	Right Elbow Z [deg]	Left shoulder X [deg]	Left shoulder Y [deg]	Left shoulder Z [deg]	Right shoulder X [deg]	Right shoulder Y [deg]	Right shoulder Z [deg]	Left Knee X [deg]	Left Knee Y [deg]	Left Knee Z [deg]	Right Knee X [deg]	Right Knee Y [deg]	Right Knee Z [deg]	Left Foot X [deg]	Left Foot Y [deg]	Left Foot Z [deg]	Right Foot X [deg]	Right Foot Y [deg]	Right Foot Z [deg]	Left Hip X [deg]	Left Hip Y [deg]	Left Hip Z [deg]	Right Hip X [deg]	Right Hip Y [deg]	Right Hip Z [deg]	Right Foot Mz [deg]	Left Foot Mz [deg]
P302W	DocGreen	28.7	77.5	64.7	36.3	70.3	60.9	76.3	72.7	22.3	79.6	71.2	21.7	75.7	72.4	157.1	80.9	88.9	170.8	69.3	20.7	90.5	16.1	106.0	92.0	83.3	98.7	169.0	92.7	97.6	171.9	16.0	69.3
P591W	DocGreen	24.0	78.6	69.1	40.4	61.6	63.9	87.1	74.9	15.4	77.4	65.5	27.9	78.5	80.6	165.1	88.5	87.7	177.2	28.6	61.7	94.1	4.0	92.8	92.8	78.8	101.7	163.7	90.6	95.7	174.3	2.9	28.4
P678W	DocGreen	21.4	80.8	70.9	26.9	68.6	74.5	98.6	75.6	16.9	84.9	69.9	20.8	76.2	79.5	162.5	86.8	82.0	171.4	46.7	43.5	93.2	2.1	88.1	90.9	81.4	98.5	167.9	89.7	98.3	171.7	1.9	46.6
P702W	DocGreen	20.4	70.7	83.7	16.0	78.9	78.7	82.7	79.8	12.6	80.7	66.6	25.4	74.3	73.8	157.1	83.2	85.4	171.8	36.3	53.7	90.2	2.3	88.1	91.4	82.2	100.3	167.0	93.2	93.2	175.5	1.9	36.3
P852W	DocGreen	15.9	78.0	79.7	22.4	73.4	75.4	80.0	72.4	20.4	80.1	65.5	26.7	67.9	80.4	155.7	78.8	83.0	166.8	26.0	64.1	91.5	6.2	95.9	91.7	86.9	96.1	173.1	94.3	96.5	172.2	5.9	25.9
P111W	SinWheel	42.9	72.7	52.3	37.6	85.6	52.8	76.9	90.3	13.1	79.6	57.2	34.8	68.8	88.4	158.7	75.1	87.6	164.9	4.0	89.4	86.0	11.8	79.2	85.3	89.9	101.8	168.2	88.1	91.7	177.4	10.8	0.6
P302W	SinWheel	41.0	76.2	52.3	40.7	78.4	51.6	76.9	79.2	17.1	76.5	74.9	20.5	71.5	76.6	156.9	77.3	90.0	167.3	48.3	41.9	93.1	12.4	102.3	89.1	82.3	97.5	169.3	91.9	96.5	173.2	12.3	48.2
P411W	SinWheel	31.2	74.0	63.9	32.7	78.4	59.9	75.5	79.3	18.2	82.3	69.4	22.1	57.6	79.3	145.5	81.1	84.2	169.3	22.7	69.0	98.0	6.6	83.4	89.9	83.6	91.8	173.4	84.6	97.8	170.5	6.6	21.3
P543W	SinWheel	36.0	56.2	78.9	21.3	79.5	71.7	79.3	75.3	18.3	76.4	70.2	24.3	78.8	81.0	165.6	79.7	87.4	169.4	63.6	26.7	93.7	11.0	79.5	93.5	75.0	103.2	159.8	85.9	100.7	168.5	10.5	63.6
P591W	SinWheel	37.9	74.2	56.6	43.1	76.5	50.0	85.3	79.2	11.7	82.2	68.0	23.5	77.8	84.4	166.6	79.5	86.7	169.0	20.0	70.1	92.5	6.1	84.3	92.2	75.1	98.3	162.9	87.6	96.6	173.0	5.7	19.9
P678W	SinWheel	31.9	86.7	58.3	33.0	72.7	62.8	87.2	77.2	13.1	83.0	74.3	17.2	77.6	79.0	163.3	80.9	84.1	169.2	59.9	31.3	97.9	7.4	92.5	83.0	77.7	100.9	163.5	84.1	97.0	170.8	2.5	59.6
P702W	SinWheel	28.8	65.5	75.7	24.9	94.9	65.6	68.1	88.4	21.9	79.0	66.2	26.5	75.8	79.5	162.2	85.1	83.4	171.7	32.1	58.0	87.1	6.4	83.9	88.2	83.3	98.3	169.3	91.7	94.6	175.1	6.1	32.0
P852W	SinWheel	26.3	76.5	67.9	25.1	81.4	66.7	73.8	72.9	23.9	82.3	67.1	24.3	68.0	80.3	155.7	78.6	83.5	166.9	30.2	59.9	91.9	1.1	90.9	90.7	85.5	98.0	170.8	94.6	95.2	173.1	0.9	30.1
mean		**29.7**	**74.4**	**67.2**	**30.8**	**76.9**	**64.2**	**80.6**	**78.2**	**17.3**	**80.3**	**68.2**	**24.3**	**73.0**	**79.6**	**159.4**	**81.2**	**85.7**	**169.7**	**37.5**	**53.1**	**92.3**	**7.2**	**89.8**	**90.1**	**81.9**	**98.9**	**167.5**	**89.9**	**96.3**	**172.9**	**6.5**	**37.1**

male

Proband	Scooter	Left Elbow X [deg]	Left Elbow Y [deg]	Left Elbow Z [deg]	Right Elbow X [deg]	Right Elbow Y [deg]	Right Elbow Z [deg]	Left shoulder X [deg]	Left shoulder Y [deg]	Left shoulder Z [deg]	Right shoulder X [deg]	Right shoulder Y [deg]	Right shoulder Z [deg]	Left Knee X [deg]	Left Knee Y [deg]	Left Knee Z [deg]	Right Knee X [deg]	Right Knee Y [deg]	Right Knee Z [deg]	Left Foot X [deg]	Left Foot Y [deg]	Left Foot Z [deg]	Right Foot X [deg]	Right Foot Y [deg]	Right Foot Z [deg]	Left Hip X [deg]	Left Hip Y [deg]	Left Hip Z [deg]	Right Hip X [deg]	Right Hip Y [deg]	Right Hip Z [deg]	Right Foot Mz [deg]	Left Foot Mz [deg]
P192M	DocGreen	42.2	64.9	58.6	41.5	77.9	51.1	90.6	79.7	10.3	94.8	73.4	17.3	76.3	77.7	161.5	89.8	87.0	177.0	37.6	52.4	88.1	14.4	104.4	89.1	84.6	94.0	173.3	85.5	100.1	168.9	14.4	37.6
P234M	DocGreen	41.0	75.4	52.7	47.3	72.8	47.7	83.9	82.0	10.1	80.4	72.0	20.5	73.2	76.5	158.2	82.8	94.7	171.4	64.2	25.9	91.0	28.4	118.3	88.0	81.3	100.2	166.5	88.9	98.6	171.3	28.3	64.2
P447M	DocGreen	35.4	83.8	55.3	37.8	70.5	59.0	76.8	78.5	17.6	87.1	72.3	18.0	78.0	82.1	165.6	83.2	91.8	173.0	52.1	38.0	91.9	1.5	91.5	90.0	89.1	106.3	163.6	90.0	102.6	167.4	1.5	52.1
P522M	DocGreen	48.8	75.7	44.8	49.1	81.9	42.1	72.7	81.1	19.6	80.4	67.8	24.4	74.4	73.6	157.1	81.9	86.2	171.0	60.1	30.2	93.7	5.4	85.1	92.2	84.9	97.0	171.4	94.9	97.6	170.9	4.9	60.0
P660M	DocGreen	33.0	65.9	68.9	25.9	76.9	68.0	77.8	76.0	18.7	79.1	71.6	21.6	73.0	76.9	158.3	91.3	85.1	174.9	46.0	44.1	87.8	7.0	83.5	87.2	86.7	95.5	173.6	87.7	96.2	173.4	6.5	46.0
P895M	DocGreen	50.1	68.6	47.5	35.2	85.0	55.2	77.7	80.0	16.0	80.2	68.7	23.6	73.3	83.2	161.9	81.8	85.2	170.5	23.4	66.6	90.7	8.1	81.9	89.9	82.1	94.5	170.9	87.5	94.0	175.3	8.1	23.4
P192M	SinWheel	55.7	65.0	44.8	53.4	88.3	36.6	79.1	81.7	13.8	81.5	76.3	16.2	76.4	75.0	159.5	85.1	88.2	174.8	42.3	48.0	85.8	13.3	102.6	85.9	83.7	94.2	172.5	86.4	100.6	168.8	12.6	42.1
P234M	SinWheel	55.3	75.2	38.6	50.1	83.7	40.6	84.2	84.7	7.9	86.6	75.2	15.2	69.5	76.2	154.9	70.9	95.3	160.1	57.8	32.2	90.4	9.2	98.9	87.9	78.5	99.0	165.3	90.1	96.8	173.2	8.9	57.8
P447M	SinWheel	46.9	82.6	44.0	46.1	78.3	46.2	71.2	84.1	19.8	79.9	75.3	18.0	76.2	85.5	165.5	74.9	91.3	164.9	54.8	35.4	93.5	4.1	94.1	90.3	82.3	108.5	159.9	89.8	104.3	165.7	4.1	54.8
P660M	SinWheel	41.0	68.9	56.7	42.7	81.9	48.5	76.6	78.3	18.0	73.7	71.9	24.8	71.9	77.8	158.0	84.0	86.7	173.1	46.7	43.4	87.6	5.1	87.9	85.3	85.2	94.7	173.3	85.7	95.6	172.9	2.1	46.6
mean		**44.9**	**72.6**	**51.2**	**42.9**	**79.7**	**49.5**	**79.1**	**80.6**	**15.2**	**82.4**	**72.5**	**20.0**	**74.2**	**78.5**	**160.1**	**82.6**	**89.2**	**171.1**	**48.5**	**41.6**	**90.1**	**9.7**	**94.8**	**88.6**	**83.8**	**98.4**	**169.0**	**88.7**	**98.6**	**170.8**	**9.1**	**48.5**

TABLE C IX

DRIVING POSTURE 9 FOR DIFFERENT SCOOTER TYPES AND SEXES.

Driving Posture 9

female

Proband	Scooter	Left Elbow X [deg]	Left Elbow Y [deg]	Left Elbow Z [deg]	Right Elbow X [deg]	Right Elbow Y [deg]	Right Elbow Z [deg]	Left shoulder X [deg]	Left shoulder Y [deg]	Left shoulder Z [deg]	Right shoulder X [deg]	Right shoulder Y [deg]	Right shoulder Z [deg]	Left Knee X [deg]	Left Knee Y [deg]	Left Knee Z [deg]	Right Knee X [deg]	Right Knee Y [deg]	Right Knee Z [deg]	Left Foot X [deg]	Left Foot Y [deg]	Left Foot Z [deg]	Right Foot X [deg]	Right Foot Y [deg]	Right Foot Z [deg]	Left Hip X [deg]	Left Hip Y [deg]	Left Hip Z [deg]	Right Hip X [deg]	Right Hip Y [deg]	Right Hip Z [deg]	Right Foot Mz [deg]	Left Foot Mz [deg]
P411W	DocGreen	20.6	75.2	76.0	27.9	71.4	70.0	83.6	75.1	16.3	87.2	67.9	22.3	59.9	64.9	139.0	86.7	83.4	172.6	52.7	43.6	109.3	3.3	92.7	92.0	86.6	89.1	176.5	82.3	97.3	169.4	2.7	50.1
P543W	DocGreen	32.1	58.5	95.7	22.8	67.3	88.3	85.1	70.2	20.4	79.9	67.8	24.6	51.1	91.0	141.1	86.0	77.8	167.2	35.5	77.1	122.3	3.9	88.6	93.6	88.0	87.6	176.9	81.6	107.2	160.8	1.4	15.4
P241W	SinWheel	42.5	85.8	47.8	33.2	87.1	56.9	77.3	81.5	15.4	74.4	77.1	20.4	44.5	75.3	130.7	81.0	87.8	170.7	65.2	84.4	154.5	1.2	89.4	89.0	99.8	88.3	170.0	87.8	99.1	170.6	0.6	13.2
P245W	SinWheel	39.8	86.7	50.4	41.5	72.0	54.1	90.1	78.3	11.7	91.1	75.2	14.8	49.7	69.1	132.4	82.1	86.3	171.2	54.0	70.5	137.5	7.4	97.3	91.1	89.1	89.3	178.9	89.9	99.6	170.4	7.4	29.6
mean		**33.8**	**76.6**	**67.5**	**31.4**	**74.5**	**67.3**	**84.0**	**76.3**	**16.0**	**83.2**	**72.0**	**20.5**	**51.3**	**75.1**	**135.8**	**84.0**	**83.8**	**170.4**	**51.9**	**68.9**	**130.9**	**4.0**	**92.0**	**91.4**	**90.9**	**88.6**	**175.6**	**85.4**	**100.8**	**167.8**	**3.0**	**27.1**

male

Proband	Scooter	Left Elbow X [deg]	Left Elbow Y [deg]	Left Elbow Z [deg]	Right Elbow X [deg]	Right Elbow Y [deg]	Right Elbow Z [deg]	Left shoulder X [deg]	Left shoulder Y [deg]	Left shoulder Z [deg]	Right shoulder X [deg]	Right shoulder Y [deg]	Right shoulder Z [deg]	Left Knee X [deg]	Left Knee Y [deg]	Left Knee Z [deg]	Right Knee X [deg]	Right Knee Y [deg]	Right Knee Z [deg]	Left Foot X [deg]	Left Foot Y [deg]	Left Foot Z [deg]	Right Foot X [deg]	Right Foot Y [deg]	Right Foot Z [deg]	Left Hip X [deg]	Left Hip Y [deg]	Left Hip Z [deg]	Right Hip X [deg]	Right Hip Y [deg]	Right Hip Z [deg]	Right Foot Mz [deg]	Left Foot Mz [deg]
P745M	DocGreen	54.7	78.0	37.9	55.7	67.5	42.9	94.7	75.4	15.4	84.5	71.7	19.2	54.5	75.5	140.8	79.6	88.7	169.5	43.2	72.7	128.0	1.4	91.2	89.3	91.6	91.9	177.5	88.0	97.1	172.6	1.2	22.2
P522M	SinWheel	53.7	77.7	39.0	52.3	83.9	38.3	77.7	79.6	16.2	81.3	75.8	16.8	74.3	69.0	153.3	79.4	89.0	169.4	60.7	31.1	99.4	7.7	97.7	90.0	89.7	90.0	179.7	96.2	97.1	170.6	7.7	60.2
mean		**54.2**	**77.9**	**38.5**	**54.0**	**75.7**	**40.6**	**86.2**	**77.5**	**15.8**	**82.9**	**73.8**	**18.0**	**64.4**	**72.3**	**147.1**	**79.5**	**88.9**	**169.5**	**52.0**	**51.9**	**113.7**	**4.6**	**94.5**	**89.7**	**90.7**	**91.0**	**178.6**	**92.1**	**97.1**	**171.6**	**4.5**	**41.2**