Capacitive Touch Sensing on General 3D Surfaces - Supplemental material

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1 INTRODUCTION

This document contains the supporting information of the paper "Capacitive Touch Sensing on General 3D Surfaces". Section 2 shows additional photos of the fabricated prototypes. Section 3 presents the data of all the tests for the SNR measurement. Section 4 presents the data of all the tests to evaluate the spatial accuracy.

2 FABRICATED PROTOTYPES

This section displays photos of the prototypes before and after the placement of the sensor conductors. For each prototype, we provide renderings of the relative 3D model, the internal pipes, and a bottom-view visualization to illustrate the exits of the conductors.

Fig. 1. Photo of the 3D printed prototype for the Bunny model. Next are the renderings of the 3D model used for printing, the internal pipes, and the bottom part of the model with the exits of the sensor conductors.
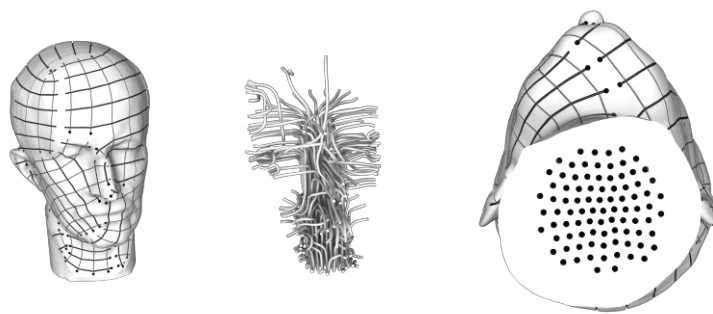
Fig. 2. Photo of the 3D printed prototype for the Max Planck model. Next are the renderings of the 3D model used for printing, the internal pipes, and the bottom part of the model with the exits of the sensor conductors.
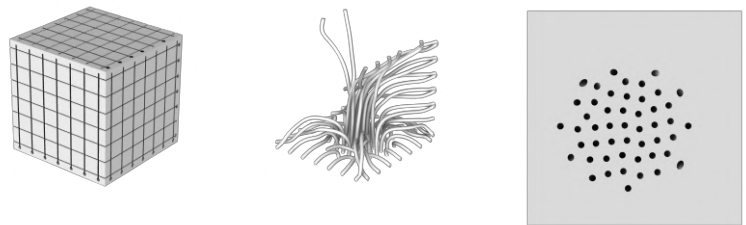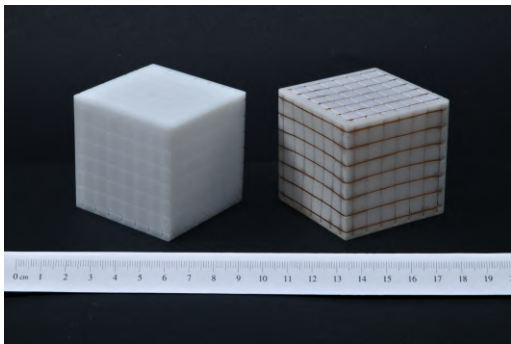
Fig. 3. Photo of the 3D printed prototype for the Cube model. Next are the renderings of the 3D model used for printing, the internal pipes, and the bottom part of the model with the exits of the sensor conductors.

Fig. 4. Photo of the 3D printed prototype for the SphereA model. Next are the renderings of the 3D model used for printing, the internal pipes, and the bottom part of the model with the exits of the sensor conductors.
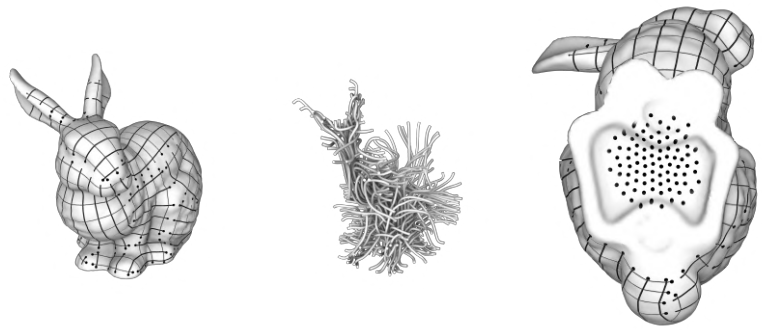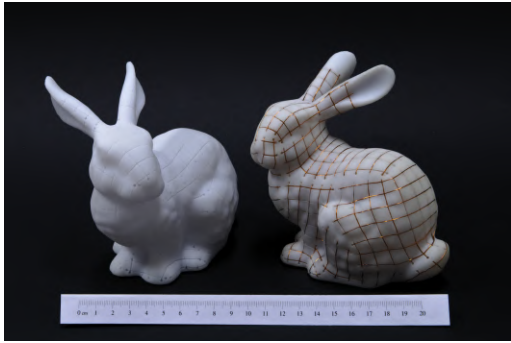

Fig. 5. Photo of the 3D printed prototype for the SphereB model. Next are the renderings of the 3D model used for printing, the internal pipes, and the bottom part of the model with the exits of the sensor conductors.
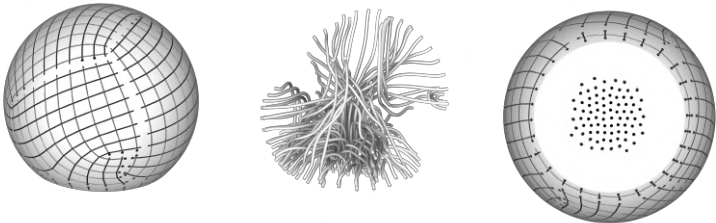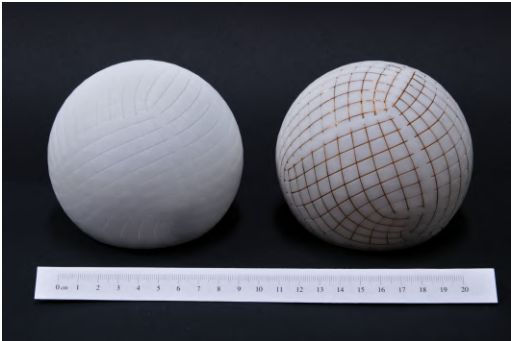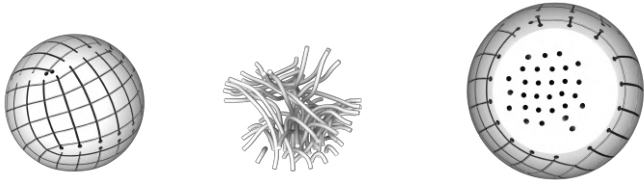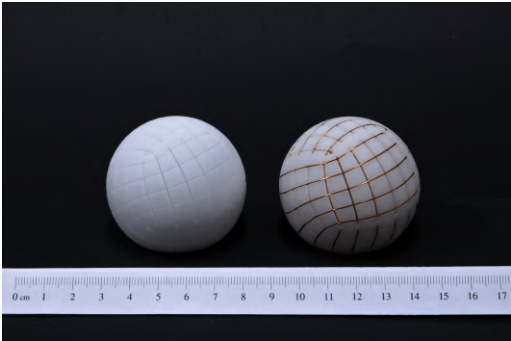
3 SNR EVALUATION TESTS

Sensing performance was evaluated by touching the sensor on the measuring point 10 times with the index finger at intervals of at least 1 second and computing the Signal-to-Noise Ratio (SNR) using the raw capacitance values acquired by the Muca controller. For each measuring point, we conducted four tests with different touch conditions: single-touch (Single touch); simultaneous touching with a second finger on the same TX line (2-touches Tx); touching with a second finger on the same RX line (2-touches Rx); and touching with three fingers with the second and third fingers on the same Tx and Rx lines (3-touches). In the case of multi-touch input, secondary and tertiary fingers were positioned on the respective TX or RX lines at 3 intersections from the measuring point. We performed each test twice. We conducted additional tests to confirm the trend for a few points that exhibited low consistency between the SNR values of the first two trials. For each measurement point, we report the data of all the trials (mean and standard deviation for touch and no-touch event, and the computer SNR using the formula presenters in [Davison 2010]) and the figure to show its position on the sensor (the intersection of the sensor grid on the green quad). The caption contains a brief description of the features of the points.

3.1 Cube

Table 1. Measurement point on a flat surface inside a regular patch.

Chip1 Tx4 Rx4					
	μ Touch	σ Touch	μ No-touch	σ Touch	SNR
Single touch	86.53	11.31	0.47	1.04	82.65
Single touch	85.59	10.62	0.92	1.36	62.37
2-touches Rx	84.84	13.77	2.28	3.37	24.49
2-touches Rx	86.82	12.62	1.84	3.09	27.47
2-touches Tx	84.38	8.72	0.22	0.60	141.03
2-touches Tx	84.89	9.59	0.28	0.73	116.18
2-touches Tx	85.05	8.63	0.46	0.74	113.92
3-touches	77.35	11.24	0.61	1.59	48.31
3-touches	73.25	11.91	0.81	2.03	35.66
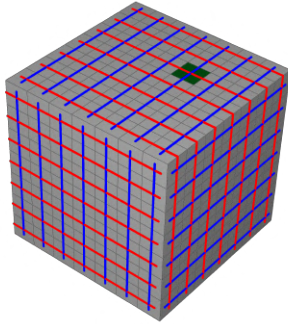
Table 2. Measurement point next to a corner on a border between patches mapped on two different touch controllers.

Chip1 Tx0 Rx6					
	μ Touch	σ Touch	μ No-touch	σ Touch	SNR
Single touch	53.03	8.61	1.21	1.41	36.87
Single touch	51.46	9.44	0.44	0.92	55.45
2-touches Rx	50.84	14.35	2.25	4.11	11.83
2-touches Rx	49.25	13.01	2.81	4.11	11.30
2-touches Tx	50.09	7.17	1.55	1.52	32.02
2-touches Tx	47.11	5.92	1.21	1.53	29.91
3-touches	41.54	13.15	2.08	3.42	11.53
3-touches	39.91	10.32	1.38	2.90	13.28
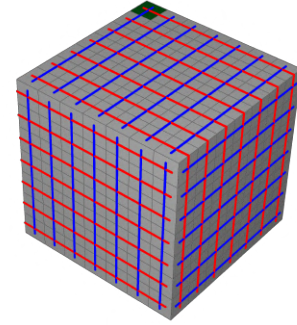
Table 3. Measurement point next to a sharp edge on the border between patches mapped on two different touch controllers.

Chip1 Tx0 Rx4					
	μ Touch	σ Touch	μ No-touch	σ Touch	SNR
Single touch	58.84	5.15	0.81	1.23	47.19
Single touch	60.48	5.83	0.83	1.08	55.10
2-touches Rx	59.03	12.17	2.57	3.73	15.15
2-touches Rx	58.29	11.84	2.79	3.79	14.63
2-touches Tx	57.92	6.43	0.61	1.15	49.82
2-touches Tx	59.66	6.23	0.65	1.08	54.47
3-touches	50.52	9.68	1.43	2.65	18.55
3-touches	48.14	12.00	0.38	1.26	37.90
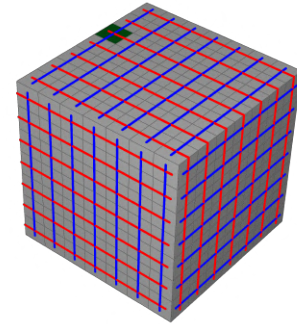
Table 4. Measurement point on a flat surface inside a patch close to the border.

Chip1 Tx12 Rx1					
	μ Touch	σ Touch	μ No-touch	σ Touch	SNR
Single touch	81.28	9.25	2.11	1.62	48.91
Single touch	80.92	7.14	2.88	2.04	38.21
2-touches Rx	78.68	12.43	5.58	4.76	15.35
2-touches Rx	75.77	12.93	5.16	5.39	13.10
2-touches Tx	78.03	7.24	5.79	1.65	43.82
2-touches Tx	78.60	7.29	5.34	2.00	36.57
3-touches	65.57	14.81	3.03	3.91	16.00
3-touches	66.62	12.17	2.42	3.49	18.39
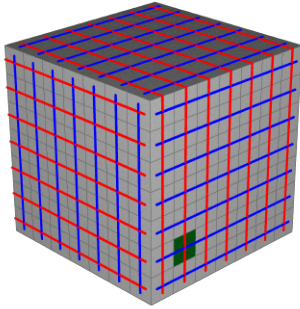
Table 5. Measurement point next to a sharp edge inside a regular patch.

Chip1 Tx6 Rx2					
	μ Touch	σ Touch	μ No-touch	σ Touch	SNR
Single touch	74.21	8.37	1.77	1.33	54.29
Single touch	76.06	6.52	2.16	1.82	40.57
2-touches Rx	63.57	13.50	3.52	4.74	12.67
2-touches Rx	65.85	13.08	2.57	3.64	17.37
2-touches Tx	68.60	10.29	3.27	2.29	28.47
2-touches Tx	70.96	7.35	3.01	1.80	37.82
3-touches	58.84	13.49	1.65	2.92	19.57
3-touches	48.91	13.79	0.41	1.63	29.85
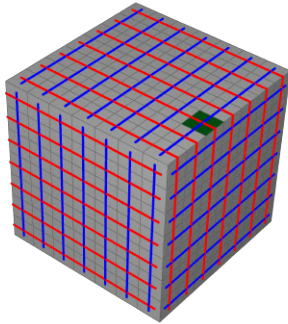
3.2 Bunny

Table 6. Measurement point next to the border between two patches mapped on two different touch controllers.

	μ Touch	σ Touch	μ No-touch	σ Touch	SNR
Chip0 Tx19 Rx11					
Single touch	44.90	3.69	0.70	0.85	52.29
Single touch	46.45	2.39	1.23	1.19	37.95
2-touches Rx	41.54	5.95	1.34	2.17	18.49
2-touches Rx	40.58	7.03	1.23	1.98	19.92
2-touches Tx	47.05	2.71	6.00	1.13	36.28
2-touches Tx	47.95	2.68	7.08	1.07	38.10
3-touches	36.74	8.42	1.50	2.53	13.91
3-touches	36.67	8.05	0.58	1.40	25.75
3-touches	37.05	6.37	1.58	2.73	13.00
3-touches	38.12	7.29	1.40	2.50	14.70
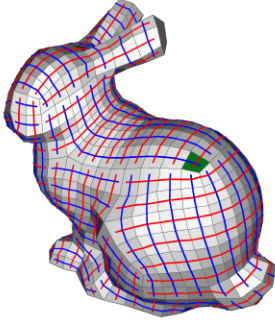
Table 7. Measurement point inside a regular patch in a concave region.

	μ Touch	σ Touch	μ No-touch	σ Touch	SNR
Chip0 Tx3 Rx10					
Single touch	62.01	4.06	1.04	0.91	66.83
Single touch	62.35	3.23	1.51	1.04	58.40
2-touches Rx	53.75	5.90	2.35	1.79	28.75
2-touches Rx	55.19	4.85	2.20	2.24	23.67
2-touches Tx	53.93	5.28	3.17	1.57	32.35
2-touches Tx	56.07	4.39	2.75	1.45	36.82
3-touches	52.01	5.85	1.12	1.30	39.10
3-touches	55.13	4.29	1.23	1.36	39.68
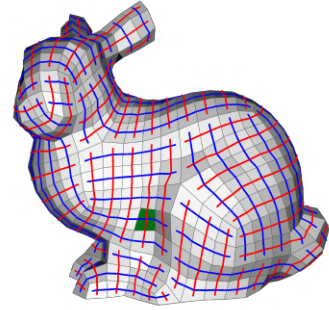
Table 8. Measurement point next to the border among patches mapped on the same touch controller.

	μ Touch	σ Touch	μ No-touch	σ Touch	SNR
Chip0 Tx3 Rx3					
Single touch	55.44	1.93	1.04	1.41	38.57
Single touch	55.49	2.03	0.97	1.26	43.25
2-touches Rx	48.77	6.42	1.64	2.52	18.71
2-touches Rx	47.32	7.27	1.71	2.31	19.71
2-touches Tx	53.85	3.54	2.15	1.10	47.10
2-touches Tx	53.25	2.96	2.25	1.42	36.03
3-touches	43.97	6.92	0.72	1.74	24.82
3-touches	46.73	6.11	1.16	2.05	22.21
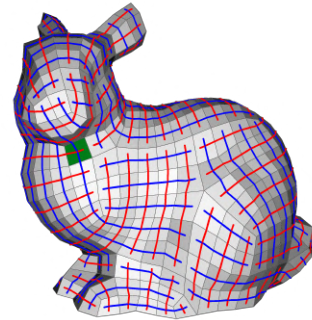
Table 9. Measurement point next to the border between patches mapped on two different touch controllers in a convex region.

	μ Touch	σ Touch	μ No-touch	σ Touch	SNR
Chip0 Tx7 Rx9					
Single touch	43.50	5.82	0.05	0.65	67.11
Single touch	48.04	4.85	0.95	0.88	53.76
2-touches Rx	45.45	9.38	2.91	3.50	12.15
2-touches Rx	45.46	9.37	2.25	3.04	14.22
2-touches Rx	41.85	9.25	0.76	1.50	27.44
2-touches Rx	43.30	6.53	0.71	1.48	28.76
2-touches Tx	42.69	5.32	0.22	0.55	77.35
2-touches Tx	42.94	4.50	0.60	0.77	54.76
3-touches	41.37	9.61	0.80	1.51	26.85
3-touches	35.63	10.57	0.20	0.79	44.86
3-touches	35.85	9.22	0.27	0.97	36.68
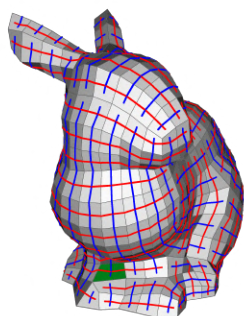
Table 10. Measurement point next to the border among patches mapped on the same touch controller.

	μ Touch	σ Touch	μ No-touch	σ Touch	SNR
Chip0 Tx6 Rx4					
Single touch	82.84	4.26	1.48	1.00	81.13
Single touch	84.52	3.82	2.08	1.23	66.81
2-touches Rx	59.85	9.80	1.97	3.14	18.42
2-touches Rx	61.20	12.73	2.81	4.26	13.71
2-touches Tx	73.98	3.01	0.22	0.46	159.49
2-touches Tx	70.88	3.95	0.24	0.56	126.70
3-touches	68.33	5.34	0.26	0.64	106.93
3-touches	65.52	5.96	0.43	1.19	54.64
3-touches	68.91	6.03	0.87	1.36	49.94
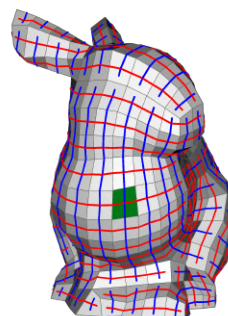
Table 11. Measurement point next to the border among patches mapped on two different touch controllers.

	μ Touch	σ Touch	μ No-touch	σ Touch	SNR
Chip0 Tx1 Rx2					
Single touch	51.38	4.25	0.77	0.93	54.13
Single touch	51.93	3.86	0.46	0.76	67.46
2-touches Rx	46.75	5.99	1.53	1.99	22.76
2-touches Rx	50.45	4.63	2.03	2.09	23.12
2-touches Tx	48.34	4.16	0.39	0.64	74.70
2-touches Tx	48.54	3.69	0.51	0.88	54.56
3-touches	46.63	4.39	0.41	0.85	54.40
3-touches	44.74	4.00	0.18	0.58	76.95
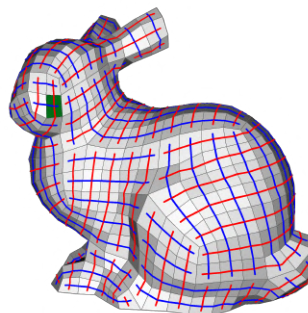
Table 12. Measurement point inside a regular patch.

Chip0 Tx17 Rx9					
	μ Touch	σ Touch	μ No-touch	σ Touch	SNR
Single touch	82.69	4.91	0.24	0.66	124.80
Single touch	85.79	6.26	0.63	0.74	115.10
2-touches Rx	75.42	7.27	1.65	2.08	35.45
2-touches Rx	75.52	10.27	1.93	3.18	23.13
2-touches Tx	74.98	8.18	3.04	1.31	55.00
2-touches Tx	78.67	6.95	2.30	1.17	65.25
3-touches	74.55	7.86	2.00	1.84	39.53
3-touches	72.71	6.95	1.02	2.04	35.15
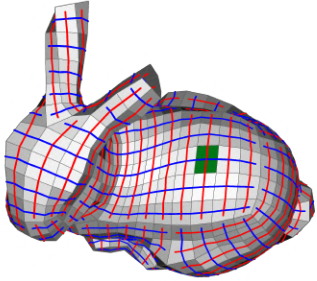
Table 13. Measurement point next to the border among patches mapped on two different touch controllers.

Chip1 Tx20 Rx1					
	μ Touch	σ Touch	μ No-touch	σ Touch	SNR
Single touch	86.42	8.09	0.01	0.12	728.17
Single touch	84.73	8.42	0.17	0.62	136.76
Single touch	82.07	6.15	0.04	0.36	230.41
2-touches Rx	73.53	12.23	1.22	2.48	29.20
2-touches Rx	70.65	12.03	1.24	2.55	27.18
2-touches Tx	76.64	8.80	0.06	0.24	321.37
2-touches Tx	79.13	9.02	0.09	0.28	280.71
3-touches	71.25	12.30	0.24	0.59	120.57
3-touches	70.57	8.14	0.13	0.64	109.24
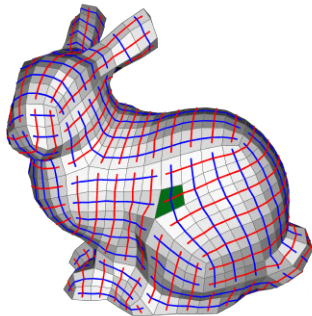
Table 14. Measurement point next to the border among patches mapped on the same touch controller.

| **Chip1 Tx15 Rx6**					
	μ Touch	σ Touch	μ No-touch	σ Touch	SNR
Single touch	63.77	6.85	3.08	2.31	26.23
Single touch	65.32	7.16	2.36	1.79	35.15
2-touches Rx	58.31	8.31	2.53	3.08	18.13
2-touches Rx	58.60	9.13	2.21	2.95	19.14
2-touches Tx	51.28	7.08	1.21	1.56	32.19
2-touches Tx	51.18	6.57	1.30	1.81	27.50
3-touches	44.31	9.84	0.29	0.89	49.61
3-touches	40.88	10.06	0.44	1.50	26.98
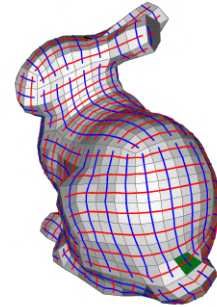
Table 15. Measurement point next to the border among patches mapped on two different touch controllers in a concave region.

Chip1 Tx9 Rx9					
	μ Touch	σ Touch	μ No-touch	σ Touch	SNR
Single touch	42.95	3.54	0.08	0.31	136.50
Single touch	45.97	2.50	0.09	0.31	146.36
2-touches Rx	40.35	3.97	0.72	1.26	31.36
2-touches Rx	41.76	4.18	0.88	1.36	30.04
2-touches Tx	39.53	4.66	0.42	0.70	55.92
2-touches Tx	41.53	3.00	0.27	0.56	73.72
3-touches	37.93	3.59	0.03	0.17	227.49
3-touches	37.19	4.55	0.02	0.12	302.02
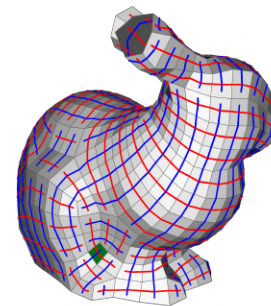
Table 16. Measurement point next to the border among patches mapped on two different touch controllers near a singular point.

Chip1 Tx10 Rx3					
	μ Touch	σ Touch	μ No-touch	σ Touch	SNR
Single touch	99.21	7.71	1.48	1.77	55.23
Single touch	101.75	7.63	1.25	1.67	60.34
2-touches Rx	86.51	20.69	2.45	3.93	21.41
2-touches Rx	101.25	8.24	2.09	2.58	38.42
2-touches Tx	89.11	12.90	2.49	1.64	52.79
2-touches Tx	105.61	6.25	2.73	1.67	61.60
3-touches	85.51	11.38	0.56	1.60	53.06
3-touches	88.43	9.67	0.54	1.63	53.96
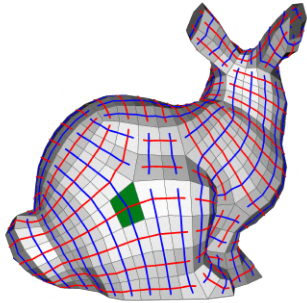
Table 17. Measurement point next to the border among patches mapped on two different touch controllers in a concave region.

Chip1 Tx3 Rx7					
	μ Touch	σ Touch	μ No-touch	σ Touch	SNR
Single touch	56.37	12.16	0.43	0.79	70.71
Single touch	55.16	7.61	0.10	0.38	145.06
2-touches Rx	56.07	6.64	1.18	1.45	37.73
2-touches Rx	56.01	11.16	0.36	0.84	66.13
2-touches Tx	49.72	5.18	0.07	0.49	101.83
2-touches Tx	50.89	4.89	0.08	0.32	161.04
3-touches	51.03	7.22	0.48	1.24	40.88
3-touches	49.66	5.59	0.28	0.87	56.93
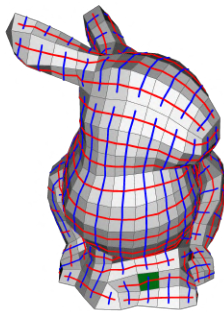
Table 18. Measurement point inside a regular patch.

| Chip1 Tx16 Rx3					
	μ Touch	σ Touch	μ No-touch	σ Touch	SNR
Single touch	104.41	2.33	0.69	1.03	100.66
Single touch	101.09	2.30	0.25	0.90	111.69
2-touches Rx	91.87	8.81	0.88	1.82	50.06
2-touches Rx	94.76	6.62	1.30	1.92	48.56
2-touches Tx	90.52	5.26	0.89	1.24	72.34
2-touches Tx	91.60	5.72	1.18	1.17	77.38
3-touches	88.87	6.81	1.16	1.55	56.71
3-touches	93.60	7.23	0.78	1.41	65.71
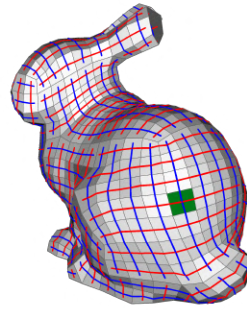
Table 19. Measurement point next to a border among patches mapped on two different touch controllers.

Chip1 Tx5 Rx7					
	μ Touch	σ Touch	μ No-touch	σ Touch	SNR
Single touch	79.54	4.13	1.04	1.89	41.48
Single touch	81.16	8.66	1.14	1.30	61.70
2-touches Rx	65.09	9.11	1.25	2.69	23.69
2-touches Rx	67.53	6.88	0.84	2.08	32.03
2-touches Tx	77.63	3.11	0.95	1.10	69.61
2-touches Tx	77.42	4.43	1.20	1.22	62.37
3-touches	59.43	10.21	0.76	2.42	24.21
3-touches	59.12	8.09	0.35	1.21	48.66
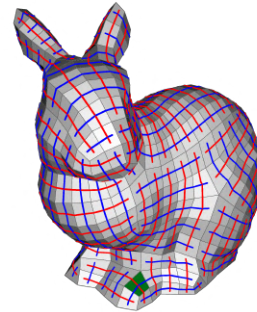
Table 20. Measurement point on a border of a regular point in a cylindrical region with the longest conductors from the touch controller.

Chip2 Tx0 Rx1					
	μ Touch	σ Touch	μ No-touch	σ Touch	SNR
Single touch	82.24	6.87	1.21	1.27	63.70
Single touch	79.65	6.64	0.84	1.09	72.08
2-touches Rx	85.37	7.27	3.80	2.49	32.78
2-touches Rx	83.75	8.92	2.71	2.52	32.12
2-touches Tx	81.54	5.46	2.73	1.49	52.78
2-touches Tx	81.05	5.85	2.91	1.37	57.05
3-touches	77.12	5.35	6.52	2.06	34.28
3-touches	79.86	8.02	6.80	2.37	30.88
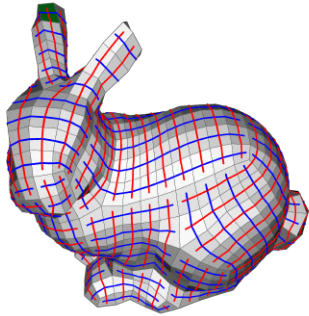
Table 21. Measurement point on a border among patches mapped on two different touch controllers.

| Chip2 Tx8 Rx8					
	μ Touch	σ Touch	μ No-touch	σ Touch	SNR
Single touch	43.23	1.53	3.34	1.23	32.48
Single touch	40.54	3.15	2.64	1.07	35.32
2-touches Rx	42.18	3.92	4.47	2.44	15.43
2-touches Rx	42.56	4.78	4.23	2.97	12.90
2-touches Tx	44.72	2.26	7.04	1.38	27.37
2-touches Tx	44.46	3.07	7.74	1.24	29.55
3-touches	31.42	5.37	0.72	2.27	13.52
3-touches	29.20	6.72	1.10	2.71	10.36
3-touches	32.77	6.52	1.43	2.64	11.88
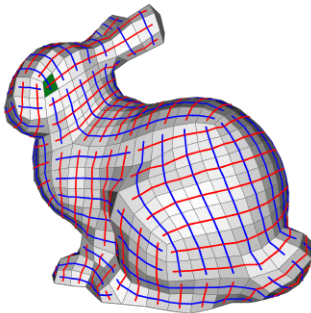
Table 22. Measurement point inside a regular patch.

Chip2 Tx6 Rx5					
	μ Touch	σ Touch	μ No-touch	σ Touch	SNR
Single touch	92.10	4.74	0.34	0.75	122.81
Single touch	101.22	2.68	0.24	0.78	129.20
2-touches Rx	82.57	9.39	0.50	1.15	71.13
2-touches Rx	82.02	8.82	0.62	1.27	64.02
2-touches Tx	76.84	7.07	0.61	0.92	83.29
2-touches Tx	78.77	6.50	0.54	0.84	92.84
3-touches	74.01	7.98	0.17	0.85	86.48
3-touches	74.05	11.88	0.11	0.59	124.57
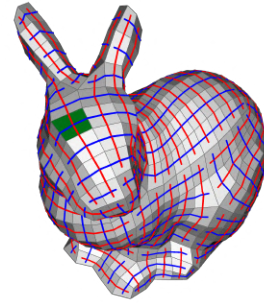
Table 23. Measurement point on the border among patches mapped on the same touch controller.

Chip2 Tx4 Rx0					
	μ Touch	σ Touch	μ No-touch	σ Touch	SNR
Single touch	59.33	3.37	0.47	0.69	85.55
Single touch	57.55	2.85	0.49	0.79	72.02
2-touches Rx	48.82	6.75	1.87	2.83	16.56
2-touches Rx	51.96	6.77	1.96	3.16	15.84
2-touches Tx	60.11	2.34	3.01	1.25	45.83
2-touches Tx	58.79	2.40	2.29	1.28	44.08
3-touches	55.00	3.82	1.28	1.74	30.94
3-touches	50.68	6.34	0.73	1.63	30.73
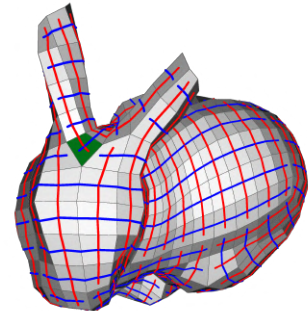
4 SPATIAL ACCURACY EVALUATION TESTS

We evaluate the spatial accuracy of the touch points under two distinct conditions: interacting with a fixed point and traversing a path on the surface. For the fixed point, the test protocol involved touching it for at least 2 seconds. For the path, the test consists of moving the index finger along it at a constant speed. Each test case included five trials, and the data from each trial were compared by calculating the distance error of each recorded touch point from the ground truth. The ground truth points and paths are marked on the surface of the physical prototype with small spherical and cylindrical reliefs created during the 3D printing process. These reliefs provided both visual and haptic feedback during the test. During the test, real-time visualization of the interpolated touch point on the triangle mesh surface further enhanced feedback. For each test, we report the statistics of the distance error for all five trials (mean errors *mu*, min and max values, mean absolute deviation MAD, standard deviation σ, variance σ^2, root mean square error *RMS*) and the aggregated values by mean over all the trials. For each test, we also show the acquired touch positions for all five trials (each one with the color reported in the above table) with a transparent visualization of the ground truth. We use spheres (for the fixed points) and pipes (for the paths) with a 0.5mm radius to visualize the ground truth.

4.1 Cube - Fixed Points

Table 24. Corner with singularity #3 on a border between two touch controllers.

3-cornerChipBorder

	μ error	Min	Max	MAD	σ	σ^2	RMS
Test 1	2.14	0.59	5.05	1.11	1.24	1.54	2.47
Test 2	2.94	1.64	4.53	0.57	0.69	0.48	3.02
Test 3	3.10	0.76	5.02	0.58	0.80	0.64	3.20
Test 4	1.70	0.56	2.90	0.68	0.73	0.54	1.86
Test 5	1.97	0.94	3.42	0.41	0.53	0.28	2.04
Total	2.37	0.90	4.18	0.67	0.80	0.70	2.52
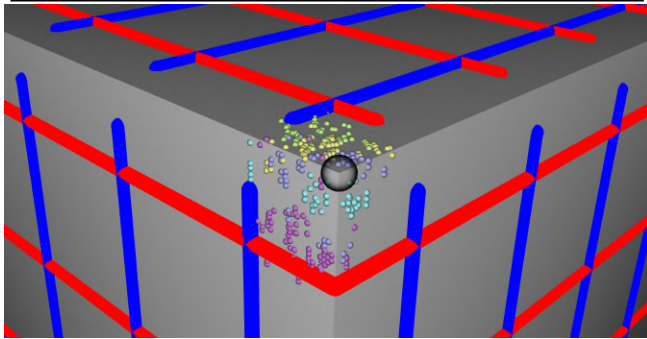
Table 25. Corner with singularity #3 on a border between two touch controllers.

3-cornerChipBorder2

	μ error	Min	Max	MAD	σ	σ^2	RMS
Test 1	1.97	1.05	2.82	0.34	0.44	0.19	2.02
Test 2	2.17	1.33	3.66	0.44	0.58	0.34	2.25
Test 3	2.04	0.66	3.70	0.58	0.72	0.52	2.16
Test 4	1.69	0.66	3.15	0.44	0.54	0.29	1.77
Test 5	1.81	1.00	2.62	0.32	0.40	0.16	1.85
Total	1.93	0.94	3.19	0.42	0.53	0.30	2.01
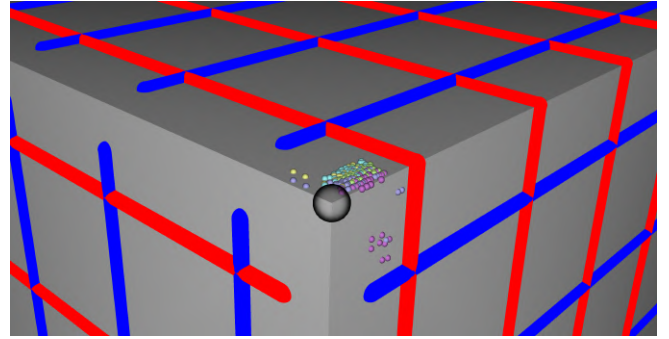
Table 26. Point on a sharp edge between two touch controllers.

4-chipBorderSharp

	μ error	Min	Max	MAD	σ	σ^2	RMS
Test 1	1.09	0.23	2.16	0.51	0.60	0.36	1.24
Test 2	1.17	0.12	3.50	0.72	0.80	0.65	1.42
Test 3	0.56	0.03	1.68	0.25	0.33	0.11	0.65
Test 4	0.58	0.07	2.80	0.29	0.49	0.24	0.76
Test 5	0.73	0.07	2.00	0.41	0.53	0.28	0.90
Total	0.83	0.11	2.43	0.44	0.55	0.33	0.99
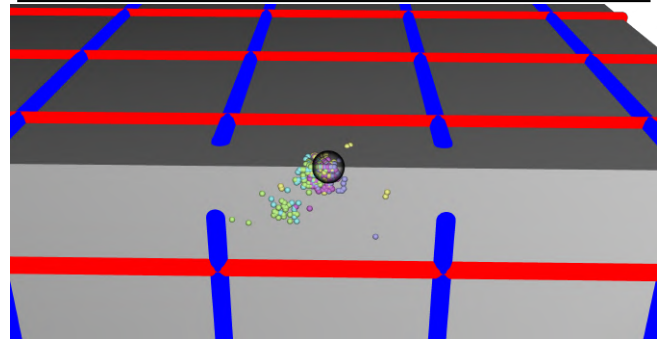
Table 27. Point inside a regular patch.

4-inside

	μ error	Min	Max	MAD	σ	σ^2	RMS
Test 1	0.69	0.05	1.86	0.56	0.58	0.33	0.90
Test 2	0.76	0.49	0.99	0.08	0.11	0.01	0.77
Test 3	0.63	0.52	0.76	0.05	0.07	0.00	0.64
Test 4	0.47	0.22	0.62	0.06	0.07	0.01	0.47
Test 5	0.45	0.37	0.51	0.02	0.03	0.00	0.45
Total	0.60	0.33	0.95	0.15	0.17	0.07	0.65
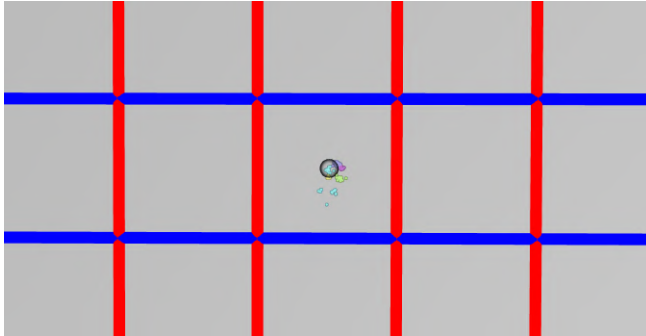
Table 28. Point on a sharp edge inside a regular patch.

4-sharpInside

	μ error	Min	Max	MAD	σ	σ^2	RMS
Test 1	0.39	0.16	0.71	0.11	0.14	0.02	0.41
Test 2	0.55	0.44	0.73	0.05	0.06	0.00	0.55
Test 3	0.66	0.42	0.79	0.08	0.10	0.01	0.67
Test 4	0.57	0.43	0.73	0.07	0.08	0.01	0.57
Test 5	0.66	0.45	0.82	0.06	0.08	0.01	0.67
Total	0.57	0.38	0.76	0.07	0.09	0.01	0.58
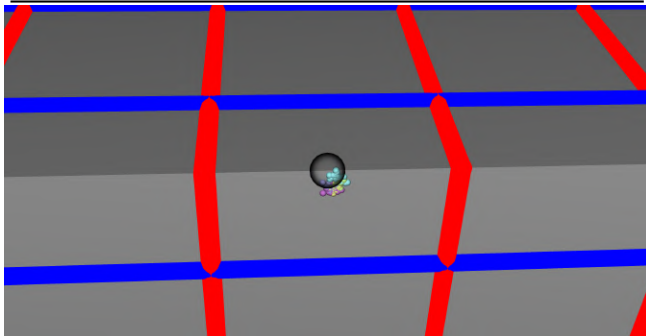
4.2 Bunny - Fixed Points

Table 29. Point near to a singularity #3 on a border between two touch controllers.

3-chipBorder1

	μ error	Min	Max	MAD	σ	σ^2	RMS
Test 1	0.68	0.28	1.54	0.35	0.42	0.17	0.79
Test 2	0.65	0.10	1.72	0.43	0.52	0.28	0.84
Test 3	0.71	0.05	1.62	0.45	0.51	0.26	0.87
Test 4	0.90	0.18	2.10	0.53	0.58	0.33	1.07
Test 5	1.05	0.92	1.16	0.05	0.06	0.00	1.05
Total	0.80	0.30	1.63	0.36	0.42	0.21	0.93
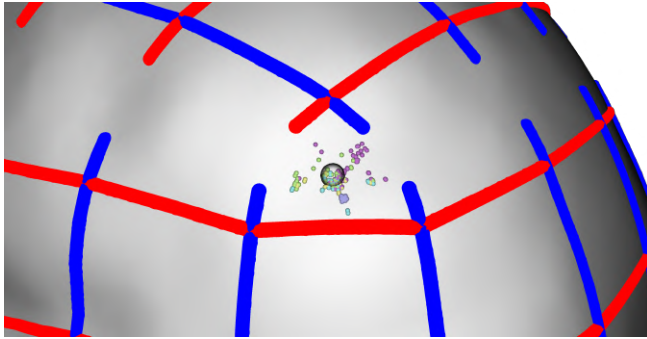
Table 30. Point near to a singularity #3 on a border between two touch controllers.

3-chipBorder2

	μ error	Min	Max	MAD	σ	σ^2	RMS
Test 1	1.05	0.71	1.30	0.13	0.17	0.03	1.06
Test 2	1.08	0.71	1.59	0.16	0.20	0.04	1.10
Test 3	0.95	0.65	1.27	0.14	0.17	0.03	0.96
Test 4	1.09	0.84	1.28	0.08	0.11	0.01	1.10
Test 5	0.73	0.51	0.86	0.06	0.08	0.01	0.73
Total	0.98	0.69	1.26	0.12	0.14	0.02	0.99
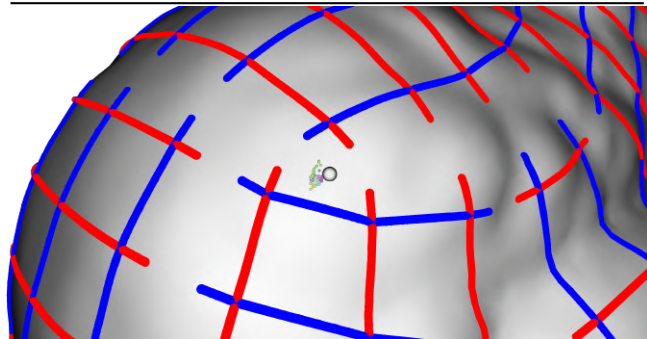
Table 31. Point near to a singularity #3 on a border between two touch controllers.

3-chipBorder2

	μ error	Min	Max	MAD	σ	σ^2	RMS
Test 1	0.66	0.42	0.90	0.08	0.11	0.01	0.67
Test 2	0.46	0.31	0.80	0.11	0.13	0.02	0.48
Test 3	0.83	0.53	1.27	0.17	0.20	0.04	0.85
Test 4	0.45	0.20	0.83	0.15	0.18	0.03	0.48
Test 5	0.55	0.17	0.75	0.10	0.14	0.02	0.57
Total	0.59	0.33	0.91	0.12	0.15	0.02	0.61

Table 32. Point near to a singularity #3 on a border between patches mapped on the same touch controller.

3-patchBorder1

	μ error	Min	Max	MAD	σ	σ^2	RMS
Test 1	0.75	0.37	1.12	0.25	0.27	0.07	0.80
Test 2	0.43	0.22	0.56	0.07	0.09	0.01	0.44
Test 3	0.90	0.13	1.33	0.27	0.31	0.10	0.96
Test 4	0.90	0.13	1.33	0.27	0.31	0.10	0.96
Test 5	0.54	0.14	0.91	0.22	0.24	0.06	0.59
Total	0.70	0.20	1.05	0.22	0.25	0.07	0.75

Table 33. Point near to a singularity #3 on a border between patches mapped on the same touch controller.

3-patchBorder2

	μ error	Min	Max	MAD	σ	σ^2	RMS
Test 1	0.57	0.28	0.72	0.09	0.12	0.01	0.58
Test 2	0.76	0.35	1.17	0.19	0.23	0.05	0.79
Test 3	0.60	0.34	0.86	0.14	0.16	0.03	0.62
Test 4	0.68	0.36	0.98	0.17	0.20	0.04	0.71
Test 5	0.58	0.25	0.86	0.16	0.18	0.03	0.60
Total	0.64	0.32	0.92	0.15	0.18	0.03	0.66

Table 35. Point in a regular region on a border between two touch controllers with orthogonal Tx-Rx field directions.

4-chipBorder1

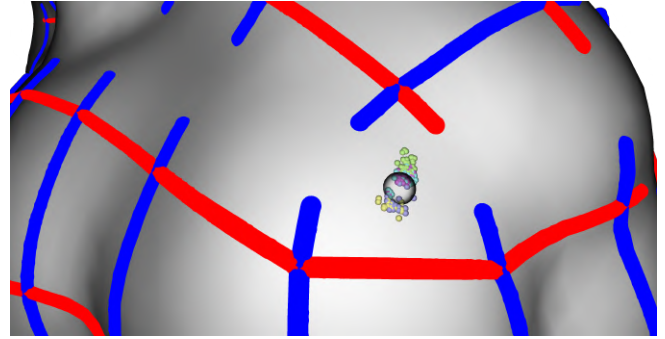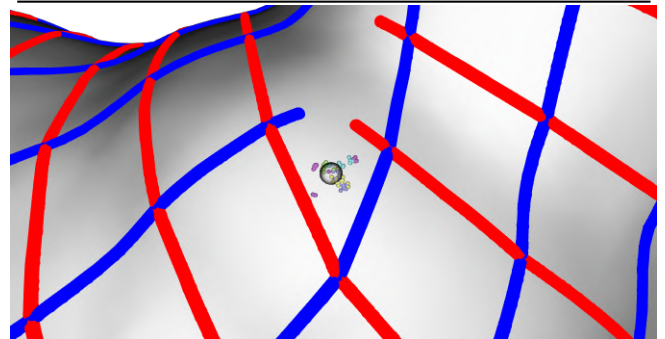|	μ error	Min	Max	MAD	σ	σ^2	RMS
Test 1	0.65	0.27	1.00	0.16	0.18	0.03	0.68
Test 2	0.76	0.24	1.13	0.20	0.24	0.06	0.80
Test 3	0.48	0.08	0.76	0.12	0.16	0.02	0.51
Test 4	0.68	0.12	0.99	0.30	0.32	0.10	0.75
Test 5	1.09	0.93	1.25	0.08	0.09	0.01	1.09
Total	0.73	0.33	1.03	0.17	0.20	0.05	0.77

Table 34. Point near to a singularity #3 on a border between patches mapped on the same touch controller.

3-patchBorder2

	μ error	Min	Max	MAD	σ	σ^2	RMS
Test 1	0.67	0.19	1.21	0.17	0.24	0.06	0.71
Test 2	0.72	0.44	0.89	0.11	0.13	0.02	0.73
Test 3	0.98	0.84	1.21	0.10	0.13	0.02	0.99
Test 4	0.86	0.64	1.08	0.06	0.10	0.01	0.86
Test 5	0.73	0.62	0.81	0.07	0.07	0.01	0.73
Total	0.79	0.55	1.04	0.10	0.13	0.02	0.81

Table 36. Point in a regular region on a border between two touch controllers with the continuous Tx-Rx field direction.

4-chipBorder1

	μ error	Min	Max	MAD	σ	σ^2	RMS
Test 1	0.57	0.44	0.76	0.08	0.09	0.01	0.58
Test 2	0.38	0.25	0.55	0.07	0.08	0.01	0.39
Test 3	0.86	0.65	1.18	0.09	0.11	0.01	0.87
Test 4	0.36	0.17	0.53	0.09	0.11	0.01	0.37
Test 5	0.66	0.47	0.91	0.10	0.12	0.01	0.67
Total	0.57	0.39	0.78	0.08	0.10	0.01	0.58

Table 37. Point in a regular region on a border between two touch controllers with continuous Tx-Rx field direction. A controller also presents a border between patches.

4-chipPatchBorder

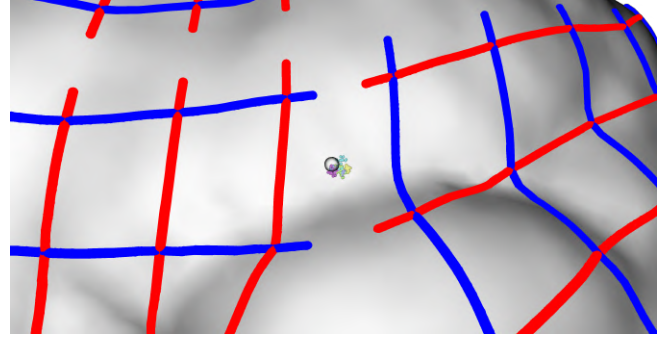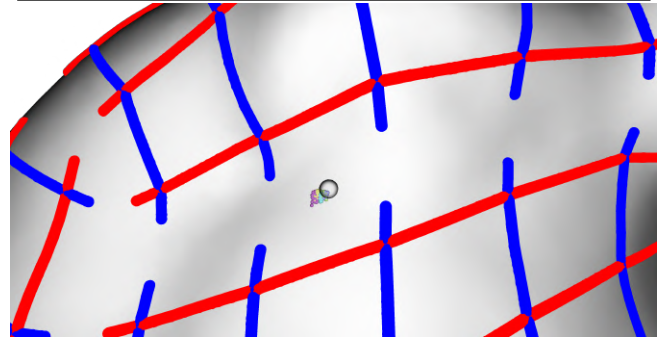|	μ error	Min	Max	MAD	σ	σ²	RMS
Test 1	1.41	0.08	2.45	0.38	0.54	0.30	1.51
Test 2	1.67	0.67	2.26	0.48	0.52	0.27	1.75
Test 3	1.98	1.43	2.86	0.33	0.41	0.17	2.02
Test 4	1.92	1.60	2.26	0.13	0.16	0.03	1.92
Test 5	1.54	0.80	4.12	0.90	1.13	1.29	1.91
Total	1.70	0.91	2.79	0.44	0.55	0.41	1.82
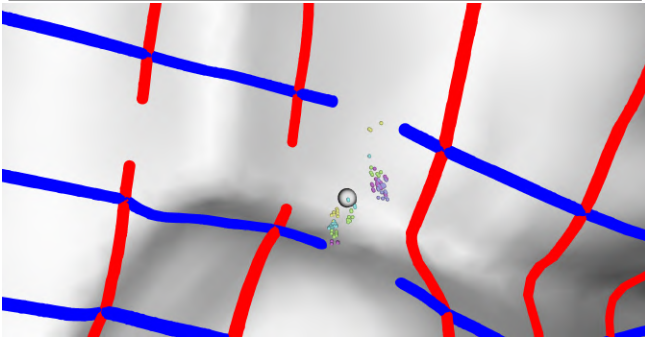
Table 38. Point with the longest conductors.

4-farthestPoint1

	μ error	Min	Max	MAD	σ	σ²	RMS
Test 1	0.31	0.15	0.49	0.07	0.08	0.01	0.32
Test 2	0.52	0.36	0.75	0.09	0.11	0.01	0.53
Test 3	0.27	0.07	0.71	0.11	0.16	0.02	0.31
Test 4	0.34	0.05	0.67	0.13	0.17	0.03	0.39
Test 5	0.42	0.23	0.64	0.12	0.13	0.02	0.44
Total	0.37	0.17	0.65	0.10	0.13	0.02	0.40
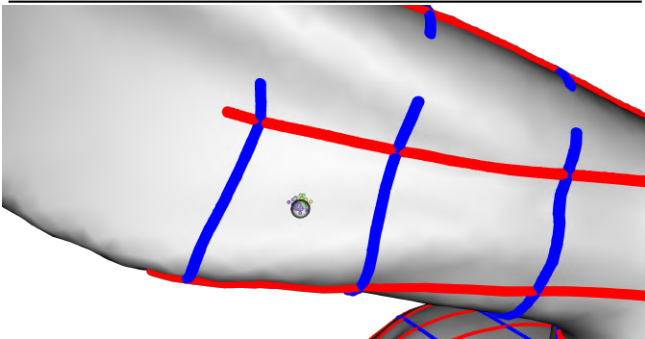
Table 39. Point with the longest conductors.

4-fartestPoint2

	μ error	Min	Max	MAD	σ	σ²	RMS
Test 1	0.23	0.12	0.34	0.07	0.08	0.01	0.25
Test 2	0.65	0.51	0.79	0.06	0.08	0.01	0.65
Test 3	0.45	0.17	0.60	0.07	0.10	0.01	0.47
Test 4	0.62	0.42	0.77	0.08	0.09	0.01	0.63
Test 5	0.57	0.31	0.92	0.13	0.16	0.02	0.59
Total	0.50	0.31	0.68	0.08	0.10	0.01	0.52
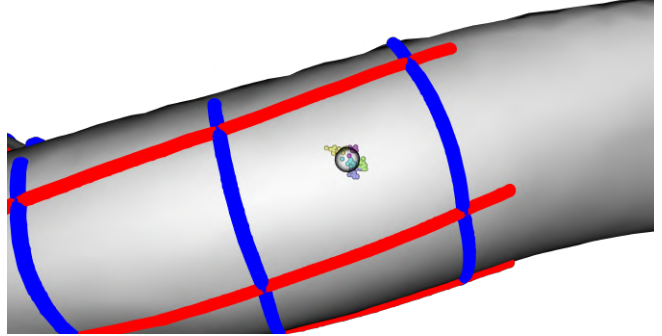
Table 40. Point in the middle of a regular patch in a convex region.

4-inside1

	μ error	Min	Max	MAD	σ	σ²	RMS
Test 1	0.33	0.13	0.45	0.07	0.09	0.01	0.34
Test 2	0.63	0.51	0.72	0.07	0.07	0.01	0.64
Test 3	0.49	0.29	0.70	0.11	0.13	0.02	0.51
Test 4	0.94	0.72	1.19	0.09	0.11	0.01	0.95
Test 5	0.55	0.42	0.84	0.08	0.10	0.01	0.56
Total	0.59	0.41	0.78	0.08	0.10	0.01	0.60
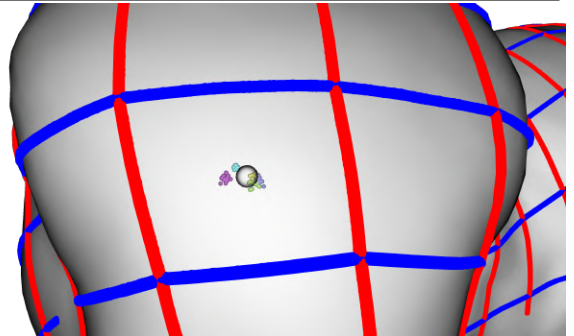
Table 41. Point in the middle of a regular patch in a convex region.

4-inside2

	μ error	Min	Max	MAD	σ	σ^2	RMS
Test 1	0.79	0.37	1.09	0.20	0.24	0.06	0.82
Test 2	0.66	0.40	0.98	0.16	0.18	0.03	0.68
Test 3	1.14	0.84	1.57	0.13	0.19	0.04	1.15
Test 4	1.04	0.75	1.61	0.18	0.23	0.05	1.07
Test 5	0.94	0.61	1.11	0.11	0.14	0.02	0.95
Total	0.91	0.59	1.27	0.16	0.20	0.04	0.94

Table 43. Point in the middle of a regular patch in a concave region.

4-inside

	μ error	Min	Max	MAD	σ	σ^2	RMS
Test 1	1.60	1.39	1.74	0.08	0.11	0.01	1.60
Test 2	1.60	1.32	1.89	0.14	0.16	0.03	1.60
Test 3	1.48	1.23	1.88	0.15	0.18	0.03	1.49
Test 4	1.28	0.85	2.00	0.26	0.35	0.12	1.33
Test 5	1.24	0.78	1.64	0.21	0.24	0.06	1.27
Total	1.44	1.11	1.83	0.17	0.21	0.05	1.46

Table 42. Point in the middle of a regular patch in a convex region.

4-inside3

	μ error	Min	Max	MAD	σ	σ^2	RMS
Test 1	0.79	0.57	0.92	0.11	0.12	0.02	0.80
Test 2	1.14	0.87	1.36	0.14	0.16	0.02	1.15
Test 3	0.70	0.05	1.13	0.29	0.35	0.12	0.78
Test 4	1.10	0.47	1.81	0.31	0.37	0.13	1.16
Test 5	0.42	0.18	0.83	0.11	0.16	0.03	0.45
Total	0.83	0.43	1.21	0.19	0.23	0.06	0.87
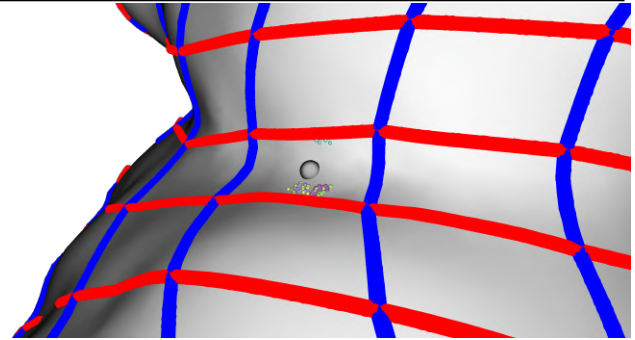
Table 44. Point in the middle of a regular patch in a convex region.

4-inside5

	μ error	Min	Max	MAD	σ	σ^2	RMS
Test 1	0.58	0.19	1.12	0.22	0.26	0.07	0.63
Test 2	0.82	0.31	1.37	0.29	0.33	0.11	0.89
Test 3	0.34	0.09	0.68	0.14	0.17	0.03	0.38
Test 4	0.49	0.43	0.64	0.04	0.05	0.00	0.49
Test 5	0.41	0.14	0.70	0.14	0.17	0.03	0.44
Total	0.53	0.23	0.90	0.17	0.20	0.05	0.57

Table 45. Point in a regular region on the border between two patches of the same touch controller with orthogonal Tx-Rx field direction.

4-patchBorder1

	μ error	Min	Max	MAD	σ	σ^2	RMS
Test 1	0.73	0.31	1.16	0.24	0.29	0.08	0.78
Test 2	0.36	0.13	0.62	0.14	0.16	0.02	0.40
Test 3	0.83	0.55	1.37	0.23	0.25	0.06	0.87
Test 4	0.29	0.04	0.54	0.09	0.12	0.01	0.31
Test 5	0.58	0.39	0.83	0.11	0.13	0.02	0.60
Total	0.56	0.28	0.90	0.16	0.19	0.04	0.59
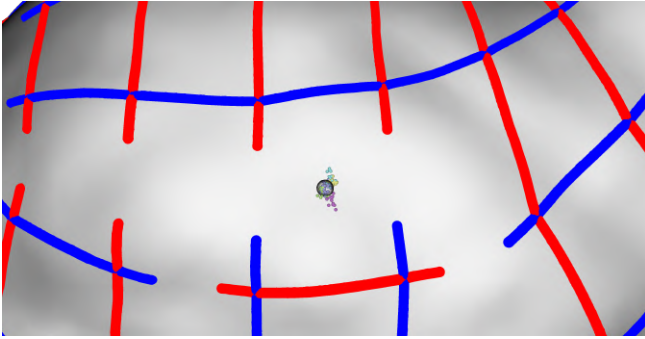
Table 46. Point in a regular region on the border between two patches of the same touch controller with continuous Tx-Rx field direction.

4-patchBorder2

	μ error	Min	Max	MAD	σ	σ^2	RMS
Test 1	0.76	0.25	1.74	0.33	0.45	0.21	0.88
Test 2	0.84	0.45	1.28	0.18	0.24	0.06	0.87
Test 3	0.80	0.51	1.24	0.18	0.22	0.05	0.83
Test 4	0.95	0.55	1.50	0.23	0.27	0.07	0.99
Test 5	0.75	0.56	1.06	0.10	0.14	0.02	0.77
Total	0.82	0.46	1.36	0.21	0.27	0.08	0.87
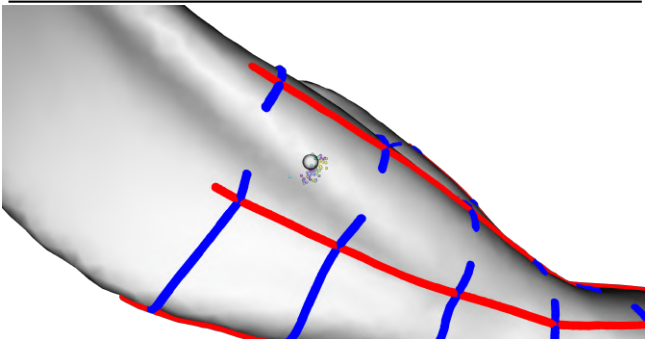
Table 47. Point in a regular region on the border among three patches of the same controller.

4-patchBorder3

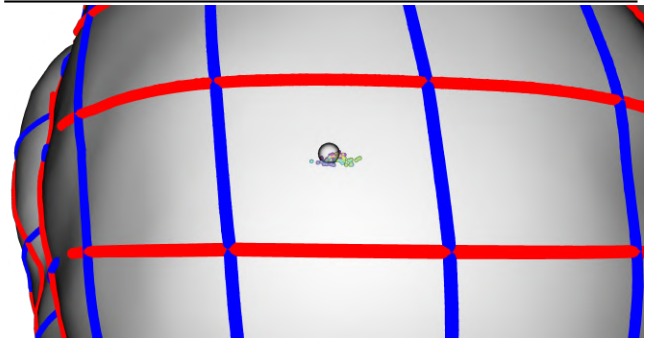|	μ error	Min	Max	MAD	σ	σ^2	RMS
Test 1	0.25	0.01	0.53	0.10	0.12	0.01	0.27
Test 2	0.45	0.09	0.67	0.14	0.17	0.03	0.48
Test 3	0.28	0.12	0.45	0.10	0.11	0.01	0.30
Test 4	0.58	0.43	0.81	0.10	0.12	0.01	0.59
Test 5	0.31	0.03	0.60	0.14	0.17	0.03	0.36
Total	0.37	0.14	0.61	0.12	0.14	0.02	0.40

Table 48. Point in a regular region on the border between two patches of the same controller.

4-patchBorder4

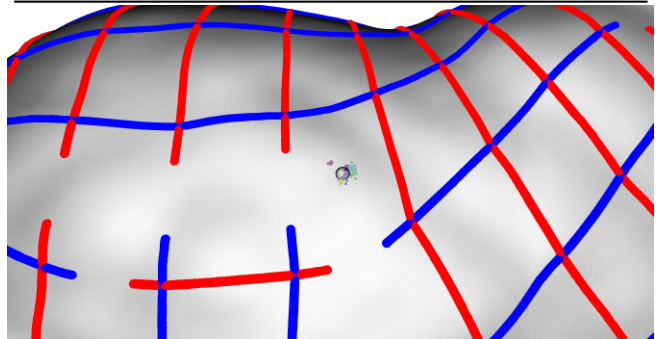|	μ error	Min	Max	MAD	σ	σ^2	RMS
Test 1	0.85	0.55	1.08	0.12	0.14	0.02	0.86
Test 2	0.65	0.44	0.92	0.14	0.17	0.03	0.67
Test 3	0.72	0.29	1.25	0.29	0.32	0.10	0.79
Test 4	0.37	0.16	0.78	0.13	0.16	0.03	0.40
Test 5	0.53	0.35	0.78	0.08	0.11	0.01	0.54
Total	0.62	0.36	0.96	0.15	0.18	0.04	0.65

Table 49. Point in a regular region on the border between two patches of the same controller.

4-patchBorder5

	μ error	Min	Max	MAD	σ	σ^2	RMS
Test 1	0.45	0.14	0.94	0.19	0.23	0.05	0.50
Test 2	0.75	0.15	1.95	0.45	0.55	0.31	0.93
Test 3	0.79	0.10	1.18	0.23	0.31	0.10	0.85
Test 4	0.57	0.13	1.14	0.29	0.33	0.11	0.66
Test 5	0.57	0.22	1.22	0.22	0.27	0.07	0.63
Total	0.62	0.14	1.29	0.27	0.34	0.13	0.71
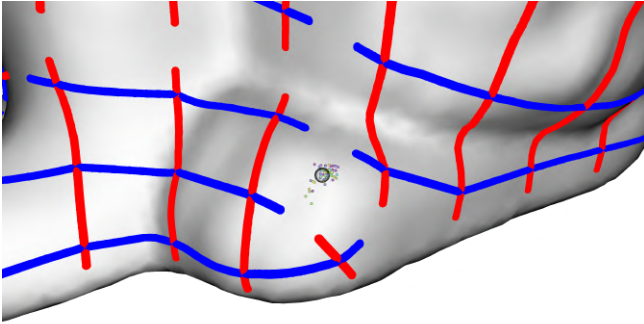
Table 50. Point on a singularity #5 on a border between two different touch controllers.

5-chipBorder1

	μ error	Min	Max	MAD	σ	σ^2	RMS
Test 1	1.17	0.33	1.93	0.28	0.36	0.13	1.23
Test 2	1.07	0.43	1.74	0.29	0.33	0.11	1.12
Test 3	0.54	0.19	1.17	0.19	0.24	0.06	0.59
Test 4	1.42	0.54	2.07	0.28	0.36	0.13	1.46
Test 5	1.08	0.57	1.52	0.22	0.27	0.07	1.11
Total	1.06	0.41	1.69	0.25	0.31	0.10	1.10
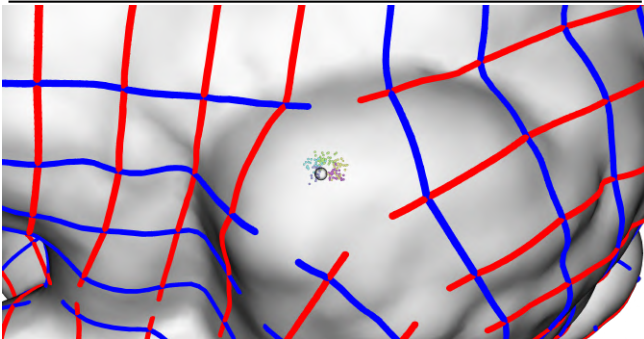
Table 51. Point on a singularity #5 on a border between two different touch controllers.

5-chipBorder2

	μ error	Min	Max	MAD	σ	σ^2	RMS
	μ error	Min	Max	MAD	σ	σ^2	RMS
Test 1	1.03	0.42	1.74	0.32	0.39	0.15	1.10
Test 2	1.11	0.39	2.15	0.43	0.51	0.26	1.22
Test 3	1.22	0.29	1.85	0.35	0.41	0.17	1.28
Test 4	0.99	0.08	1.80	0.37	0.46	0.21	1.09
Test 5	1.38	0.12	2.13	0.53	0.63	0.40	1.51
Total	1.14	0.26	1.93	0.40	0.48	0.24	1.24
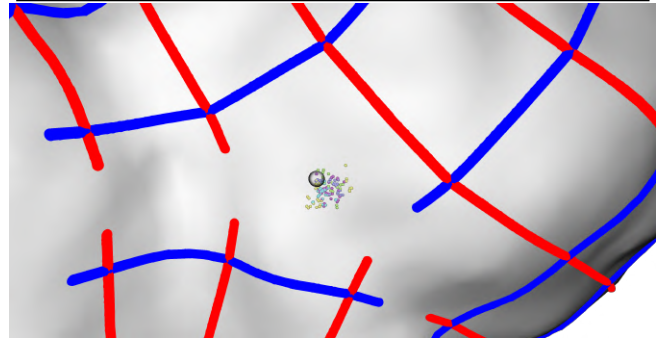
Table 52. Point on a singularity #5 on a border between two different touch controllers.

5-chipBorder2

	μ error	Min	Max	MAD	σ	σ^2	RMS
Test 1	0.89	0.19	1.36	0.25	0.32	0.11	0.95
Test 2	1.20	0.83	1.49	0.14	0.17	0.03	1.21
Test 3	0.67	0.40	1.00	0.12	0.14	0.02	0.68
Test 4	0.66	0.34	0.86	0.13	0.15	0.02	0.67
Test 5	0.90	0.51	1.20	0.17	0.20	0.04	0.92
Total	0.86	0.45	1.18	0.16	0.20	0.04	0.89
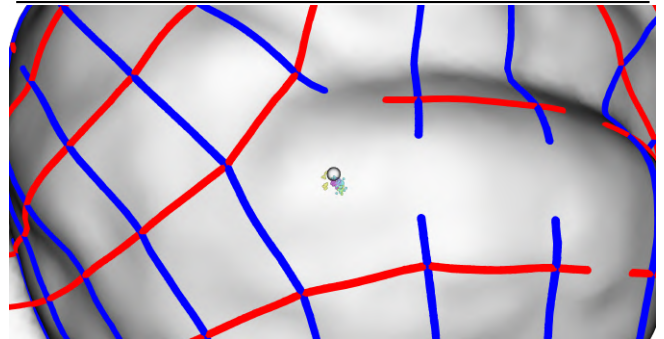
Table 53. Point on a singularity #5 on a border between two patches of the same controller.

	μ error	Min	Max	MAD	σ	σ^2	RMS
5-patchBorder1							
Test 1	0.55	0.06	0.92	0.22	0.26	0.07	0.60
Test 2	0.49	0.22	0.96	0.16	0.20	0.04	0.53
Test 3	0.67	0.35	1.29	0.21	0.27	0.07	0.73
Test 4	0.59	0.22	0.81	0.14	0.18	0.03	0.61
Test 5	0.55	0.17	0.81	0.17	0.20	0.04	0.58
Total	0.57	0.20	0.96	0.18	0.22	0.05	0.61
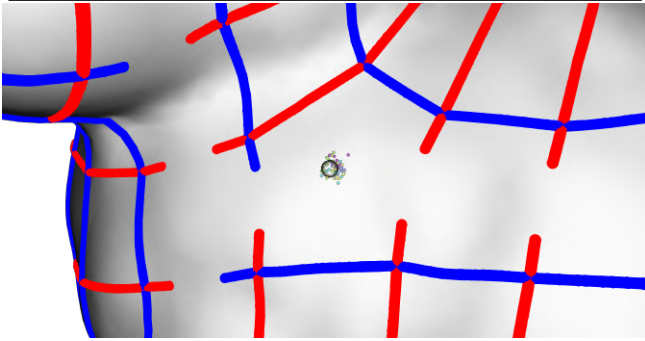
Table 54. Point on a singularity #5 on a border between two patches of the same controller.

	μ error	Min	Max	MAD	σ	σ^2	RMS
5-patchBorder2							
Test 1	0.37	0.09	0.57	0.14	0.16	0.03	0.41
Test 2	0.70	0.48	0.88	0.11	0.13	0.02	0.71
Test 3	0.28	0.05	0.49	0.11	0.13	0.02	0.31
Test 4	0.56	0.26	0.94	0.15	0.20	0.04	0.59
Test 5	0.34	0.13	0.67	0.10	0.13	0.02	0.37
Total	0.45	0.20	0.71	0.13	0.15	0.02	0.48
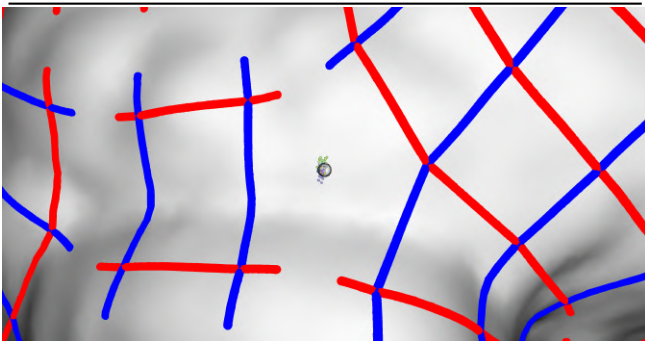
4.3 Cube - Paths

Table 55. Path on a sharp edge that is a border between two touch controllers with orthogonal Tx-Rx field directions (TxRx).

chipBorderSharpTxRx

	μ error	Min	Max	MAD	σ	σ^2	RMS
Test 1	1.18	0.00	3.93	0.69	0.87	0.76	1.47
Test 2	1.32	0.07	3.57	0.64	0.79	0.62	1.54
Test 3	1.00	0.00	3.24	0.51	0.65	0.42	1.19
Test 4	0.86	0.00	3.02	0.52	0.64	0.41	1.08
Test 5	1.42	0.06	5.11	0.67	0.89	0.79	1.67
Total	1.16	0.03	3.77	0.61	0.77	0.60	1.39
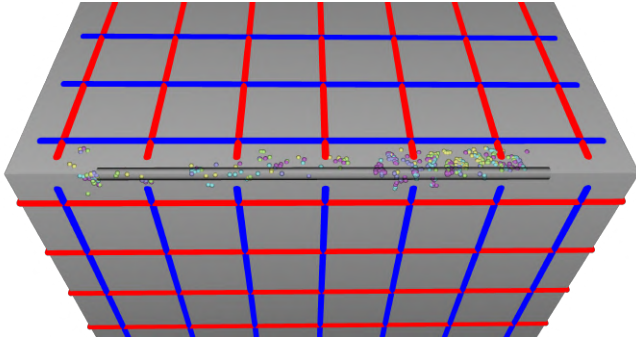
Table 56. Path on a sharp edge that is a border between two touch controllers with continuous Tx-Rx field directions (TxTx).

chipBorderSharpTxTx

	μ error	Min	Max	MAD	σ	σ^2	RMS
Test 1	0.72	0.00	2.64	0.47	0.59	0.35	0.93
Test 2	1.15	0.00	4.51	0.66	0.83	0.68	1.42
Test 3	0.99	0.09	3.06	0.58	0.73	0.53	1.23
Test 4	1.09	0.00	2.69	0.59	0.69	0.48	1.29
Test 5	1.03	0.00	3.27	0.60	0.76	0.58	1.28
Total	1.00	0.02	3.24	0.58	0.72	0.52	1.23

Table 57. Diagonal path that crosses a sharp edge between two touch controllers with orthogonal Tx-Rx field directions (TxRx).

chipCrossDiagTxRx

	μ error	Min	Max	MAD	σ	σ^2	RMS
Test 1	1.68	0.16	4.13	0.96	1.10	1.22	2.01
Test 2	1.31	0.04	3.89	0.98	1.12	1.25	1.72
Test 3	1.17	0.01	2.88	0.73	0.82	0.68	1.43
Test 4	1.14	0.01	4.82	0.94	1.09	1.18	1.58
Test 5	1.18	0.00	3.36	0.77	0.86	0.73	1.46
Total	1.30	0.04	3.82	0.88	1.00	1.01	1.64

Table 58. Diagonal path that crosses a sharp edge between two touch controllers with continuous Tx-Rx field directions (TxTx).

chipCrossDiagTxTx

	μ error	Min	Max	MAD	σ	σ^2	RMS
Test 1	1.14	0.01	3.82	0.73	0.91	0.83	1.46
Test 2	1.53	0.07	6.59	1.06	1.36	1.84	2.05
Test 3	1.05	0.01	3.31	0.77	0.90	0.81	1.39
Test 4	1.94	0.06	5.37	1.06	1.30	1.70	2.34
Test 5	1.34	0.02	6.89	0.80	1.16	1.35	1.77
Total	1.40	0.03	5.19	0.88	1.13	1.31	1.80

Table 59. Parallel path that crosses a sharp edge between two touch controllers with continuous Tx-Rx field directions (TxTx).

chipCrossParalTxTx

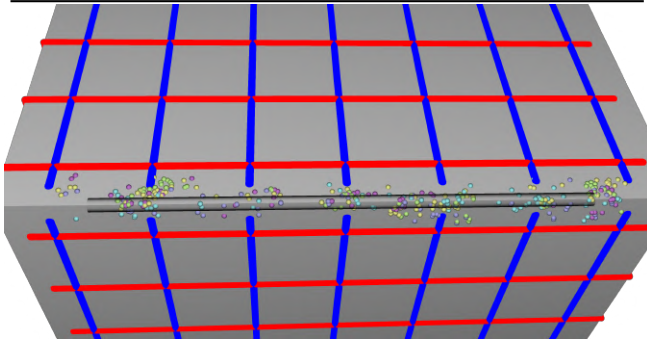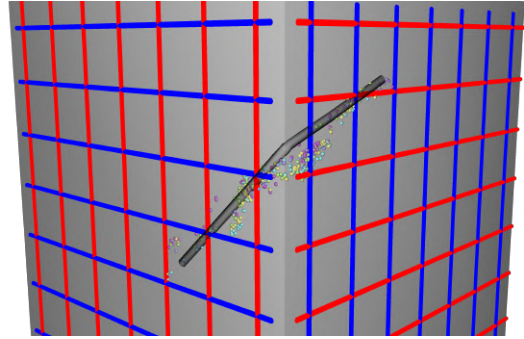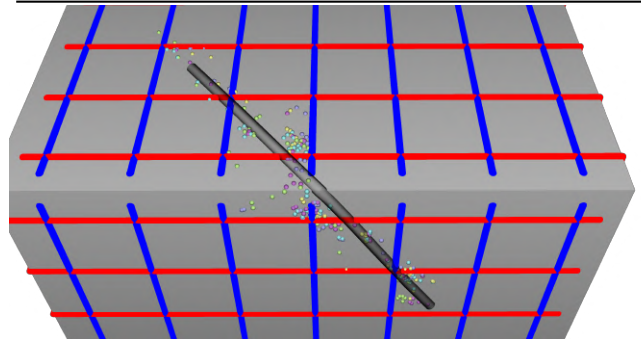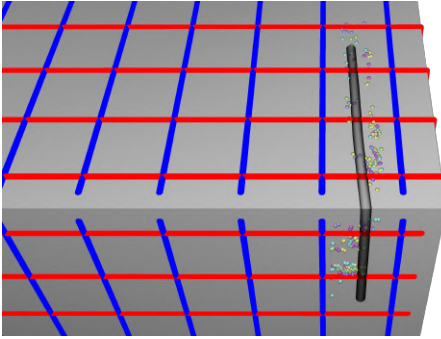|	μ error	Min	Max	MAD	σ	σ^2	RMS
Test 1	1.40	0.06	2.97	0.59	0.75	0.57	1.59
Test 2	1.33	0.01	2.99	0.61	0.75	0.56	1.52
Test 3	1.24	0.02	2.83	0.53	0.66	0.43	1.41
Test 4	1.53	0.01	4.59	0.97	1.15	1.33	1.91
Test 5	1.30	0.10	2.41	0.46	0.57	0.33	1.42
Total	1.36	0.04	3.16	0.63	0.78	0.64	1.57

Table 60. Parallel path that crosses a sharp edge between two touch controllers with orthogonal Tx-Rx field directions (TxRx).

chipCrossParalTxRx

	μ error	Min	Max	MAD	σ	σ^2	RMS
Test 1	0.79	0.04	6.01	0.48	0.81	0.65	1.13
Test 2	0.69	0.00	6.53	0.60	1.02	1.05	1.23
Test 3	1.27	0.10	6.26	0.64	0.94	0.88	1.58
Test 4	1.37	0.01	4.46	0.67	0.92	0.84	1.65
Test 5	0.84	0.01	3.37	0.64	0.80	0.63	1.16
Total	0.99	0.03	5.32	0.60	0.90	0.81	1.35
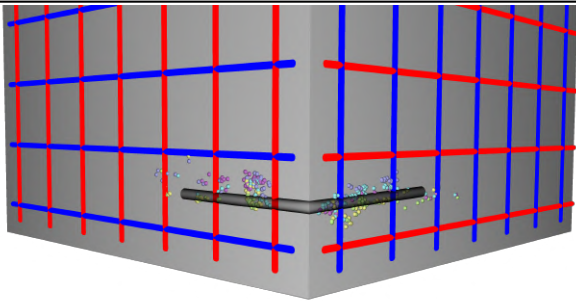
Table 61. Diagonal path that crosses a sharp edge inside a single controller.

insideDiagCrossSharp

	μ error	Min	Max	MAD	σ	σ^2	RMS
Test 1	0.95	0.00	3.54	0.78	0.93	0.87	1.33
Test 2	0.98	0.00	2.89	0.57	0.70	0.49	1.20
Test 3	0.65	0.01	1.53	0.36	0.41	0.16	0.77
Test 4	1.30	0.00	4.38	0.92	1.14	1.29	1.73
Test 5	0.76	0.04	2.34	0.48	0.59	0.34	0.96
Total	0.93	0.01	2.94	0.62	0.75	0.63	1.20
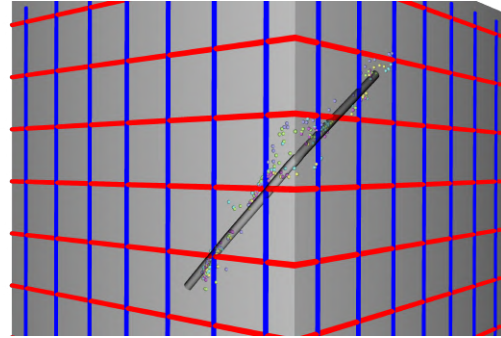
Table 62. Parallel path to the Tx lines of a single controller.

insideParallTx

	μ error	Min	Max	MAD	σ	σ^2	RMS
Test 1	0.89	0.05	2.45	0.38	0.51	0.26	1.02
Test 2	0.31	0.01	1.35	0.29	0.35	0.12	0.47
Test 3	0.48	0.01	1.89	0.36	0.48	0.23	0.68
Test 4	0.58	0.02	1.92	0.45	0.54	0.29	0.79
Test 5	0.71	0.00	2.45	0.54	0.64	0.41	0.95
Total	0.59	0.02	2.01	0.40	0.50	0.26	0.78
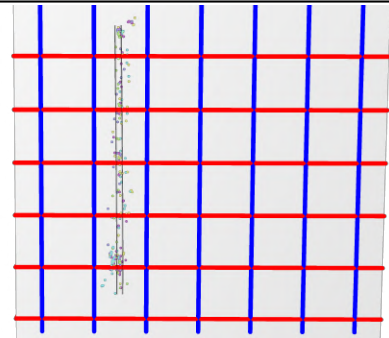
Table 63. Parallel path to the Rx lines of a single controller that crosses a sharp edge.

insideParelCrossSharpRx

	μ error	Min	Max	MAD	σ	σ^2	RMS
Test 1	0.78	0.00	3.53	0.71	0.82	0.67	1.14
Test 2	0.83	0.01	2.56	0.61	0.68	0.47	1.08
Test 3	0.75	0.00	2.42	0.51	0.61	0.38	0.97
Test 4	0.78	0.00	2.77	0.55	0.65	0.43	1.01
Test 5	0.98	0.00	6.79	0.82	1.25	1.57	1.59
Total	0.83	0.00	3.62	0.64	0.80	0.70	1.16
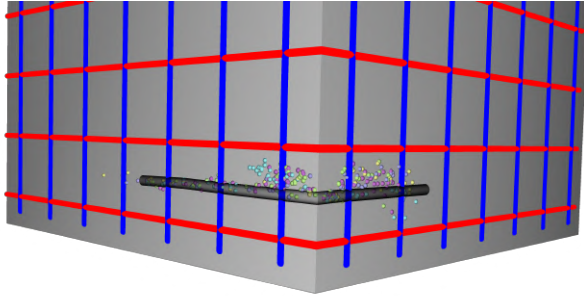
Table 64. Path on a sharp edge inside a single controller.

insideParallSharpTx

	μ error	Min	Max	MAD	σ	σ^2	RMS
Test 1	0.62	0.06	1.72	0.38	0.44	0.19	0.76
Test 2	1.17	0.16	2.71	0.52	0.68	0.46	1.35
Test 3	0.79	0.15	1.94	0.37	0.46	0.21	0.92
Test 4	1.20	0.00	2.69	0.65	0.76	0.58	1.42
Test 5	1.03	0.06	2.62	0.61	0.75	0.56	1.27
Total	0.96	0.09	2.34	0.51	0.62	0.40	1.14
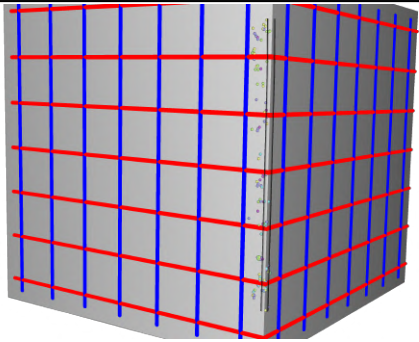
4.4 Bunny - Paths

Table 65. Path on a border between two touch controllers with orthogonal Tx-Rx field directions (TxRx).

chipBorderTxRx

	μ error	Min	Max	MAD	σ	σ^2	RMS
Test 1	0.70	0.01	4.04	0.58	0.89	0.80	1.13
Test 2	1.01	0.06	3.08	0.45	0.60	0.36	1.18
Test 3	1.22	0.29	2.93	0.37	0.46	0.21	1.30
Test 4	0.93	0.03	3.62	0.50	0.68	0.46	1.15
Test 5	1.08	0.08	2.60	0.41	0.52	0.27	1.20
Total	0.99	0.09	3.25	0.46	0.63	0.42	1.19

Table 66. Path on a border between two touch controllers with continuous Tx-Rx field directions (RxRx).

chipBorderRxRx

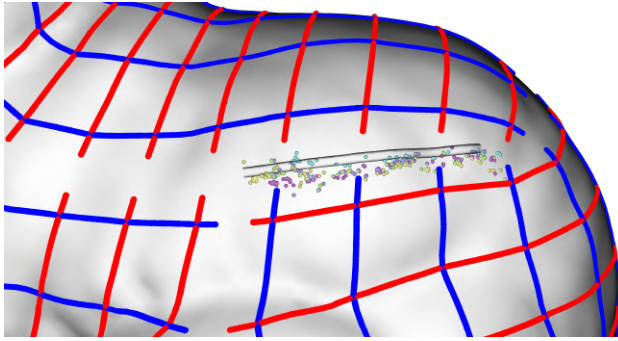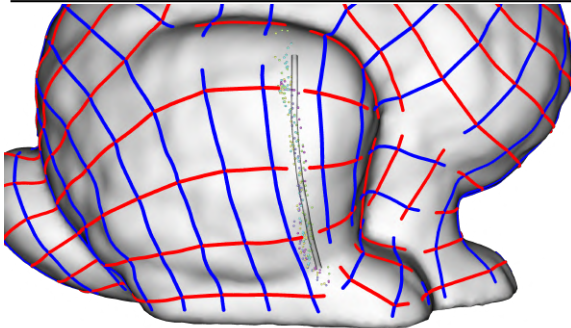|	μ error	Min	Max	MAD	σ	σ^2	RMS
Test 1	0.96	0.03	2.34	0.46	0.58	0.33	1.12
Test 2	1.01	0.05	5.88	0.70	1.09	1.18	1.49
Test 3	1.26	0.02	2.87	0.59	0.70	0.49	1.44
Test 4	1.06	0.03	2.95	0.72	0.83	0.68	1.35
Test 5	1.20	0.02	5.44	0.65	0.90	0.81	1.50
Total	1.10	0.03	3.90	0.62	0.82	0.70	1.38

Table 67. Path on a border between two touch controllers with continuous Tx-Rx field directions (TxTx).

chipBorderTxTx

	μ error	Min	Max	MAD	σ	σ^2	RMS
Test 1	0.97	0.19	2.52	0.43	0.51	0.26	1.10
Test 2	0.91	0.01	3.92	0.50	0.67	0.44	1.13
Test 3	1.16	0.02	4.13	0.64	0.82	0.67	1.42
Test 4	0.74	0.02	4.00	0.47	0.69	0.47	1.01
Test 5	0.81	0.06	4.19	0.42	0.64	0.41	1.03
Total	0.92	0.06	3.75	0.49	0.66	0.45	1.14
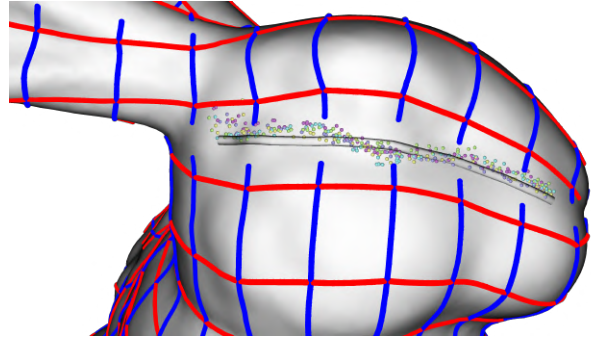
Table 68. Diagonal path that crosses two touch controllers with continuous Tx-Rx field directions (RxRx).

chipCrossDiagRxRx

	μ error	Min	Max	MAD	σ	σ^2	RMS
Test 1	1.22	0.02	1.98	0.51	0.59	0.35	1.36
Test 2	1.20	0.27	2.04	0.37	0.44	0.19	1.28
Test 3	1.16	0.01	3.16	0.66	0.81	0.65	1.41
Test 4	0.68	0.01	1.97	0.42	0.50	0.25	0.84
Test 5	0.63	0.00	1.37	0.35	0.40	0.16	0.75
Total	0.98	0.06	2.10	0.46	0.55	0.32	1.13

Table 69. Diagonal path that crosses two touch controllers with orthogonal Tx-Rx field directions (TxRx).

chipCrossDiagTxRx

	μ error	Min	Max	MAD	σ	σ²	RMS
Test 1	1.06	0.03	3.71	0.70	0.89	0.80	1.39
Test 2	0.97	0.07	2.67	0.60	0.72	0.52	1.21
Test 3	1.07	0.10	2.87	0.60	0.73	0.53	1.29
Test 4	1.00	0.01	3.77	0.69	0.88	0.77	1.33
Test 5	1.21	0.03	2.99	0.64	0.78	0.61	1.44
Total	1.06	0.05	3.20	0.64	0.80	0.65	1.33

Table 71. Parallel path to the Tx-Rx lines that crosses two touch controllers with continuous Tx-Rx field directions (RxRx).

chipCrossParallRxRx

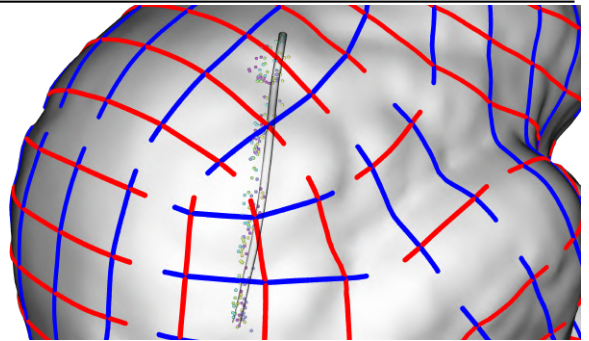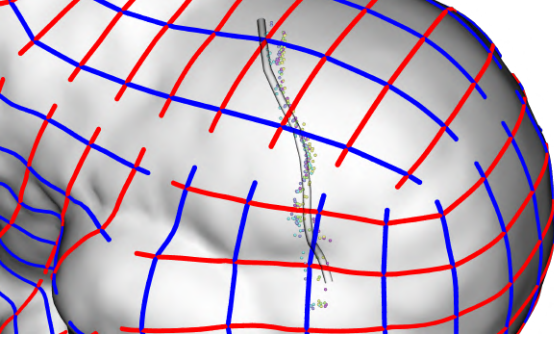|	μ error	Min	Max	MAD	σ	σ²	RMS
Test 1	0.61	0.04	1.81	0.35	0.42	0.17	0.74
Test 2	0.54	0.07	1.29	0.18	0.25	0.06	0.60
Test 3	0.52	0.03	2.64	0.42	0.61	0.38	0.81
Test 4	0.60	0.05	2.36	0.30	0.46	0.21	0.75
Test 5	0.54	0.01	2.22	0.32	0.46	0.21	0.71
Total	0.56	0.04	2.06	0.31	0.44	0.21	0.72

Table 70. Diagonal path that crosses two touch controllers with orthogonal Tx-Rx field directions (TxTx).

chipCrossDiagTxTx

	μ error	Min	Max	MAD	σ	σ²	RMS
Test 1	0.92	0.29	2.23	0.36	0.48	0.23	1.04
Test 2	0.86	0.03	2.09	0.41	0.49	0.24	0.99
Test 3	0.87	0.07	1.74	0.38	0.46	0.21	0.98
Test 4	0.75	0.03	1.91	0.47	0.54	0.29	0.93
Test 5	0.74	0.00	1.71	0.34	0.42	0.18	0.85
Total	0.83	0.08	1.94	0.39	0.48	0.23	0.96

Table 72. Parallel path to the Tx-Rx lines that crosses two touch controllers with orthogonal Tx-Rx field directions (TxRx).

chipCrossParallelTxRx

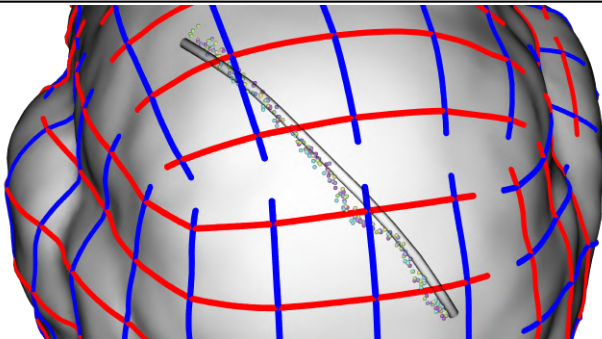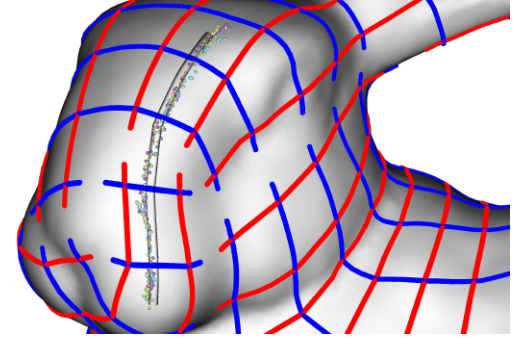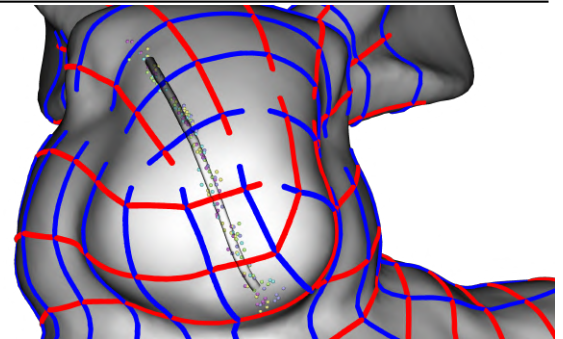|	μ error	Min	Max	MAD	σ	σ²	RMS
Test 1	0.59	0.03	2.65	0.39	0.57	0.32	0.82
Test 2	0.61	0.03	3.77	0.38	0.67	0.45	0.90
Test 3	0.93	0.01	5.94	0.97	1.38	1.91	1.67
Test 4	0.97	0.25	4.31	0.75	1.02	1.04	1.41
Test 5	0.72	0.02	4.25	0.57	0.90	0.81	1.15
Total	0.76	0.07	4.18	0.61	0.91	0.91	1.19

Table 73. Parallel path to the Tx-Rx lines that crosses two touch controllers with continuous Tx-Rx field directions (TxTx).

chipCrossParallTxTx

	μ error	Min	Max	MAD	σ	σ^2	RMS
Test 1	0.47	0.00	2.08	0.30	0.38	0.15	0.61
Test 2	0.86	0.19	1.79	0.33	0.40	0.16	0.95
Test 3	0.57	0.01	1.53	0.36	0.43	0.18	0.71
Test 4	0.50	0.00	2.63	0.28	0.40	0.16	0.64
Test 5	0.53	0.01	1.42	0.25	0.31	0.09	0.61
Total	0.59	0.04	1.89	0.30	0.38	0.15	0.70
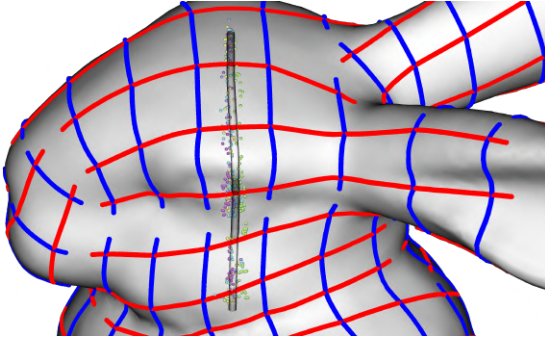
Table 74. Diagonal path inside a single controller.

insideDiag

	μ error	Min	Max	MAD	σ	σ^2	RMS
Test 1	1.26	0.06	3.18	0.63	0.78	0.60	1.48
Test 2	1.27	0.01	4.11	0.65	0.80	0.64	1.50
Test 3	1.43	0.02	4.27	0.81	1.02	1.04	1.76
Test 4	1.55	0.06	3.34	0.67	0.81	0.65	1.75
Test 5	1.63	0.01	4.47	0.85	1.06	1.11	1.94
Total	1.43	0.03	3.87	0.72	0.89	0.81	1.68
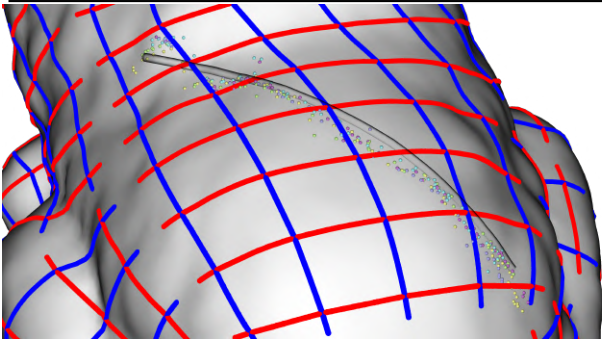
Table 75. Diagonal path inside a single controller.

insideDiag2

	μ error	Min	Max	MAD	σ	σ^2	RMS
Test 1	1.62	0.05	3.95	0.74	0.97	0.93	1.89
Test 2	1.33	0.04	3.51	0.64	0.78	0.61	1.54
Test 3	1.10	0.03	3.18	0.55	0.73	0.53	1.32
Test 4	1.50	0.08	3.77	0.77	0.94	0.88	1.77
Test 5	1.53	0.01	4.83	0.63	0.86	0.74	1.76
Total	1.42	0.04	3.85	0.67	0.85	0.74	1.66
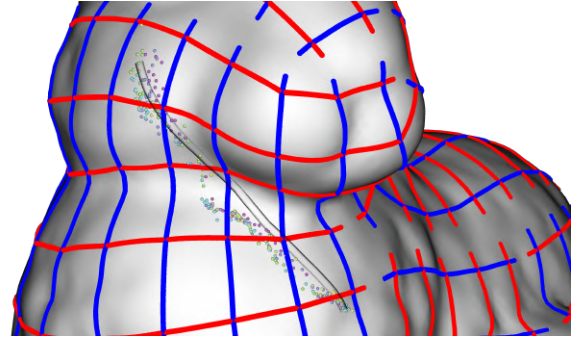
Table 76. Path inside a single controller that is parallel to the Rx lines.

insideParalleRx

	μ error	Min	Max	MAD	σ	σ^2	RMS
Test 1	0.76	0.01	3.19	0.54	0.65	0.42	1.00
Test 2	1.13	0.00	2.06	0.43	0.51	0.26	1.24
Test 3	0.73	0.01	1.96	0.48	0.55	0.31	0.91
Test 4	0.94	0.03	2.69	0.49	0.59	0.35	1.11
Test 5	1.00	0.01	3.96	0.63	0.82	0.67	1.29
Total	0.91	0.01	2.77	0.51	0.62	0.40	1.11
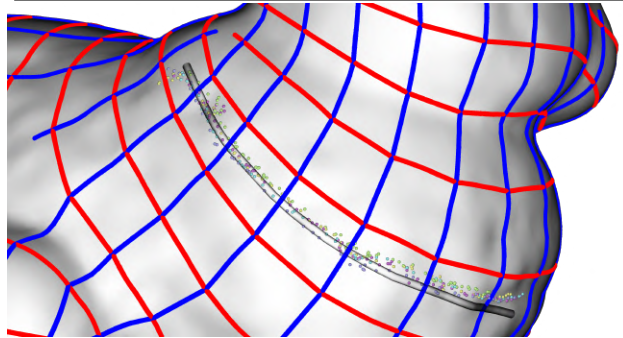
Table 77. Path inside a single controller that is parallel to the Tx lines.

insideParallTx

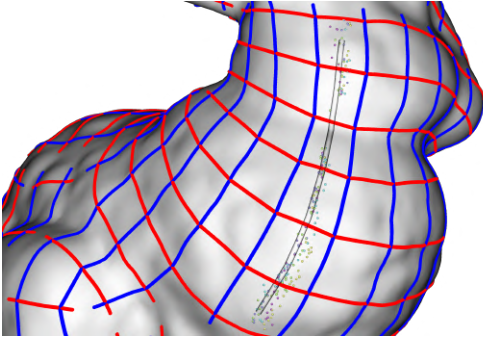|	μ error	Min	Max	MAD	σ	σ^2	RMS
Test 1	1.02	0.03	4.46	0.64	0.92	0.84	1.37
Test 2	0.74	0.06	4.07	0.52	0.80	0.64	1.09
Test 3	0.97	0.03	5.10	0.79	1.09	1.19	1.46
Test 4	0.83	0.01	4.26	0.81	1.11	1.24	1.39
Test 5	1.33	0.08	3.57	0.79	0.90	0.82	1.61
Total	0.98	0.04	4.29	0.71	0.96	0.94	1.38

Table 78. Path on a border between two patches of the same touch controller with orthogonal Tx-Rx field directions (TxRx).

patchBorderTxRx

	μ error	Min	Max	MAD	σ	σ^2	RMS
Test 1	1.20	0.03	4.52	0.83	1.09	1.19	1.62
Test 2	0.80	0.00	2.02	0.44	0.54	0.29	0.96
Test 3	1.05	0.17	2.73	0.54	0.64	0.42	1.23
Test 4	0.54	0.03	1.31	0.29	0.34	0.12	0.63
Test 5	0.67	0.14	1.57	0.29	0.36	0.13	0.76
Total	0.85	0.07	2.43	0.48	0.60	0.43	1.04

Table 79. Path on a border between two patches of the same touch controller with continuous Tx-Rx field directions (RxRx).

patchBorderRxRx

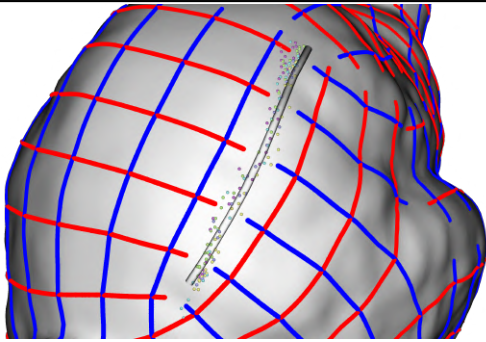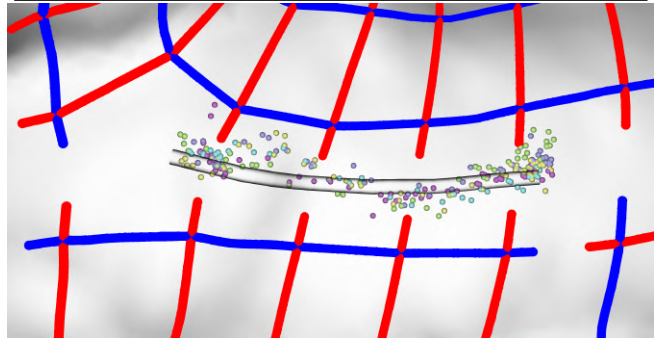|	μ error	Min	Max	MAD	σ	σ^2	RMS
Test 1	0.71	0.01	2.07	0.39	0.50	0.25	0.87
Test 2	1.09	0.04	3.17	0.61	0.77	0.59	1.33
Test 3	0.60	0.02	3.91	0.43	0.71	0.51	0.93
Test 4	1.02	0.03	2.77	0.55	0.69	0.48	1.23
Test 5	0.80	0.02	2.99	0.50	0.67	0.45	1.04
Total	0.85	0.02	2.98	0.50	0.67	0.45	1.08

Table 80. Path on a border between two patches of the same touch controller with continuous Tx-Rx field directions (TxTx).

patchBorderTxTx

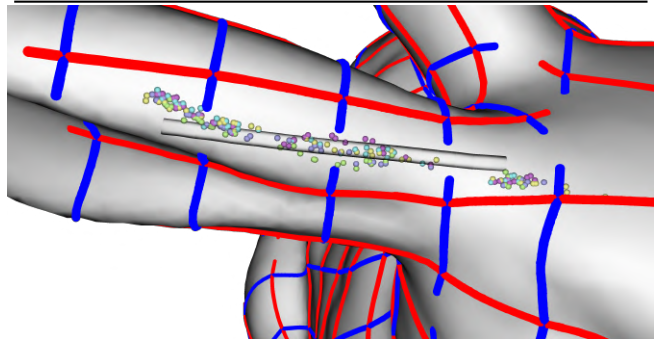|	μ error	Min	Max	MAD	σ	σ^2	RMS
Test 1	0.77	0.02	2.15	0.51	0.58	0.34	0.97
Test 2	0.84	0.00	1.89	0.40	0.48	0.23	0.97
Test 3	0.89	0.08	2.15	0.52	0.60	0.36	1.07
Test 4	0.85	0.02	2.70	0.56	0.68	0.46	1.09
Test 5	1.14	0.02	6.41	0.88	1.31	1.71	1.73
Total	0.90	0.03	3.06	0.57	0.73	0.62	1.17

Table 81. Diagonal path that crosses two patches of a single controller with continuous Tx-Rx field directions (RxRx).

patchCrossDiagRxRx

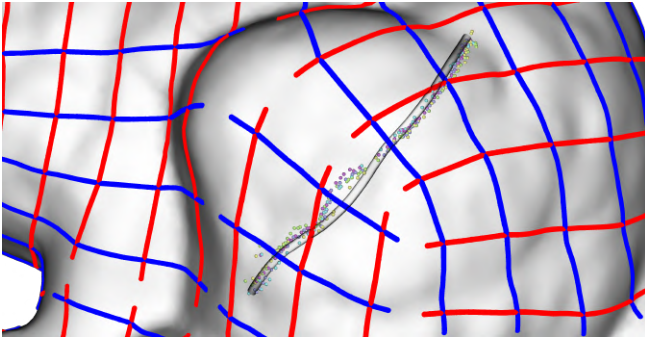|	μ error	Min	Max	MAD	σ	σ^2	RMS
Test 1	0.54	0.01	1.64	0.36	0.45	0.20	0.70
Test 2	0.89	0.07	2.47	0.38	0.49	0.24	1.01
Test 3	0.65	0.02	2.18	0.37	0.53	0.28	0.84
Test 4	0.61	0.02	2.06	0.30	0.42	0.18	0.74
Test 5	0.59	0.01	2.01	0.28	0.36	0.13	0.69
	0.66	0.03	2.07	0.34	0.45	0.20	0.80

Table 82. Diagonal path that crosses two patches of a single controller with orthogonal Tx-Rx field directions (TxRx).

patchCrossDiagTxRx

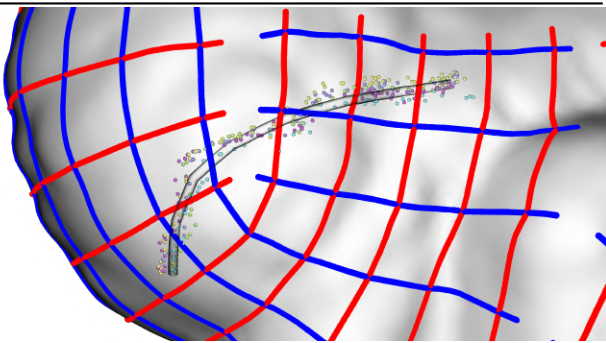|	μ error	Min	Max	MAD	σ	σ^2	RMS
Test 1	0.73	0.02	2.52	0.46	0.62	0.38	0.95
Test 2	0.74	0.07	1.87	0.38	0.46	0.21	0.87
Test 3	0.64	0.01	2.08	0.45	0.54	0.29	0.84
Test 4	0.72	0.00	1.51	0.40	0.45	0.21	0.85
Test 5	1.01	0.01	2.19	0.48	0.57	0.32	1.16
Total	0.77	0.02	2.03	0.43	0.53	0.28	0.93

Table 83. Parallel path to the Tx-Rx lines that crosses two patches of a single controller with continuous Tx-Rx field directions (RxRx).

patchCrossParallRxRx

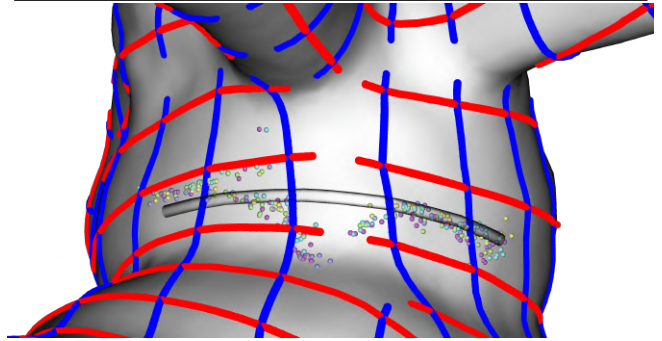|	μ error	Min	Max	MAD	σ	σ^2	RMS
Test 1	1.28	0.00	4.85	0.94	1.21	1.46	1.76
Test 2	1.30	0.11	4.65	0.66	0.84	0.71	1.55
Test 3	1.77	0.12	4.96	1.07	1.34	1.80	2.22
Test 4	1.47	0.02	5.46	1.28	1.57	2.47	2.15
Test 5	0.96	0.03	3.91	0.67	0.88	0.77	1.31
Total	1.36	0.06	4.77	0.92	1.17	1.44	1.80

Table 84. Parallel path to the Tx-Rx lines that crosses two patches of a single controller with continuous Tx-Rx field directions (TxTx).

patchCrossParalTxTx

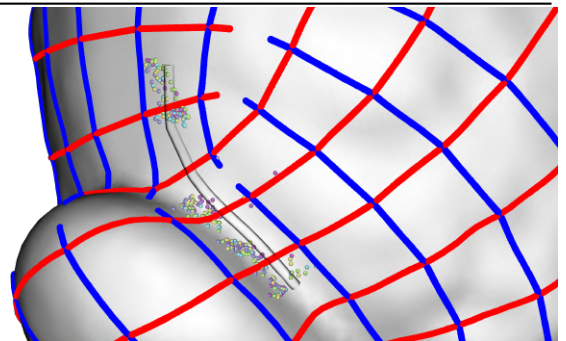|	μ error	Min	Max	MAD	σ	σ^2	RMS
Test 1	1.36	0.08	2.56	0.52	0.65	0.42	1.51
Test 2	1.40	0.14	3.15	0.50	0.64	0.41	1.53
Test 3	1.35	0.02	5.86	0.62	0.88	0.77	1.61
Test 4	1.54	0.14	3.15	0.56	0.69	0.47	1.69
Test 5	1.36	0.13	2.74	0.48	0.61	0.37	1.49
Total	1.40	0.10	3.49	0.54	0.69	0.49	1.57

Table 85. Parallel path to the Tx-Rx lines that crosses two patches of a single controller with orthogonal Tx-Rx field directions (TxRx).

	μ error	Min	Max	MAD	σ	σ^2	RMS
patchCrossParalTxRx							
Test 1	0.52	0.02	2.10	0.35	0.45	0.21	0.69
Test 2	0.40	0.00	1.66	0.31	0.37	0.14	0.54
Test 3	0.50	0.01	3.05	0.34	0.50	0.25	0.71
Test 4	0.56	0.03	2.48	0.39	0.52	0.27	0.76
Test 5	0.43	0.00	1.65	0.29	0.38	0.14	0.57
Total	0.48	0.01	2.19	0.34	0.44	0.20	0.65
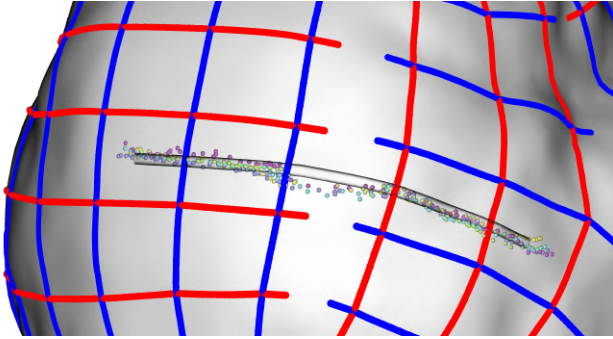
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   AN1334 Microchip Technology Inc. 53 pages.