Electrical Stimulation-Induced Gluteal and Hamstring Muscle Activation Can Reduce Sitting Pressure in Individuals with a Spinal Cord Injury

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Reade
revalidatie | reumatologie

Introduction (1)

- Pressures sores major problem in SCI
  - 85% of people with SCI develop pressure ulcers (decubitus) during their life *Liu et al. (2006)*
  - Medical costs: over 3 billion Euro annually in the UK *Riordan et al. (2009)*

- Risk factors:
  - Muscle atrophy (decrease of contact area)
  - Disturbed/decreased blood circulation below lesion
  - Long lasting sitting pressure over bony prominences (ischial tuberosities)

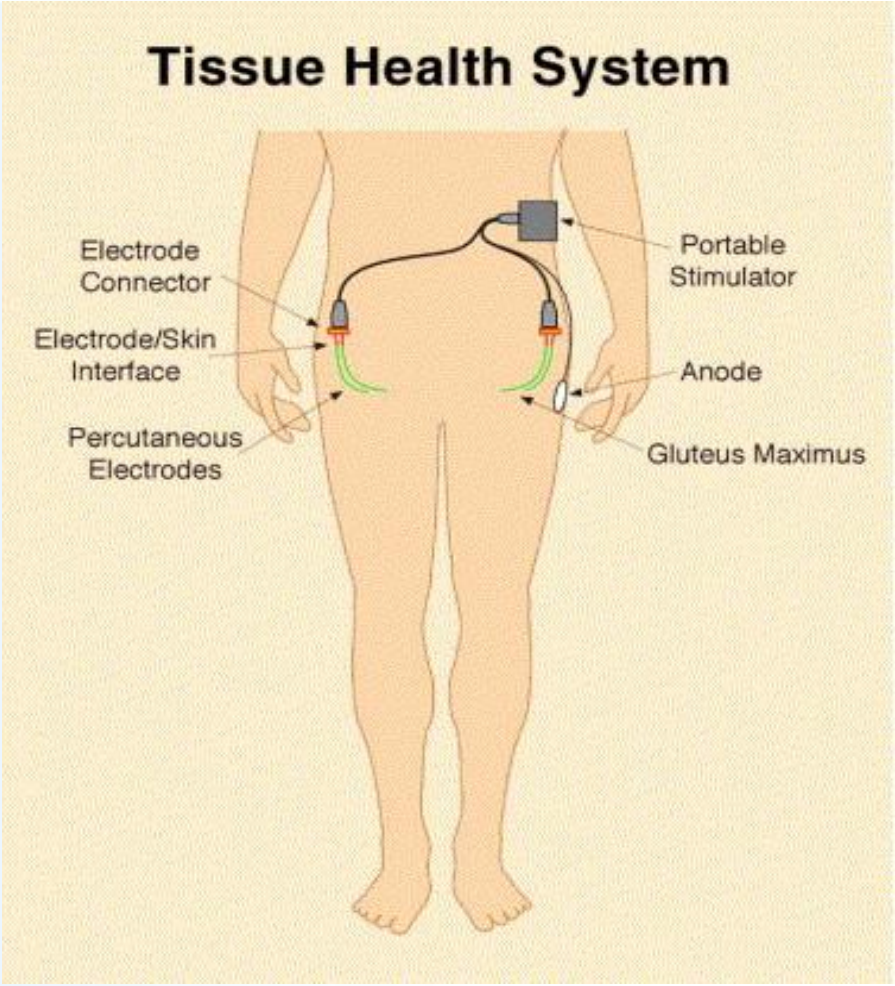
Introduction (2)

- Preventative measures
  - Special cushions
  - Weight shifting
  - Instruction of preventive measures
- Pressure sores still occur; methods may not adequate enough
- No activation= no counteracting muscle atrophy and circulation

Passive methods!

Introduction (3) Earlier research

- Acute effects of Surface ES
  - Blood flow ↑ *Janssen et al. (2003), Levine et al. (1990)*
  - Muscle size ↑ *Levine et al. (1990)*
- Long term effects of ES (implanted)
  - Same positive effects *Bogie et al. (2006)*
  - Sitting pressure ↓ *Van Londen et al. (2008)*


Tissue Health System
Electrode Connector
Electrode/Skin Interface
Percutaneous Electrodes
Portable Stimulator
Anode
Gluteus Maximus

Liu et al., *JRRD 2006*

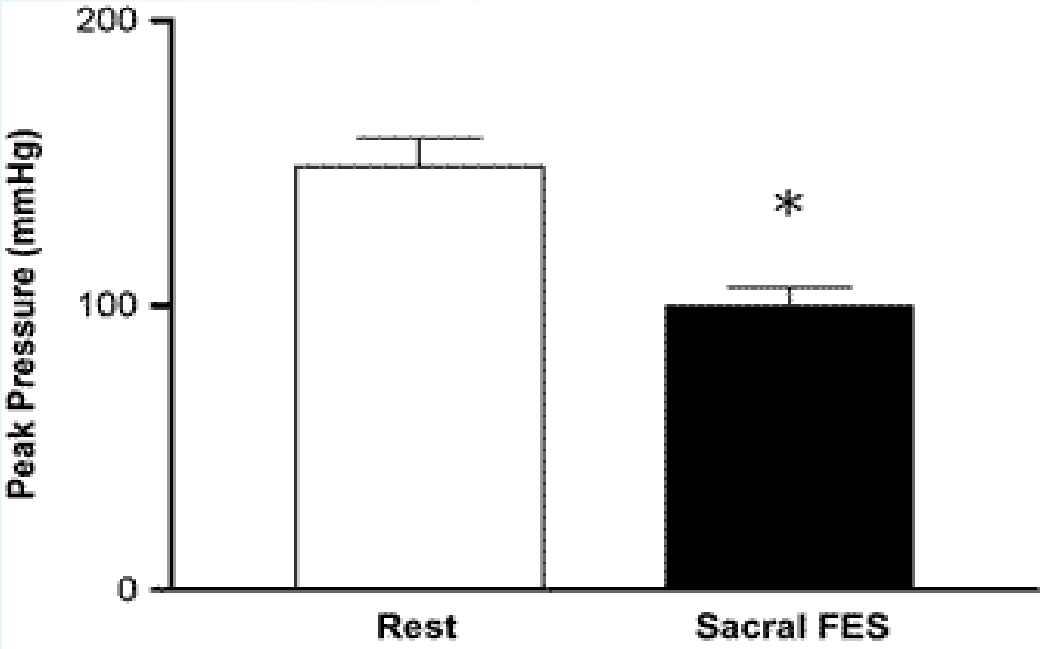
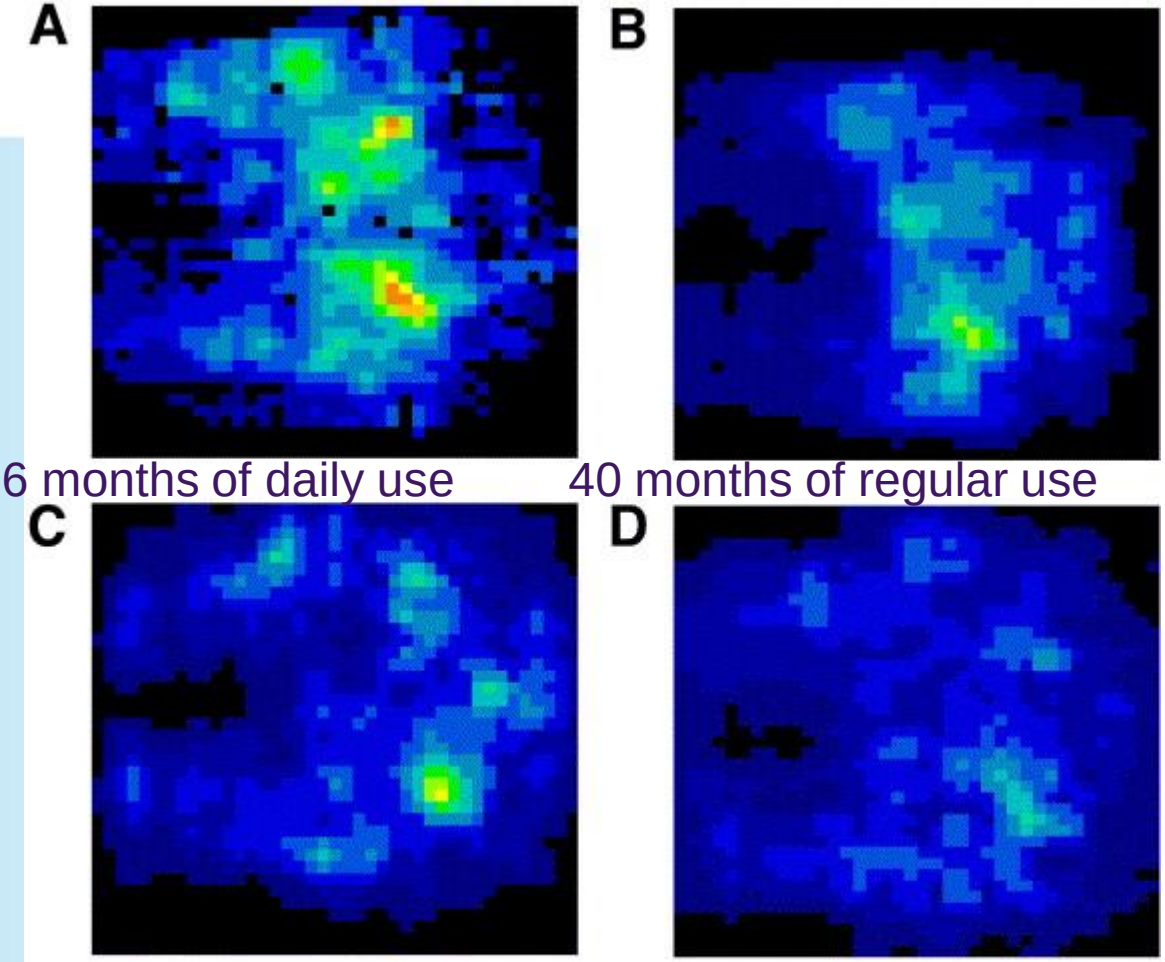


Figure 5.
Ischial tuberosity peak pressure before (rest) and during optimal sacral functional electrical stimulation (FES) in five participants with spinal cord injury and sacral anterior root stimulator implant (mean ± standard error of measurement = 148.6 mmHg ± 10.0 at rest vs 99.78 mmHg ± 6.7 during FES). *Significant at $p = 0.002$.

Baseline

Initial daily use

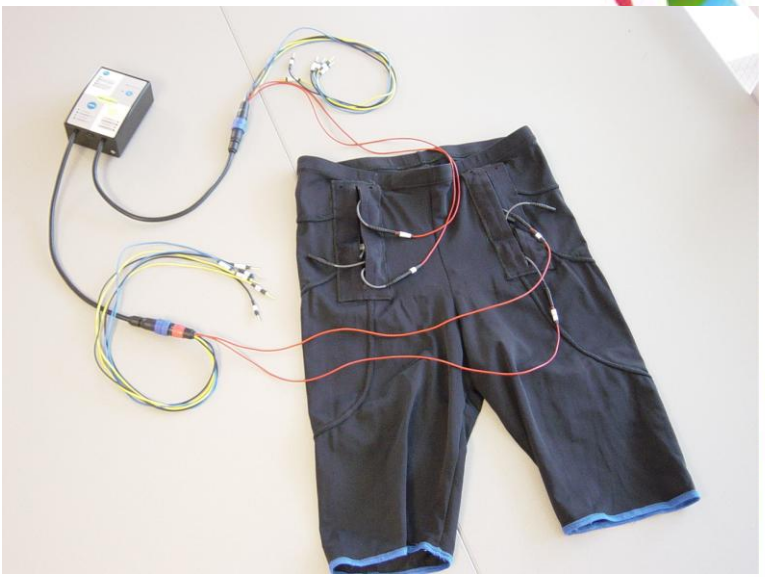


Implanted percutaneous gluteal stimulation system *Bogie et al. APMR 2006*

Introduction (4)

- Recent pilot-study: ES of *gluteals* using surface electrodes acutely reduced peak sitting pressure (Van Londen et al. APMR 2008),
- but..
  - Electrodes under buttocks not desirable;
  - Too large stimulator for daily life conditions
  - no effects studied outside lab during longer periods or different protocols.

- This study: custom-made shorts with built-in electrodes to simultaneously activate gluteal and hamstring muscles



BioShorts with built-in electrodes

NeuroPro 8-channel stimulator

Electrodes used. One on top of gluteals, the other halfway hamstrings

Purpose

To evaluate the effect of ES-induced activation of the gluteal and hamstring muscles on the sitting pressure distribution in individuals with SCI (Upper motor neuron lesion).

Methods (1) Participants Characteristics

	Mean ± SD (range)
Participants (M/F)	19 (14/5)
Age (years)	36.5 ± 10.7 (22-58)
(UMN) Lesion level	C3 - C8 (N=13) Th1-Th12 (N=6)
ASIA impairment classification	ASIA A: 15 ASIA B: 3 ASIA C: 1
Time since injury (months)	100 ± 92 (6-309)
Body mass (kg)	80.8 ± 14.3 (60-107)

Methods (2)

- 1. Stimulation Protocol A and B
  - Own daily-use wheelchair while sitting pressure was measured.
  - Two 3-hr protocols were randomly applied,
    3 min of stimulation (hamstring and gluteal muscles) 17-min rest.
  - Protocol A: 1s:1s
  - Protocol B a 1s:4s on-off duty cycle

- 2. Activating gluteal muscles exclusively versus gluteal and hamstring muscles.
  - As above,
  - Stimulatie vlgs 1s:4s on-off
  - Gluteal mm
  - Gluteal and hamstring mm

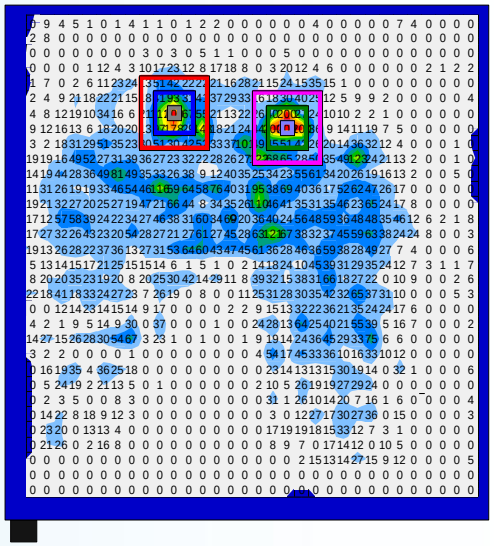
Methods (3)

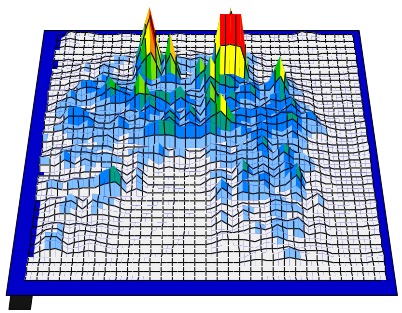
- Questionnaire on usability
  - 10 questions
  - Completely agree – completely disagree (1-5)

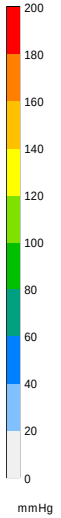
Pressure mapping system (FSA)

Methods (4)

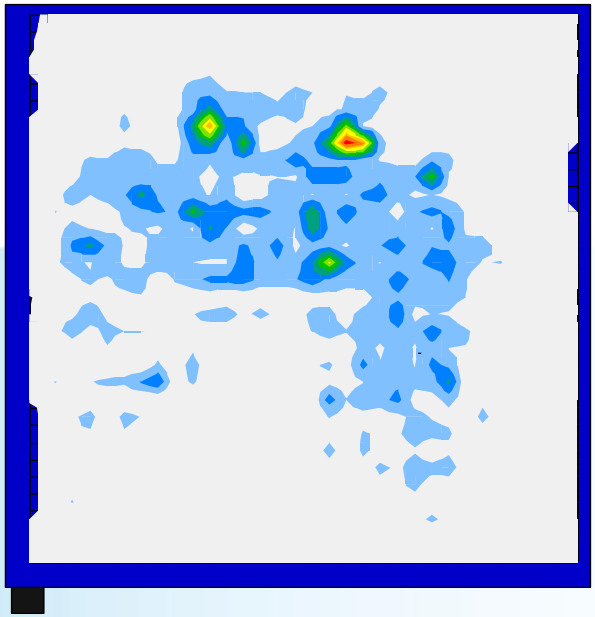
- Pressure mapping
- Recordings (4-8 Hz) at start (t0), after 1 (t1), 2 (t2), and 3 (t3) hrs during 3 min stim and last min rest.

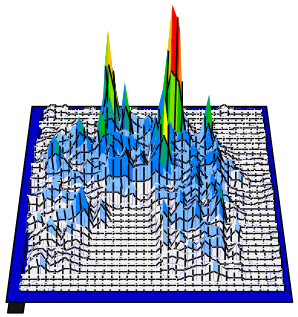




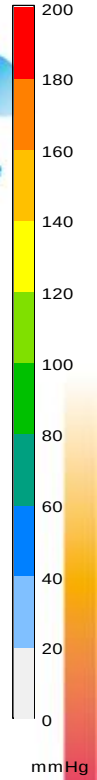


Results (1)

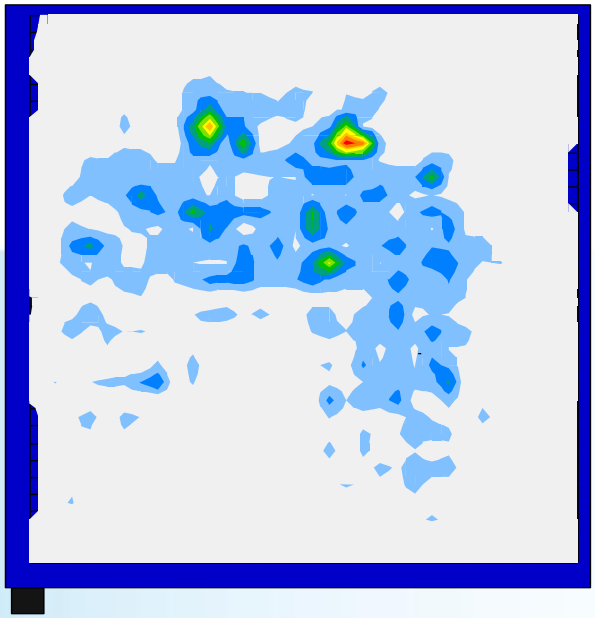


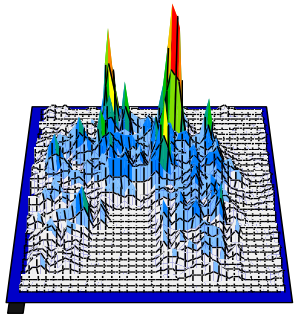


Minimum (mmHg)	0.00
Maximum (mmHg)	196.69
Average (mmHg)	12.68
Variance (mmHg²)	342.17
Standard deviation (mmHg)	18.50
Coefficient of variation (%)	145.93
Horizontal center (in)	7.85
Vertical center (in)	9.60
Sensing area (in²)	286.60
Regional distribution (%)	100.00

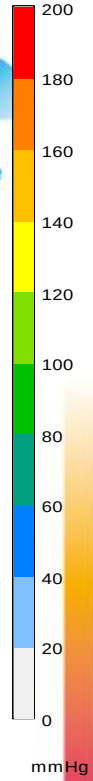


Electrical stimulation: OFF





Minimum (mmHg)	0.00
Maximum (mmHg)	200.00
Average (mmHg)	12.80
Variance (mmHg²)	349.40
Standard deviation (mmHg)	18.69
Coefficient of variation (%)	146.04
Horizontal center (in)	7.85
Vertical center (in)	9.59
Sensing area (in²)	286.60
Regional distribution (%)	100.00



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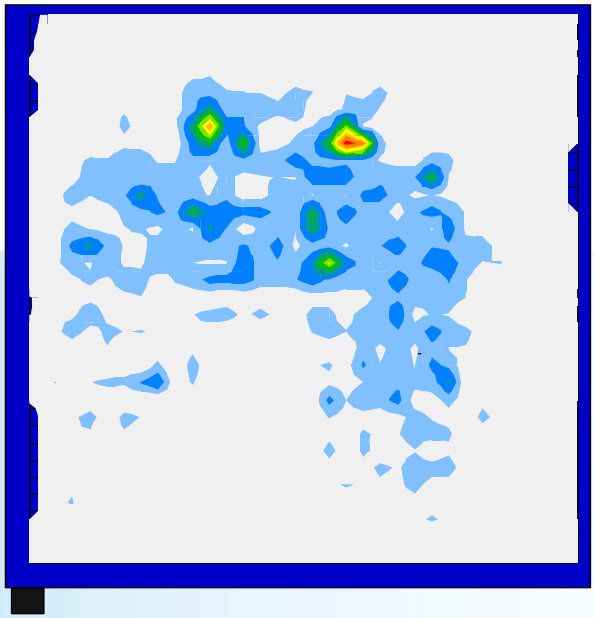

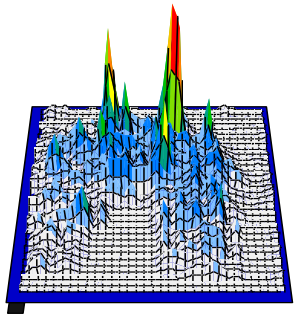

Minimum (mmHg)	0.00
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Standard deviation (mmHg)	18.69
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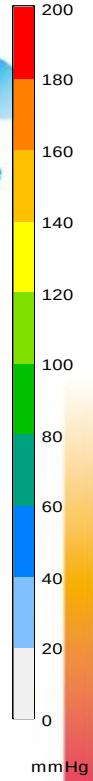

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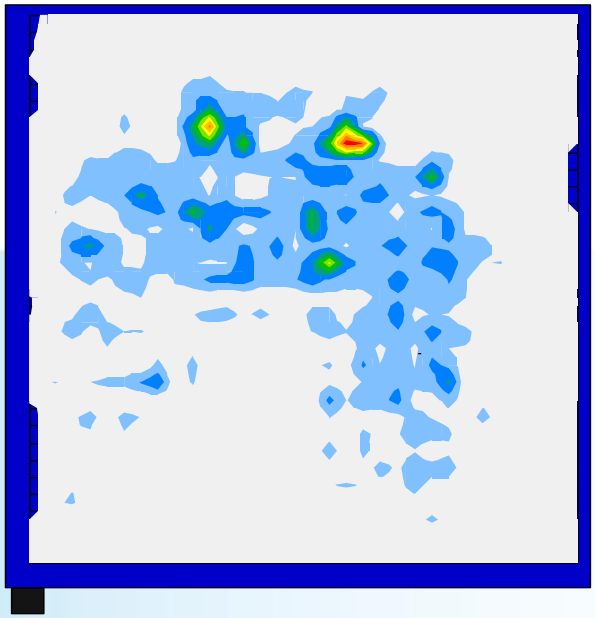
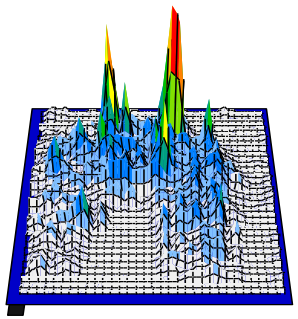
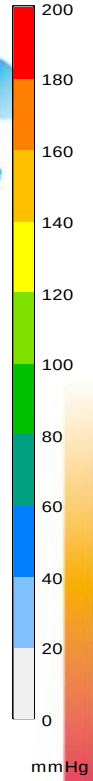




Minimum (mmHg)	0.00
Maximum (mmHg)	200.00
Average (mmHg)	12.95
Variance (mmHg²)	359.38
Standard deviation (mmHg)	18.96
Coefficient of variation (%)	146.41
Horizontal center (in)	7.85
Vertical center (in)	9.58
Sensing area (in²)	286.60
Regional distribution (%)	100.00



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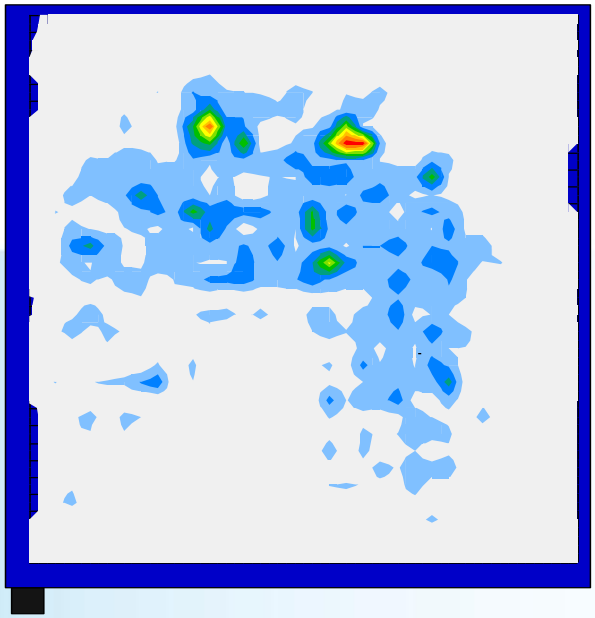
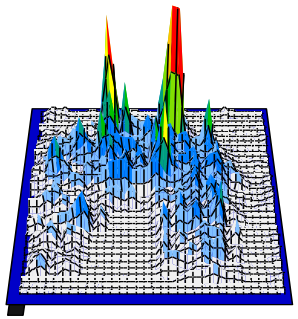
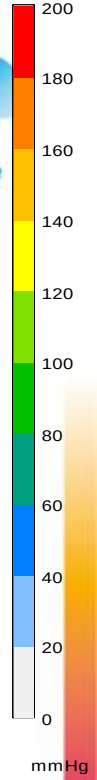




Minimum (mmHg)	0.00
Maximum (mmHg)	200.00
Average (mmHg)	13.01
Variance (mmHg²)	377.13
Standard deviation (mmHg)	19.42
Coefficient of variation (%)	149.21
Horizontal center (in)	7.88
Vertical center (in)	9.59
Sensing area (in²)	286.60
Regional distribution (%)	100.00



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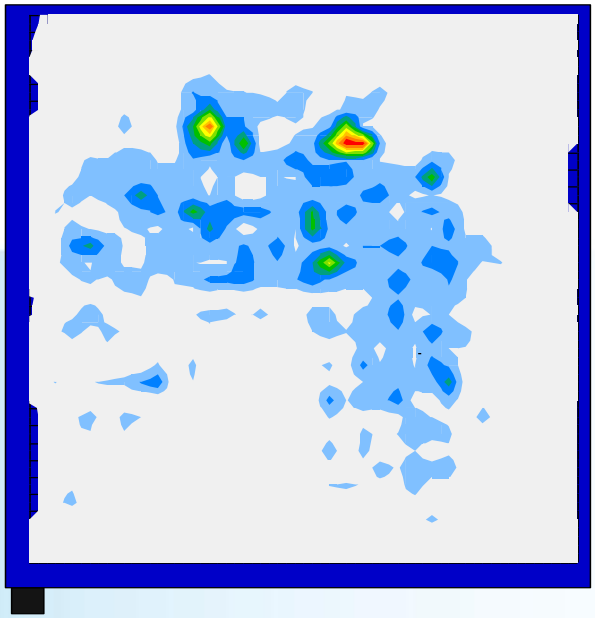
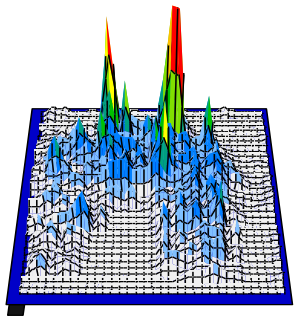
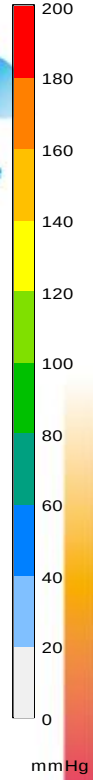




Minimum (mmHg)	0.00
Maximum (mmHg)	200.00
Average (mmHg)	13.06
Variance (mmHg²)	378.85
Standard deviation (mmHg)	19.46
Coefficient of variation (%)	149.07
Horizontal center (in)	7.88
Vertical center (in)	9.60
Sensing area (in²)	286.60
Regional distribution (%)	100.00



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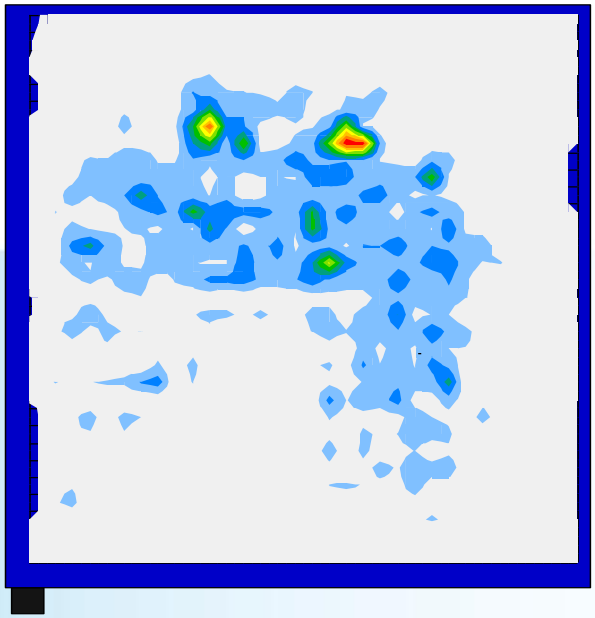
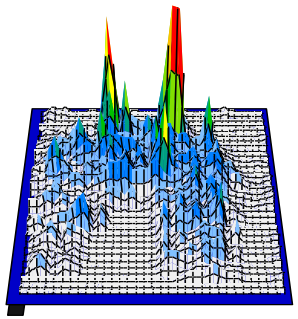
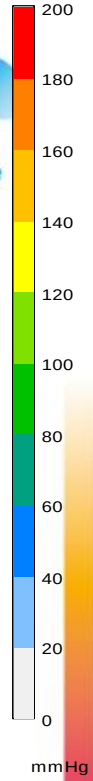




Minimum (mmHg)	0.00
Maximum (mmHg)	200.00
Average (mmHg)	13.11
Variance (mmHg²)	378.43
Standard deviation (mmHg)	19.45
Coefficient of variation (%)	148.37
Horizontal center (in)	7.88
Vertical center (in)	9.59
Sensing area (in²)	286.60
Regional distribution (%)	100.00



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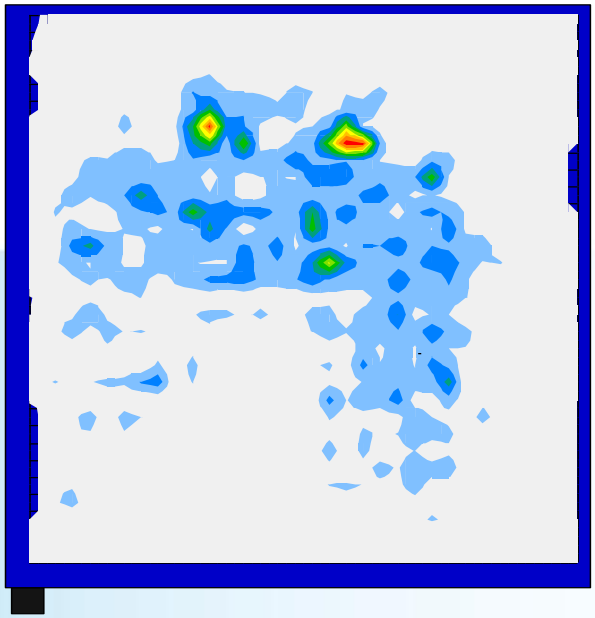
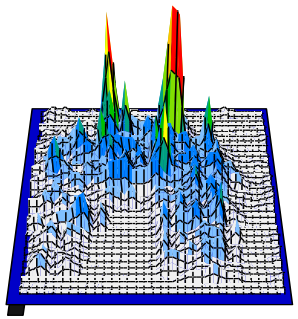
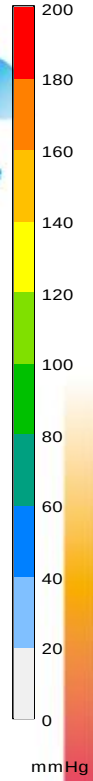




Minimum (mmHg)	0.00
Maximum (mmHg)	200.00
Average (mmHg)	13.25
Variance (mmHg²)	380.81
Standard deviation (mmHg)	19.51
Coefficient of variation (%)	147.23
Horizontal center (in)	7.86
Vertical center (in)	9.58
Sensing area (in²)	286.60
Regional distribution (%)	100.00



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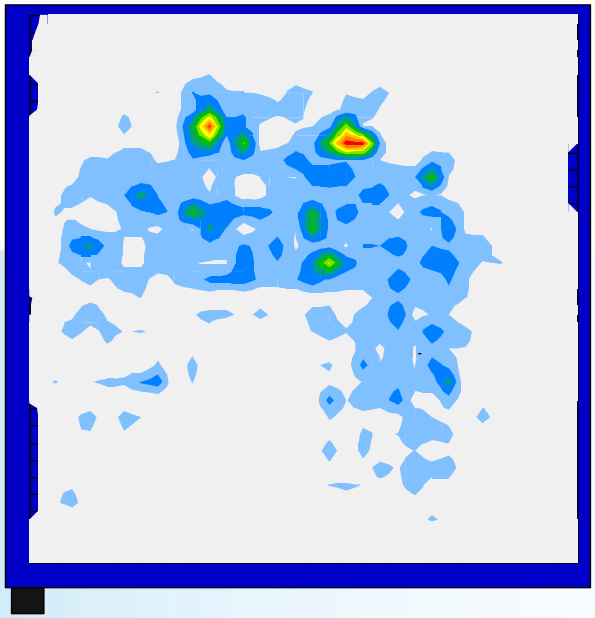
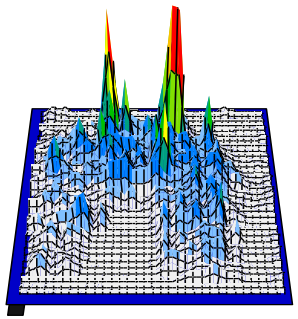
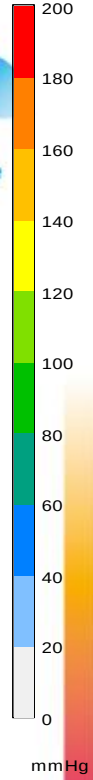




Minimum (mmHg)	0.00
Maximum (mmHg)	200.00
Average (mmHg)	13.30
Variance (mmHg²)	384.60
Standard deviation (mmHg)	19.61
Coefficient of variation (%)	147.44
Horizontal center (in)	7.86
Vertical center (in)	9.59
Sensing area (in²)	286.60
Regional distribution (%)	100.00



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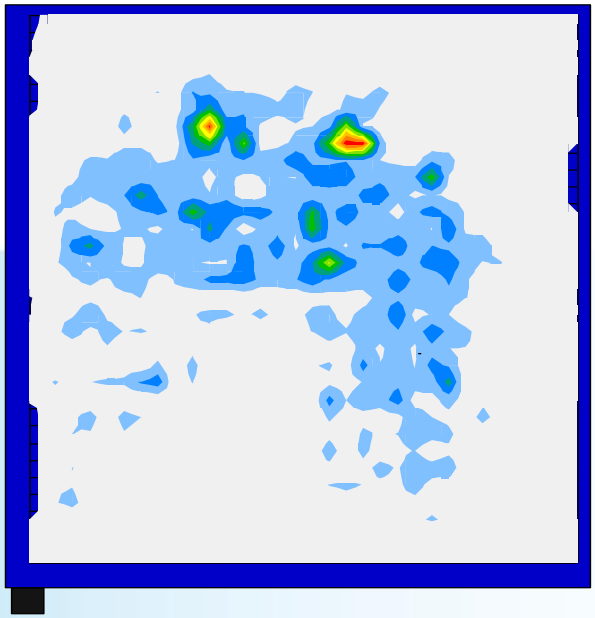
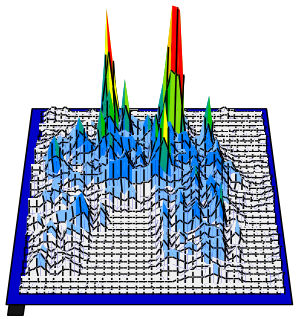
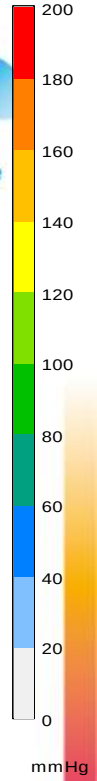




Minimum (mmHg)	0.00
Maximum (mmHg)	200.00
Average (mmHg)	13.35
Variance (mmHg²)	385.46
Standard deviation (mmHg)	19.63
Coefficient of variation (%)	147.10
Horizontal center (in)	7.85
Vertical center (in)	9.58
Sensing area (in²)	286.60
Regional distribution (%)	100.00



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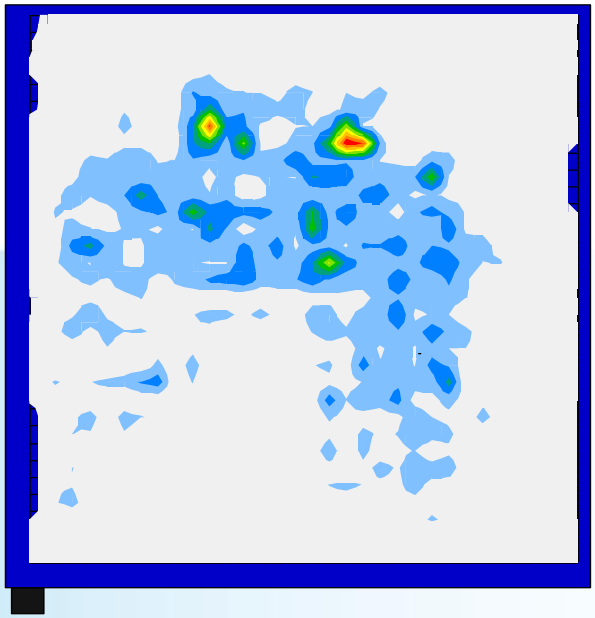
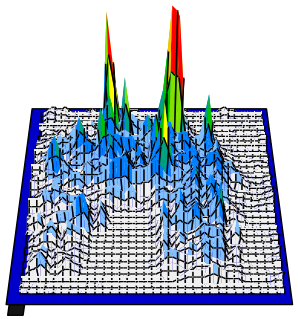
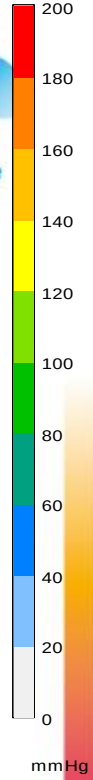




Minimum (mmHg)	0.00
Maximum (mmHg)	200.00
Average (mmHg)	13.40
Variance (mmHg²)	379.24
Standard deviation (mmHg)	19.47
Coefficient of variation (%)	145.36
Horizontal center (in)	7.85
Vertical center (in)	9.55
Sensing area (in²)	286.60
Regional distribution (%)	100.00



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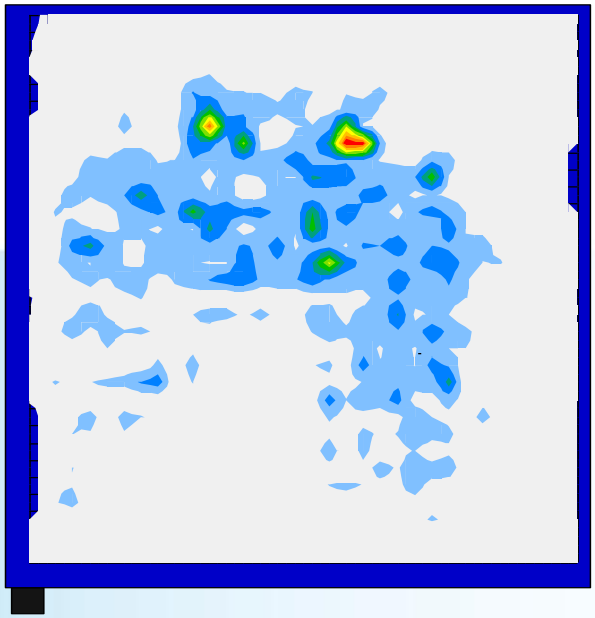
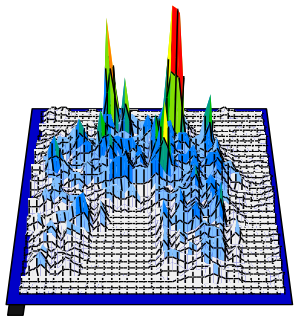
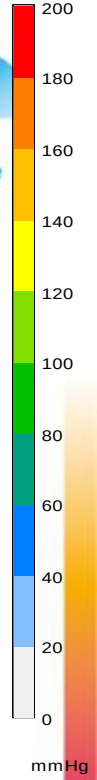
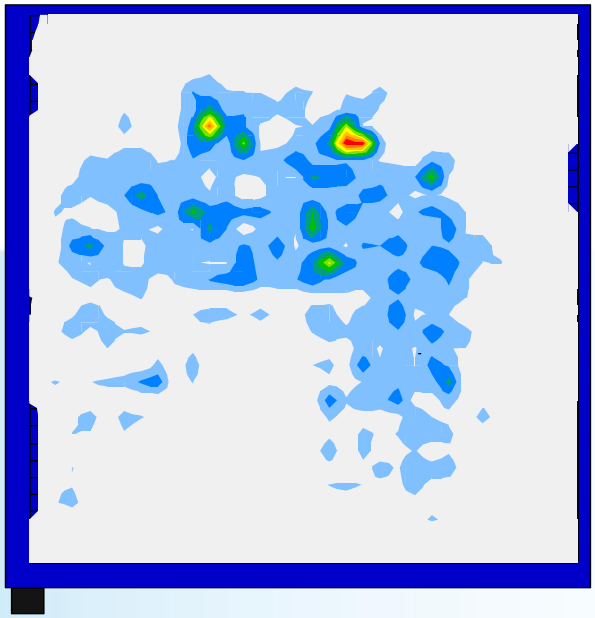


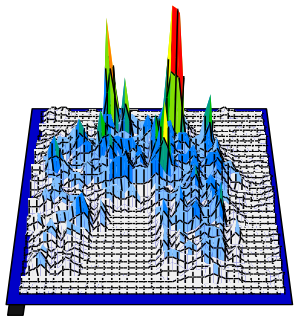


Minimum (mmHg)	0.00
Maximum (mmHg)	200.00
Average (mmHg)	13.35
Variance (mmHg²)	370.74
Standard deviation (mmHg)	19.25
Coefficient of variation (%)	144.25
Horizontal center (in)	7.86
Vertical center (in)	9.53
Sensing area (in²)	286.60
Regional distribution (%)	100.00

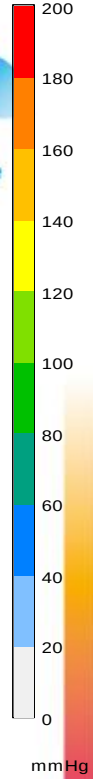


Electrical stimulation: OFF

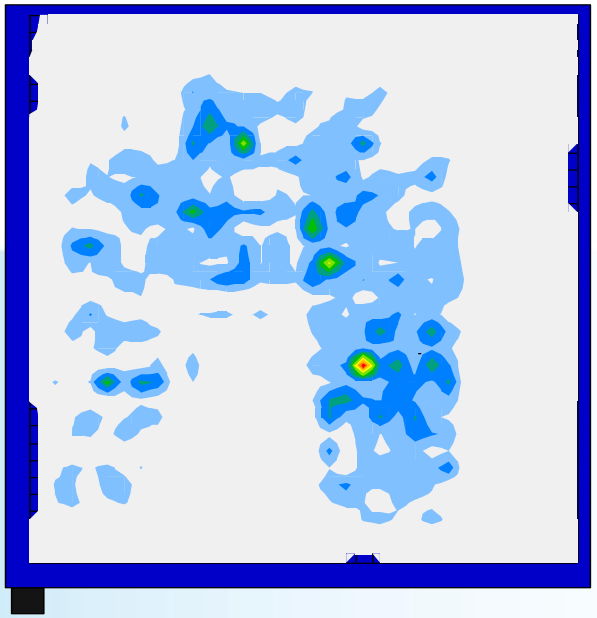


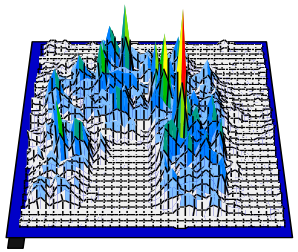


Minimum (mmHg)	0.00
Maximum (mmHg)	200.00
Average (mmHg)	13.39
Variance (mmHg²)	371.91
Standard deviation (mmHg)	19.28
Coefficient of variation (%)	144.05
Horizontal center (in)	7.86
Vertical center (in)	9.51
Sensing area (in²)	286.60
Regional distribution (%)	100.00

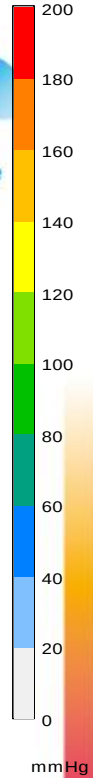


Electrical stimulation: OFF

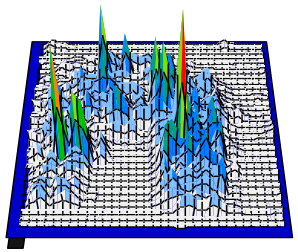




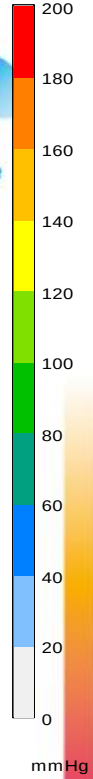
Minimum (mmHg)	0.00
Maximum (mmHg)	200.00
Average (mmHg)	12.98
Variance (mmHg²)	313.37
Standard deviation (mmHg)	17.70
Coefficient of variation (%)	136.35
Horizontal center (in)	7.75
Vertical center (in)	8.68
Sensing area (in²)	286.60
Regional distribution (%)	100.00



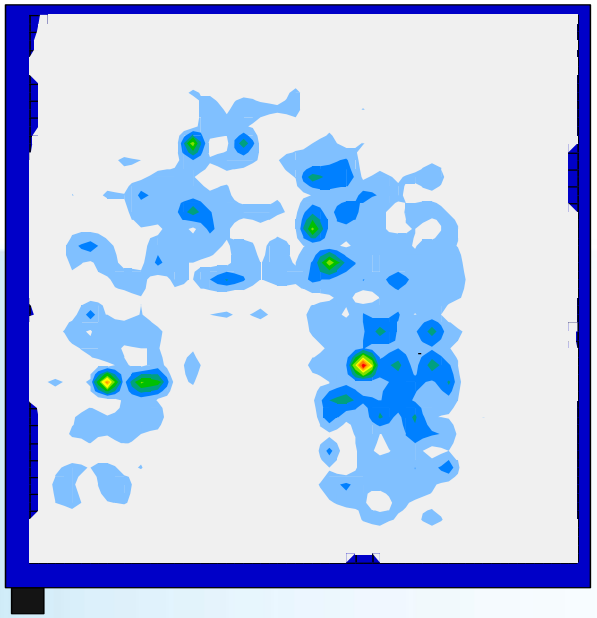
Electrical stimulation: ON

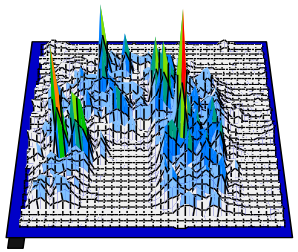


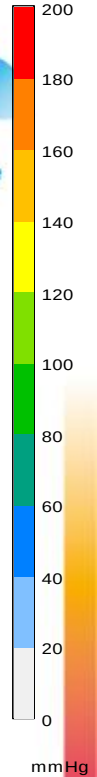
Minimum (mmHg)	0.00
Maximum (mmHg)	200.00
Average (mmHg)	12.11
Variance (mmHg²)	314.79
Standard deviation (mmHg)	17.74
Coefficient of variation (%)	146.45
Horizontal center (in)	7.80
Vertical center (in)	8.22
Sensing area (in²)	286.60
Regional distribution (%)	100.00



Electrical stimulation: ON

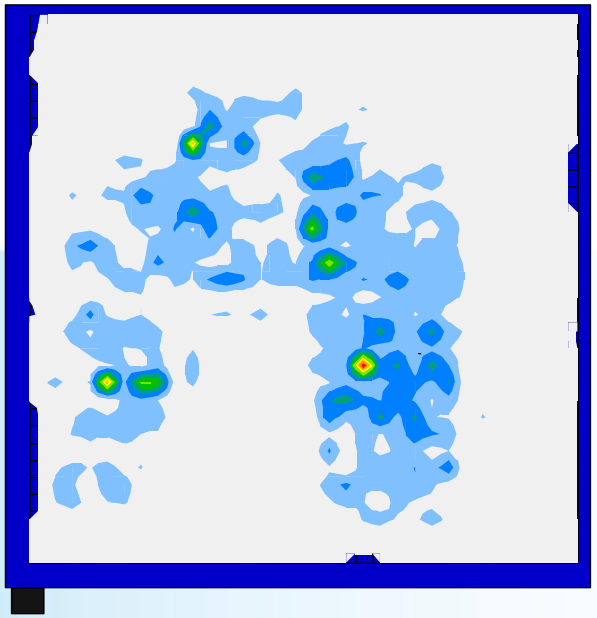


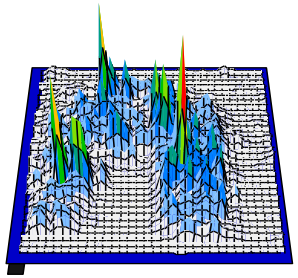


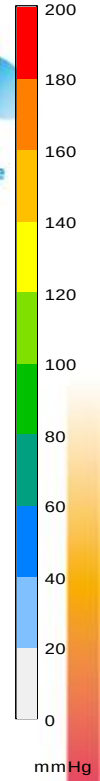


Minimum (mmHg)	0.00
Maximum (mmHg)	200.00
Average (mmHg)	12.21
Variance (mmHg²)	315.99
Standard deviation (mmHg)	17.78
Coefficient of variation (%)	145.57
Horizontal center (in)	7.78
Vertical center (in)	8.18
Sensing area (in²)	286.60
Regional distribution (%)	100.00

Electrical stimulation: ON

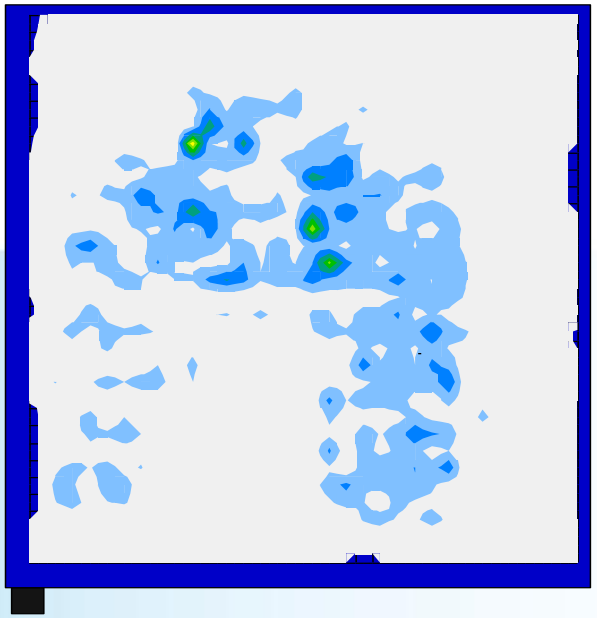


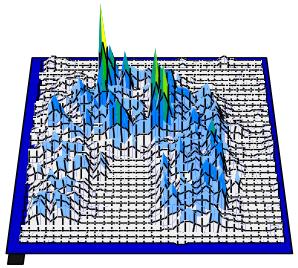




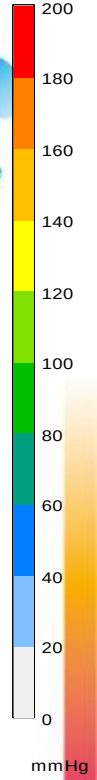
Minimum (mmHg)	0.00
Maximum (mmHg)	200.00
Average (mmHg)	12.52
Variance (mmHg²)	332.91
Standard deviation (mmHg)	18.25
Coefficient of variation (%)	145.75
Horizontal center (in)	7.73
Vertical center (in)	8.29
Sensing area (in²)	286.60
Regional distribution (%)	100.00

Electrical stimulation: ON

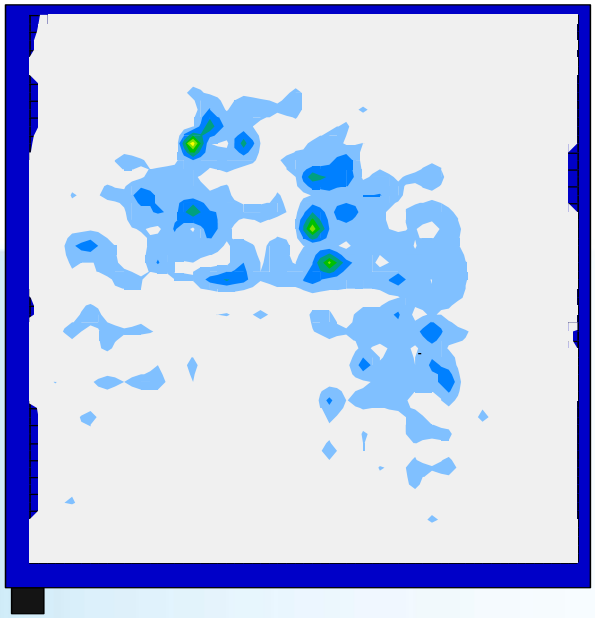


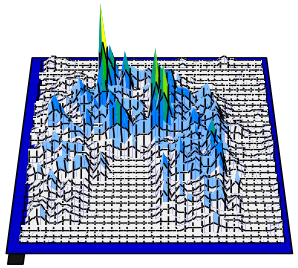


Minimum (mmHg)	0.00
Maximum (mmHg)	136.92
Average (mmHg)	10.91
Variance (mmHg²)	217.93
Standard deviation (mmHg)	14.76
Coefficient of variation (%)	135.32
Horizontal center (in)	7.79
Vertical center (in)	8.67
Sensing area (in²)	286.60
Regional distribution (%)	100.00

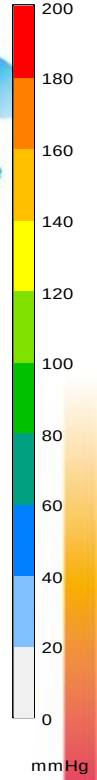


Electrical stimulation: ON

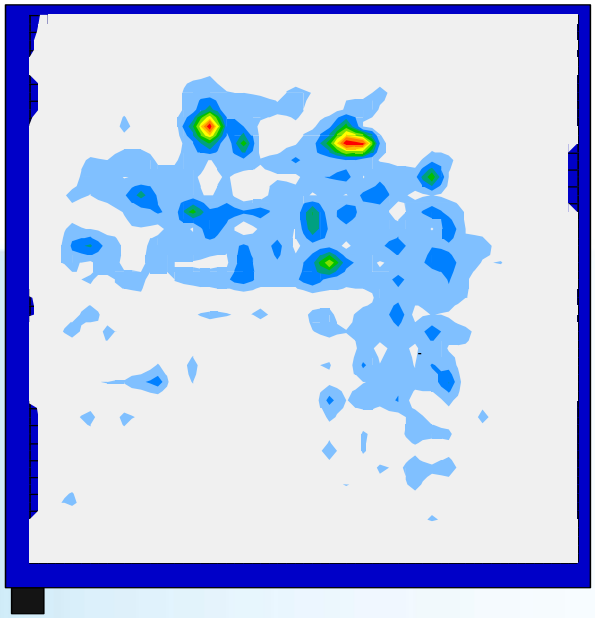


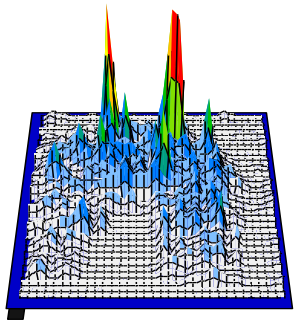


Minimum (mmHg)	0.00
Maximum (mmHg)	136.92
Average (mmHg)	10.08
Variance (mmHg²)	203.48
Standard deviation (mmHg)	14.26
Coefficient of variation (%)	141.45
Horizontal center (in)	7.77
Vertical center (in)	9.15
Sensing area (in²)	286.60
Regional distribution (%)	100.00

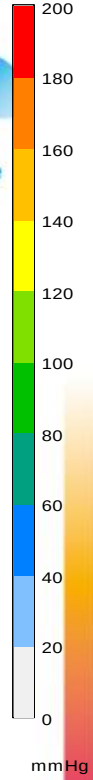


Electrical stimulation: OFF

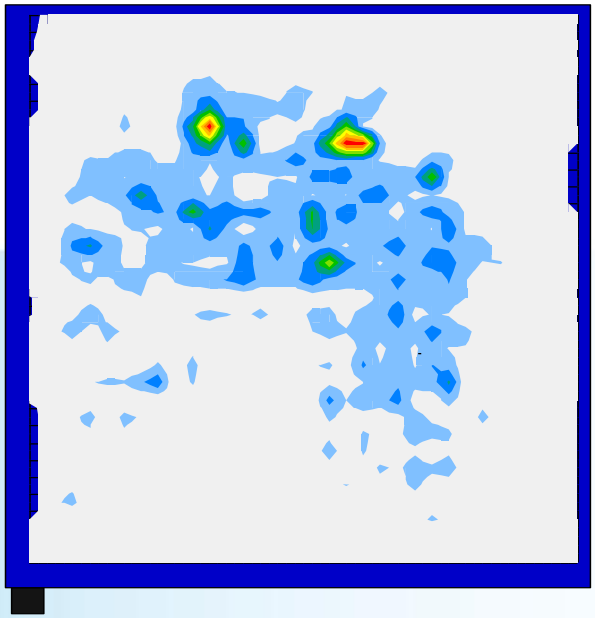


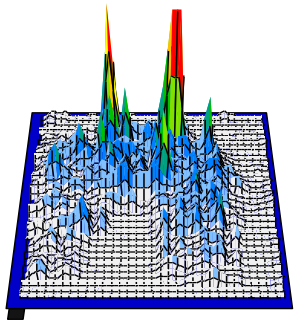


Minimum (mmHg)	0.00
Maximum (mmHg)	200.00
Average (mmHg)	12.18
Variance (mmHg²)	343.31
Standard deviation (mmHg)	18.53
Coefficient of variation (%)	152.16
Horizontal center (in)	7.90
Vertical center (in)	9.62
Sensing area (in²)	286.60
Regional distribution (%)	100.00

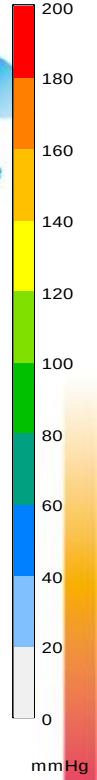


Electrical stimulation: OFF

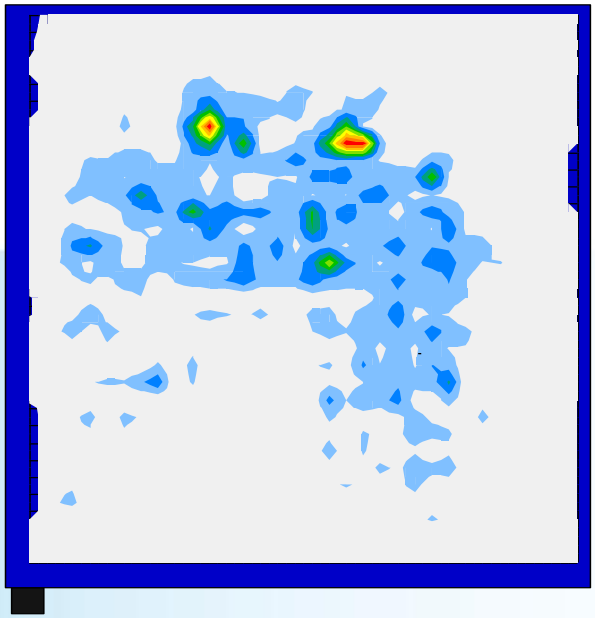


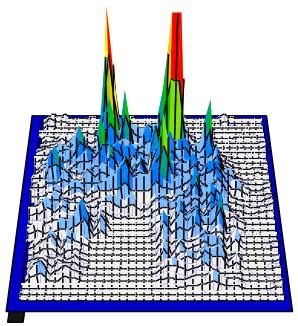


Minimum (mmHg)	0.00
Maximum (mmHg)	200.00
Average (mmHg)	12.63
Variance (mmHg²)	367.64
Standard deviation (mmHg)	19.17
Coefficient of variation (%)	151.80
Horizontal center (in)	7.88
Vertical center (in)	9.64
Sensing area (in²)	286.60
Regional distribution (%)	100.00

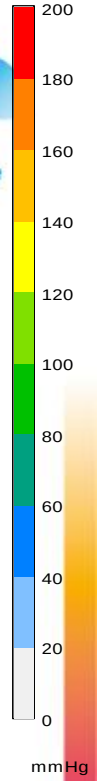


Electrical stimulation: OFF

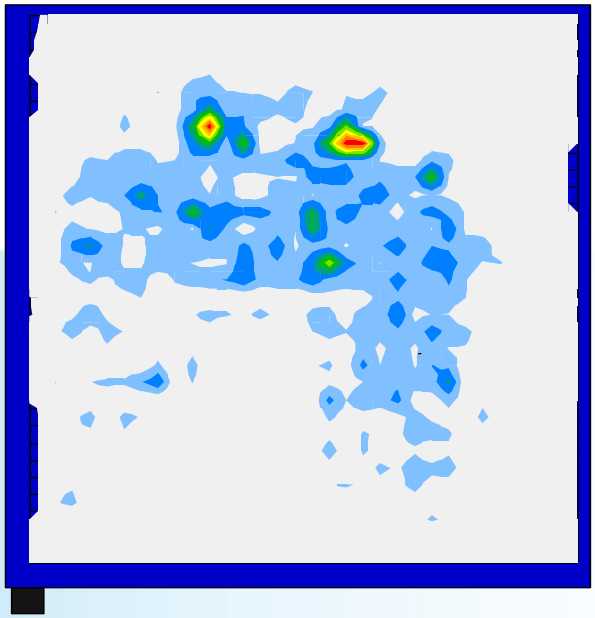


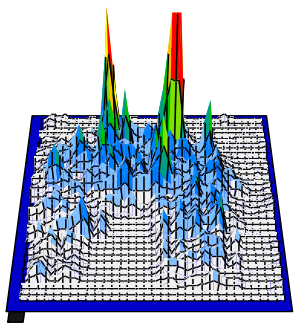


Minimum (mmHg)	0.00
Maximum (mmHg)	200.00
Average (mmHg)	12.66
Variance (mmHg²)	367.76
Standard deviation (mmHg)	19.18
Coefficient of variation (%)	151.47
Horizontal center (in)	7.88
Vertical center (in)	9.63
Sensing area (in²)	286.60
Regional distribution (%)	100.00

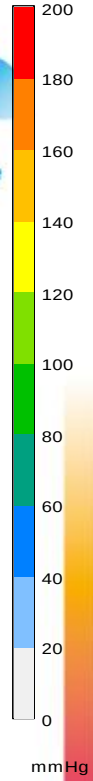


Electrical stimulation: OFF

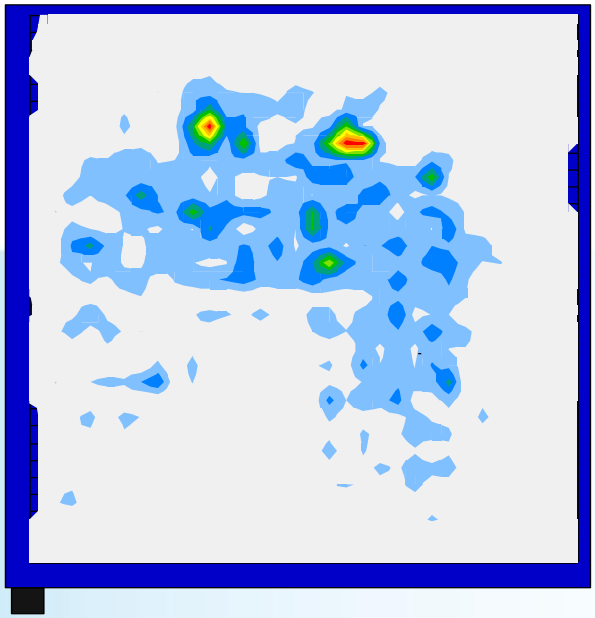


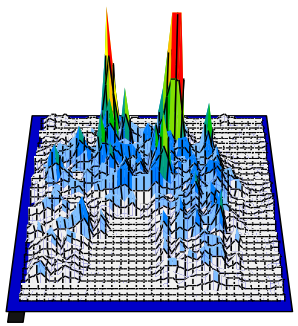


Minimum (mmHg)	0.00
Maximum (mmHg)	200.00
Average (mmHg)	12.85
Variance (mmHg²)	374.26
Standard deviation (mmHg)	19.35
Coefficient of variation (%)	150.55
Horizontal center (in)	7.87
Vertical center (in)	9.62
Sensing area (in²)	286.60
Regional distribution (%)	100.00

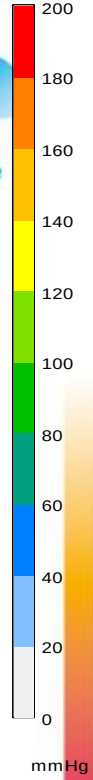


Electrical stimulation: OFF

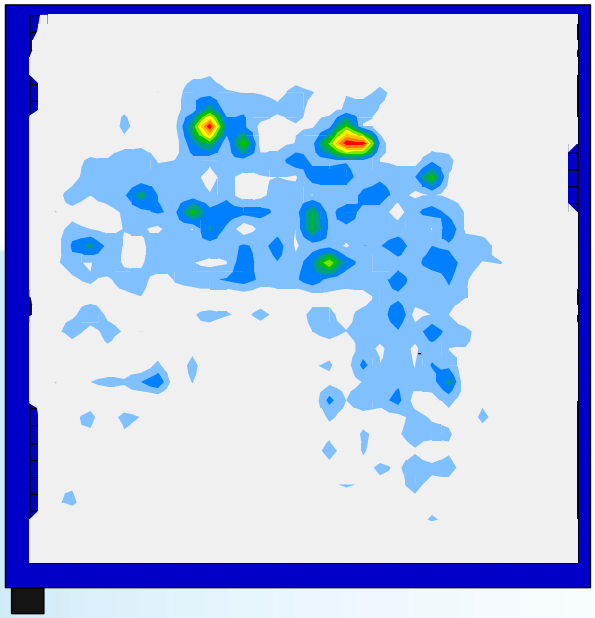


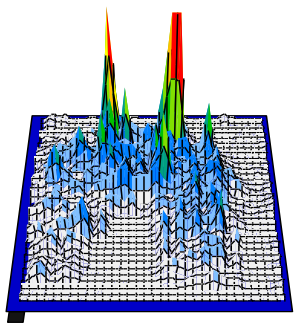


Minimum (mmHg)	0.00
Maximum (mmHg)	200.00
Average (mmHg)	12.96
Variance (mmHg²)	377.73
Standard deviation (mmHg)	19.44
Coefficient of variation (%)	150.00
Horizontal center (in)	7.86
Vertical center (in)	9.62
Sensing area (in²)	286.60
Regional distribution (%)	100.00

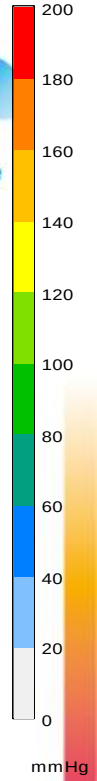


Electrical stimulation: OFF

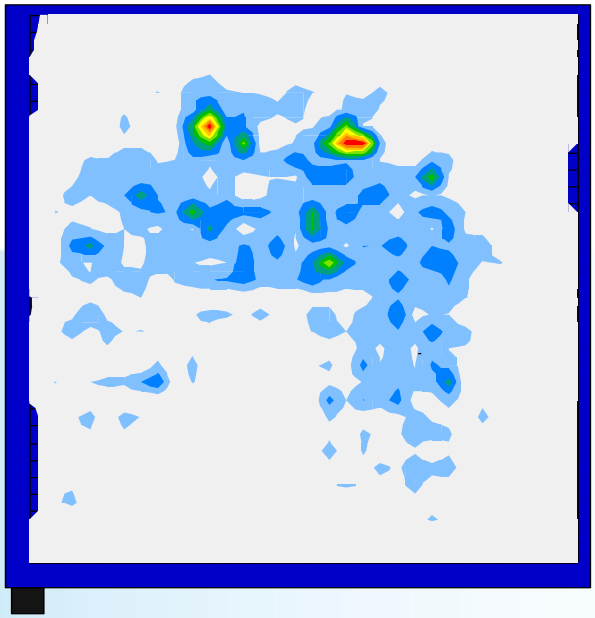


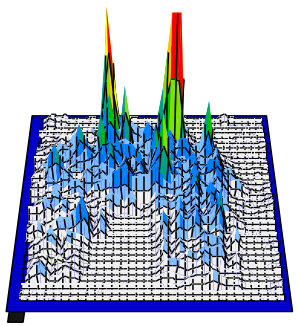


Minimum (mmHg)	0.00
Maximum (mmHg)	200.00
Average (mmHg)	12.96
Variance (mmHg²)	377.72
Standard deviation (mmHg)	19.44
Coefficient of variation (%)	149.97
Horizontal center (in)	7.86
Vertical center (in)	9.61
Sensing area (in²)	286.60
Regional distribution (%)	100.00

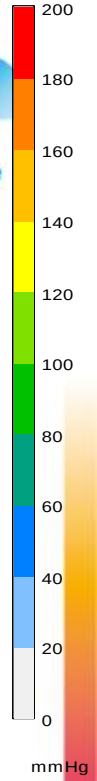


Electrical stimulation: OFF

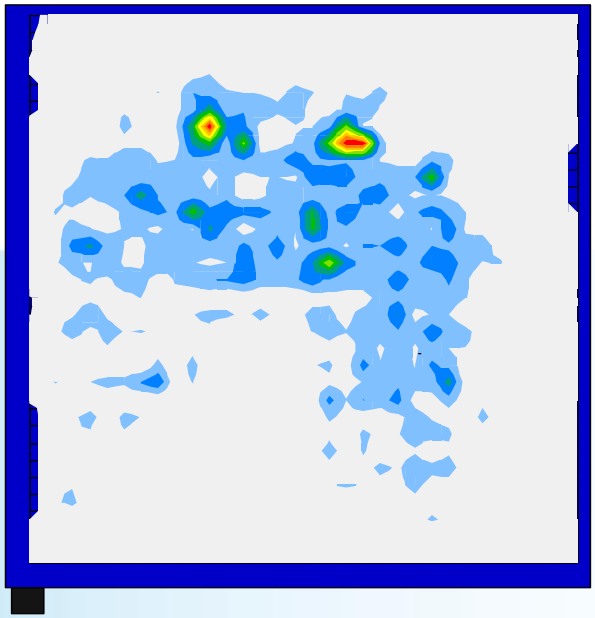


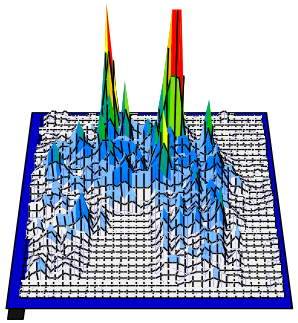


Minimum (mmHg)	0.00
Maximum (mmHg)	200.00
Average (mmHg)	13.06
Variance (mmHg²)	382.62
Standard deviation (mmHg)	19.56
Coefficient of variation (%)	149.75
Horizontal center (in)	7.85
Vertical center (in)	9.61
Sensing area (in²)	286.60
Regional distribution (%)	100.00

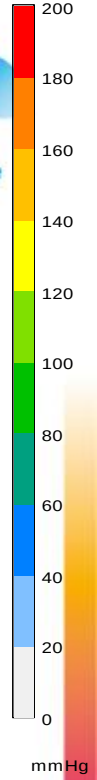


Electrical stimulation: OFF

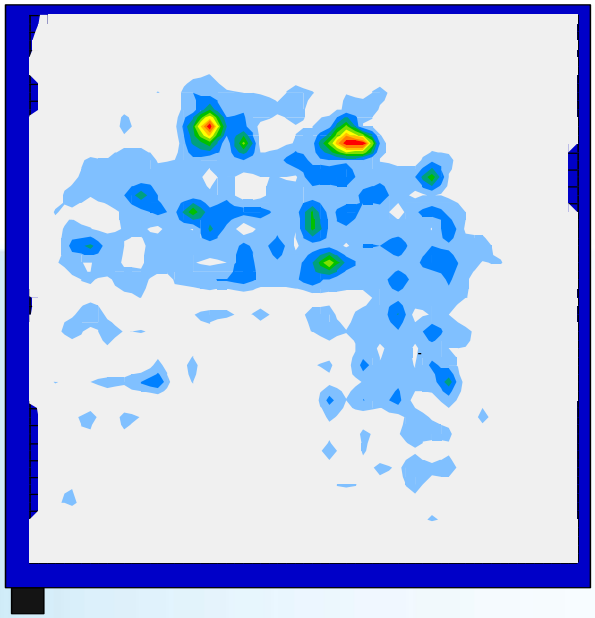


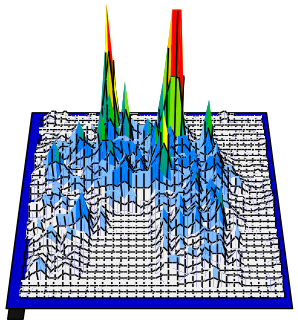


Minimum (mmHg)	0.00
Maximum (mmHg)	200.00
Average (mmHg)	13.16
Variance (mmHg²)	385.03
Standard deviation (mmHg)	19.62
Coefficient of variation (%)	149.07
Horizontal center (in)	7.85
Vertical center (in)	9.61
Sensing area (in²)	286.60
Regional distribution (%)	100.00

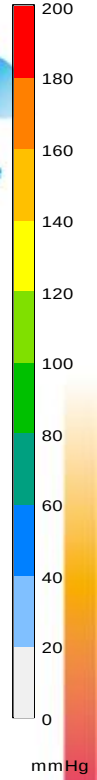


Electrical stimulation: OFF

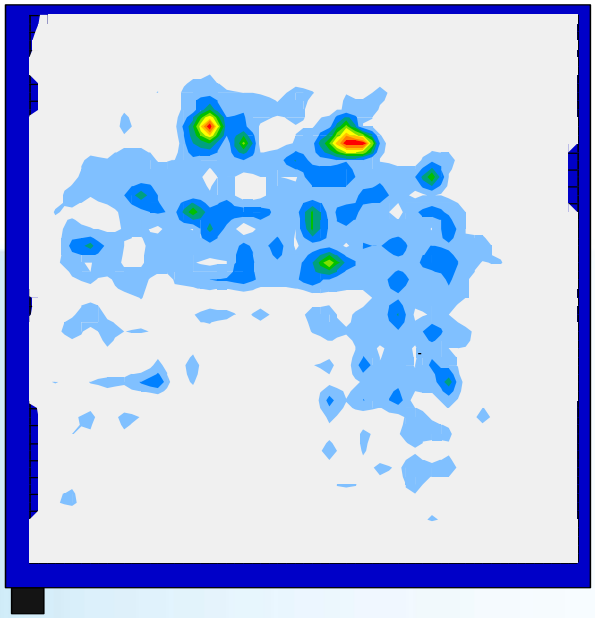


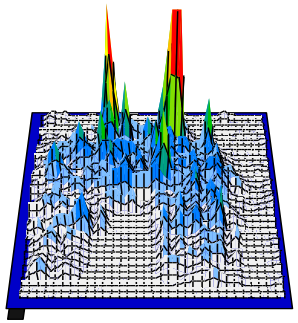


Minimum (mmHg)	0.00
Maximum (mmHg)	200.00
Average (mmHg)	13.16
Variance (mmHg²)	385.03
Standard deviation (mmHg)	19.62
Coefficient of variation (%)	149.07
Horizontal center (in)	7.85
Vertical center (in)	9.61
Sensing area (in²)	286.60
Regional distribution (%)	100.00

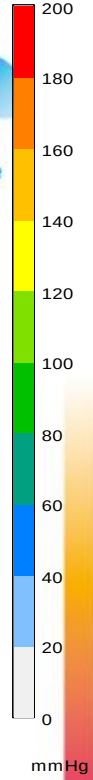


Electrical stimulation: OFF

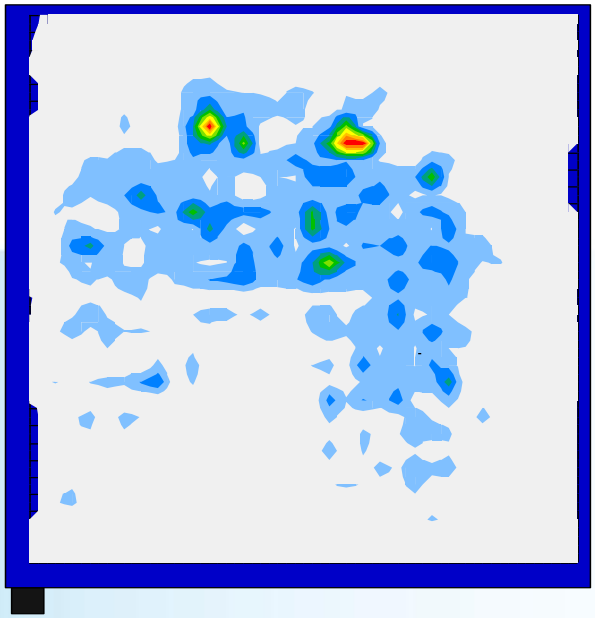


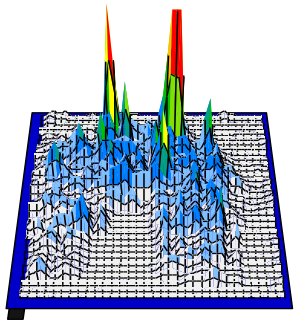


Minimum (mmHg)	0.00
Maximum (mmHg)	200.00
Average (mmHg)	13.24
Variance (mmHg²)	384.99
Standard deviation (mmHg)	19.62
Coefficient of variation (%)	148.24
Horizontal center (in)	7.85
Vertical center (in)	9.59
Sensing area (in²)	286.60
Regional distribution (%)	100.00

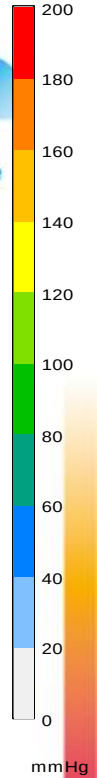


Electrical stimulation: OFF

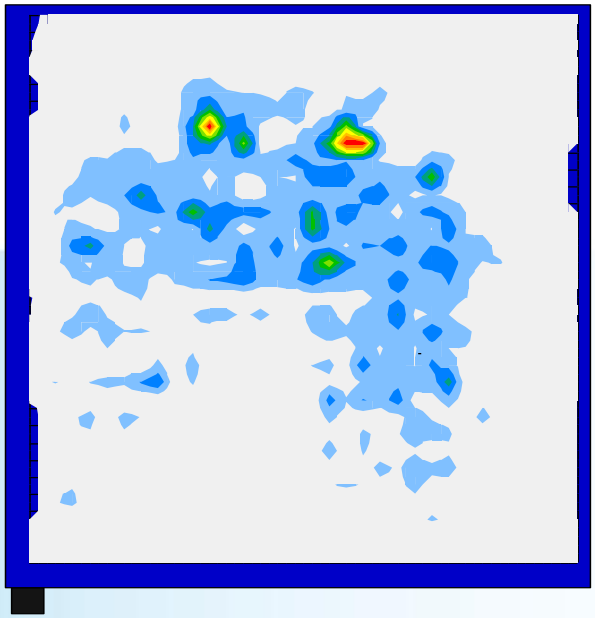


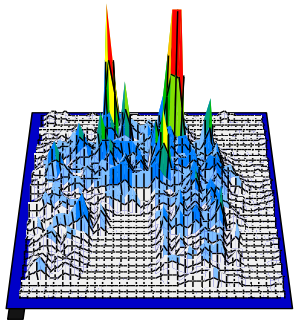


Minimum (mmHg)	0.00
Maximum (mmHg)	200.00
Average (mmHg)	13.24
Variance (mmHg²)	379.77
Standard deviation (mmHg)	19.49
Coefficient of variation (%)	147.24
Horizontal center (in)	7.86
Vertical center (in)	9.56
Sensing area (in²)	286.60
Regional distribution (%)	100.00

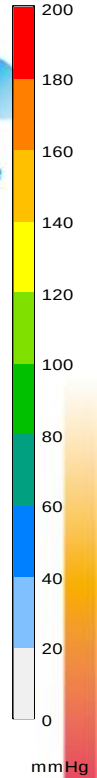


Electrical stimulation: OFF

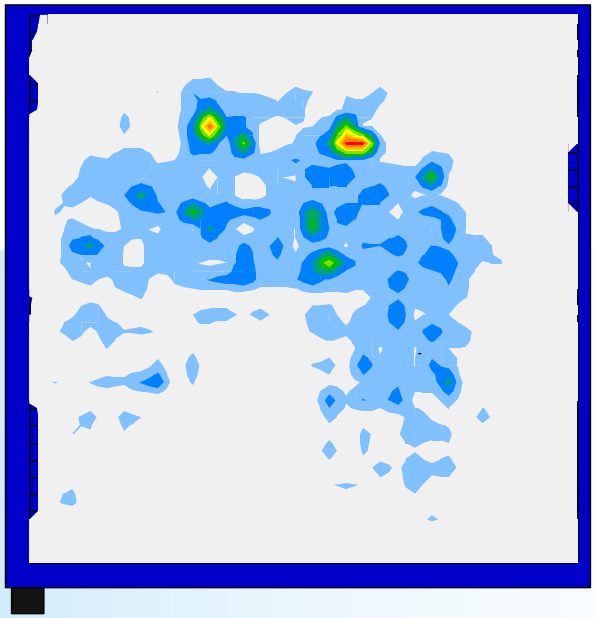


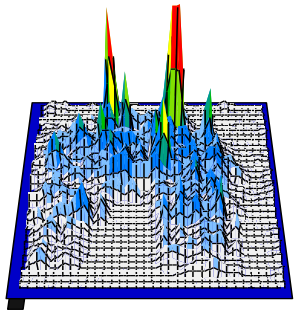


Minimum (mmHg)	0.00
Maximum (mmHg)	200.00
Average (mmHg)	13.24
Variance (mmHg²)	379.77
Standard deviation (mmHg)	19.49
Coefficient of variation (%)	147.24
Horizontal center (in)	7.86
Vertical center (in)	9.56
Sensing area (in²)	286.60
Regional distribution (%)	100.00

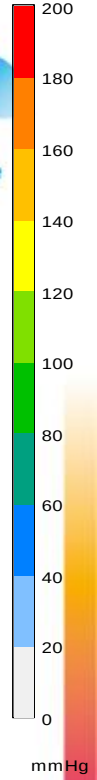


Electrical stimulation: OFF

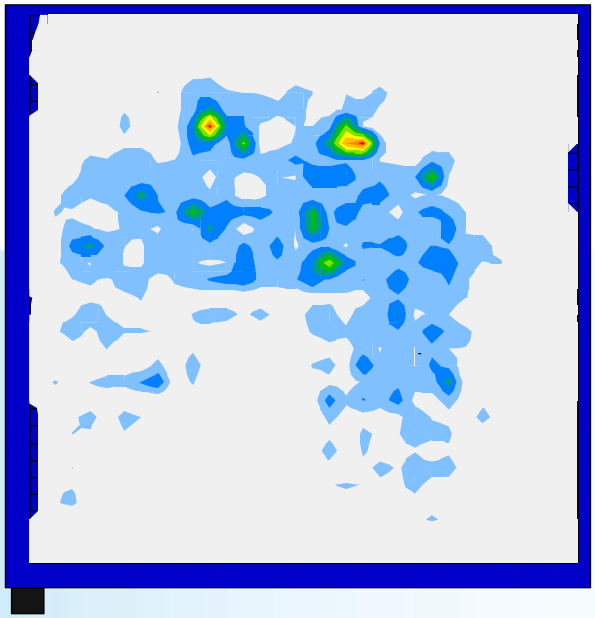


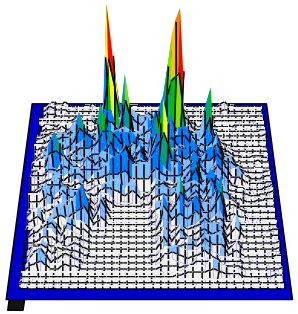


Minimum (mmHg)	0.00
Maximum (mmHg)	193.77
Average (mmHg)	13.23
Variance (mmHg²)	367.33
Standard deviation (mmHg)	19.17
Coefficient of variation (%)	144.86
Horizontal center (in)	7.86
Vertical center (in)	9.53
Sensing area (in²)	286.60
Regional distribution (%)	100.00

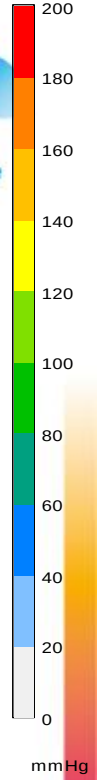


Electrical stimulation: OFF

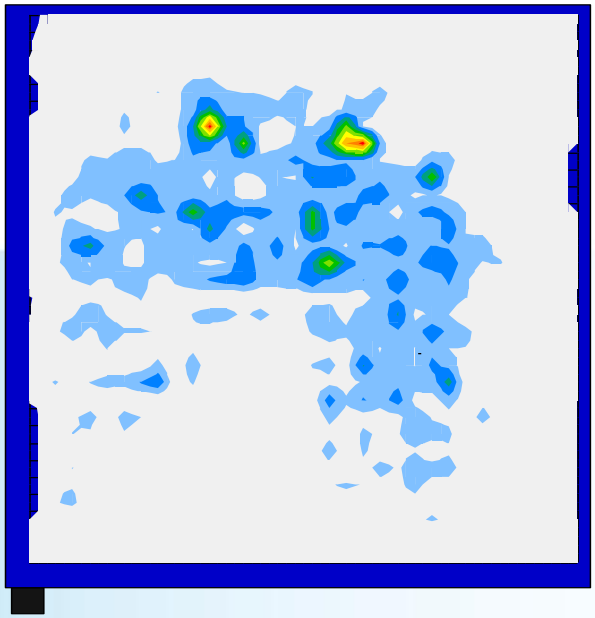


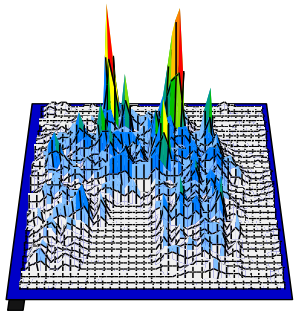


Minimum (mmHg)	0.00
Maximum (mmHg)	190.14
Average (mmHg)	13.29
Variance (mmHg²)	360.01
Standard deviation (mmHg)	18.97
Coefficient of variation (%)	142.82
Horizontal center (in)	7.85
Vertical center (in)	9.51
Sensing area (in²)	286.60
Regional distribution (%)	100.00

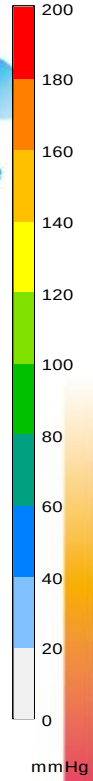


Electrical stimulation: OFF

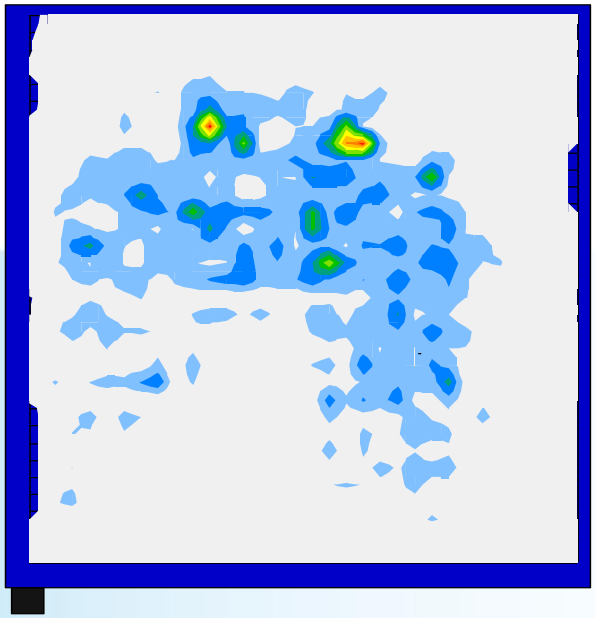


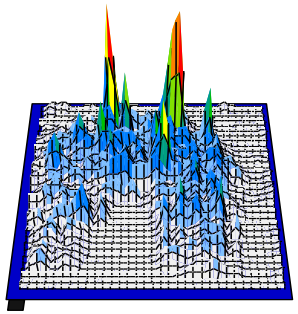


Minimum (mmHg)	0.00
Maximum (mmHg)	190.14
Average (mmHg)	13.29
Variance (mmHg²)	359.99
Standard deviation (mmHg)	18.97
Coefficient of variation (%)	142.81
Horizontal center (in)	7.85
Vertical center (in)	9.51
Sensing area (in²)	286.60
Regional distribution (%)	100.00

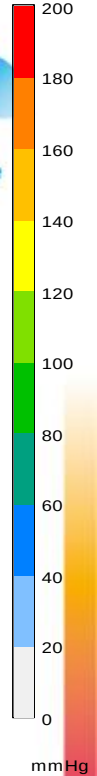


Electrical stimulation: OFF

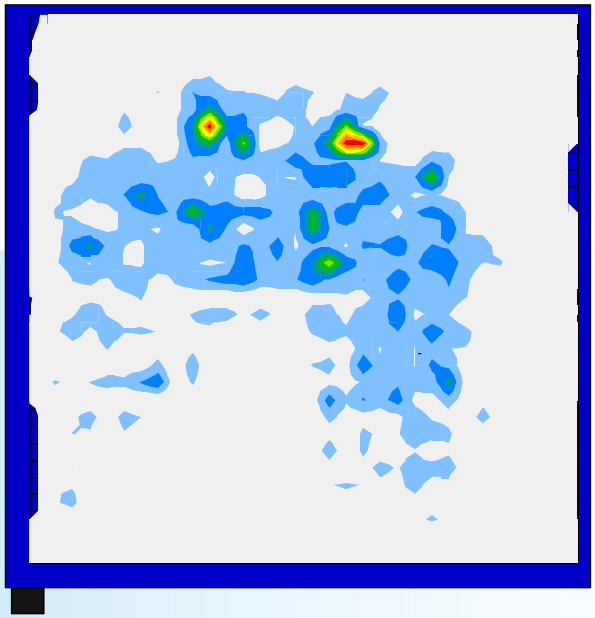


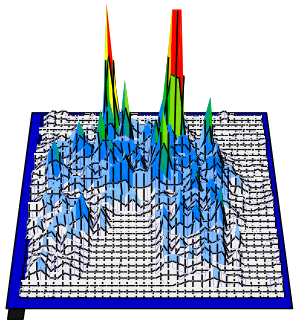


Minimum (mmHg)	0.00
Maximum (mmHg)	189.47
Average (mmHg)	13.38
Variance (mmHg²)	363.46
Standard deviation (mmHg)	19.06
Coefficient of variation (%)	142.52
Horizontal center (in)	7.84
Vertical center (in)	9.52
Sensing area (in²)	286.60
Regional distribution (%)	100.00

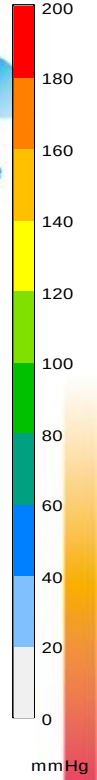


Electrical stimulation: OFF

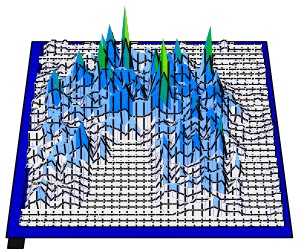




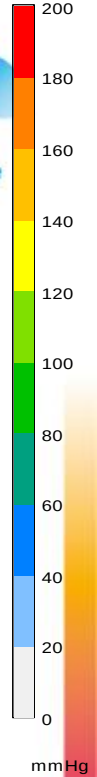
Minimum (mmHg)	0.00
Maximum (mmHg)	200.00
Average (mmHg)	13.53
Variance (mmHg²)	389.26
Standard deviation (mmHg)	19.73
Coefficient of variation (%)	145.79
Horizontal center (in)	7.84
Vertical center (in)	9.56
Sensing area (in²)	286.60
Regional distribution (%)	100.00



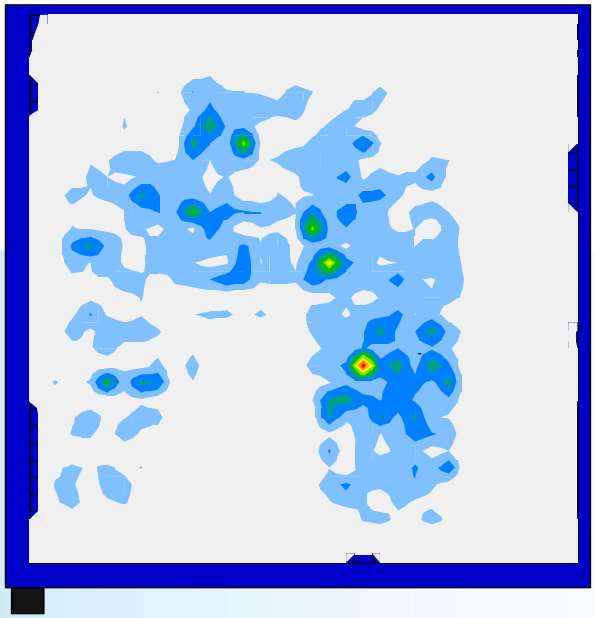
Electrical stimulation: OFF

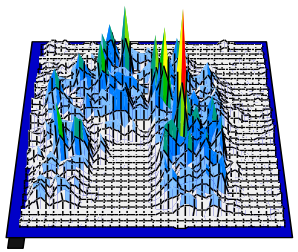


Minimum (mmHg)	0.00
Maximum (mmHg)	118.99
Average (mmHg)	12.51
Variance (mmHg²)	267.56
Standard deviation (mmHg)	16.36
Coefficient of variation (%)	130.74
Horizontal center (in)	7.83
Vertical center (in)	9.27
Sensing area (in²)	286.60
Regional distribution (%)	100.00

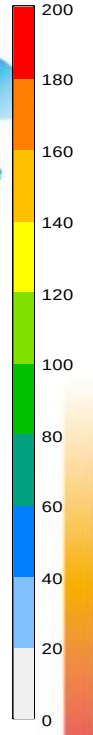


Electrical stimulation: ON

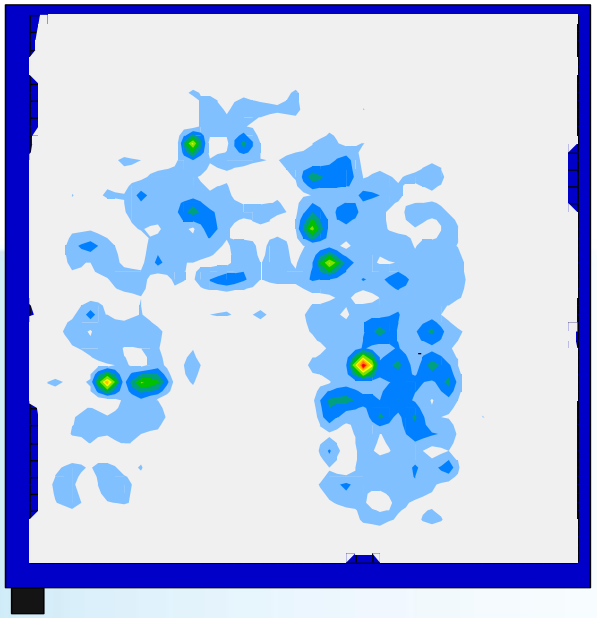


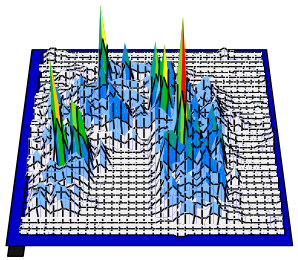


Minimum (mmHg)	0.00
Maximum (mmHg)	200.00
Average (mmHg)	12.88
Variance (mmHg²)	313.12
Standard deviation (mmHg)	17.70
Coefficient of variation (%)	137.43
Horizontal center (in)	7.75
Vertical center (in)	8.63
Sensing area (in²)	286.60
Regional distribution (%)	100.00

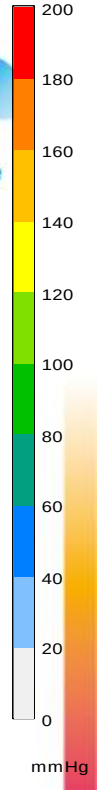


Electrical stimulation: ON

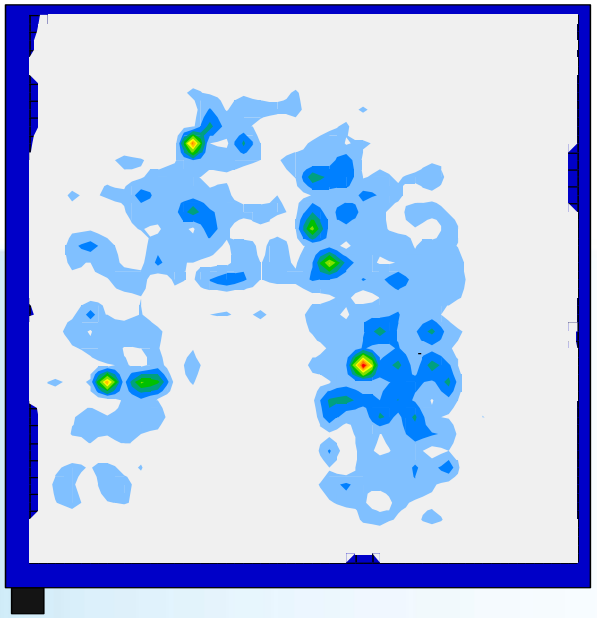


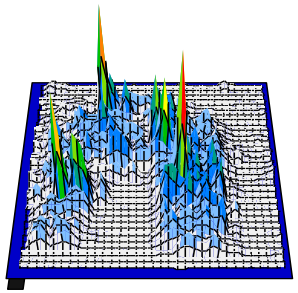


Minimum (mmHg)	0.00
Maximum (mmHg)	200.00
Average (mmHg)	12.25
Variance (mmHg²)	318.96
Standard deviation (mmHg)	17.86
Coefficient of variation (%)	145.84
Horizontal center (in)	7.77
Vertical center (in)	8.18
Sensing area (in²)	286.60
Regional distribution (%)	100.00

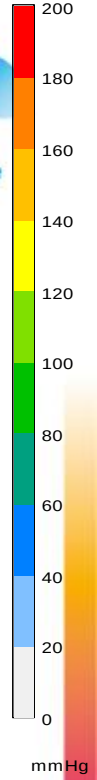


Electrical stimulation: ON

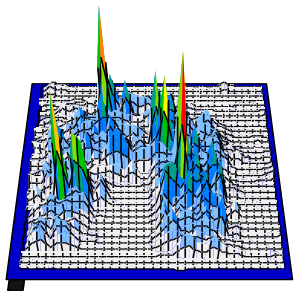




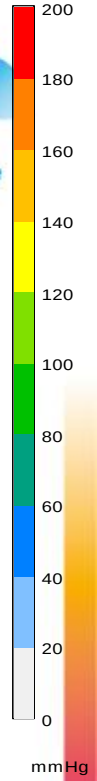
Minimum (mmHg)	0.00
Maximum (mmHg)	200.00
Average (mmHg)	12.51
Variance (mmHg²)	334.69
Standard deviation (mmHg)	18.29
Coefficient of variation (%)	146.29
Horizontal center (in)	7.73
Vertical center (in)	8.29
Sensing area (in²)	286.60
Regional distribution (%)	100.00



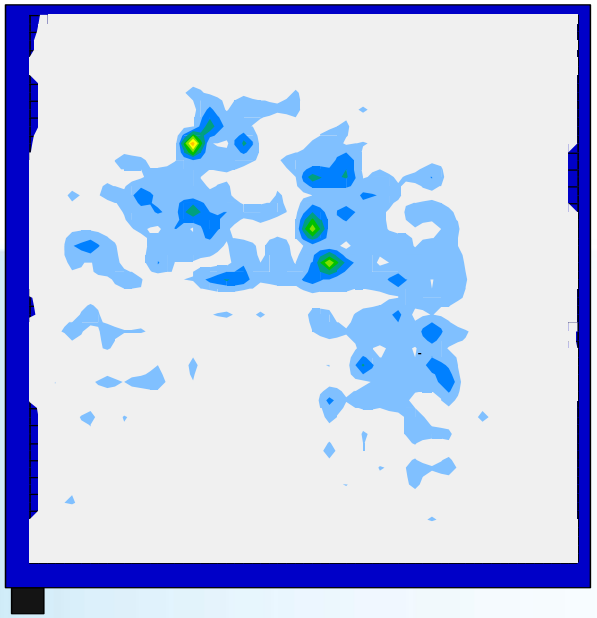
Electrical stimulation: ON

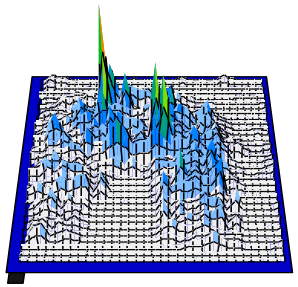


Minimum (mmHg)	0.00
Maximum (mmHg)	200.00
Average (mmHg)	12.62
Variance (mmHg²)	341.45
Standard deviation (mmHg)	18.48
Coefficient of variation (%)	146.44
Horizontal center (in)	7.71
Vertical center (in)	8.28
Sensing area (in²)	286.60
Regional distribution (%)	100.00

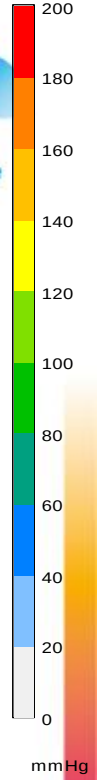


Electrical stimulation: ON

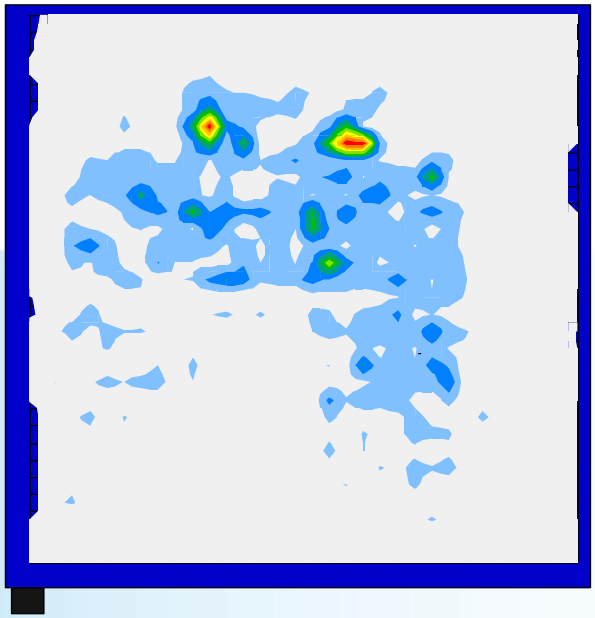


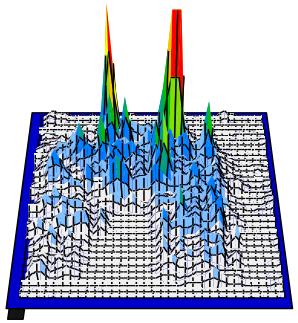


Minimum (mmHg)	0.00
Maximum (mmHg)	160.58
Average (mmHg)	10.16
Variance (mmHg²)	216.29
Standard deviation (mmHg)	14.71
Coefficient of variation (%)	144.71
Horizontal center (in)	7.77
Vertical center (in)	9.15
Sensing area (in²)	286.60
Regional distribution (%)	100.00

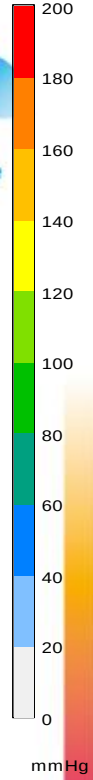


Electrical stimulation: OFF

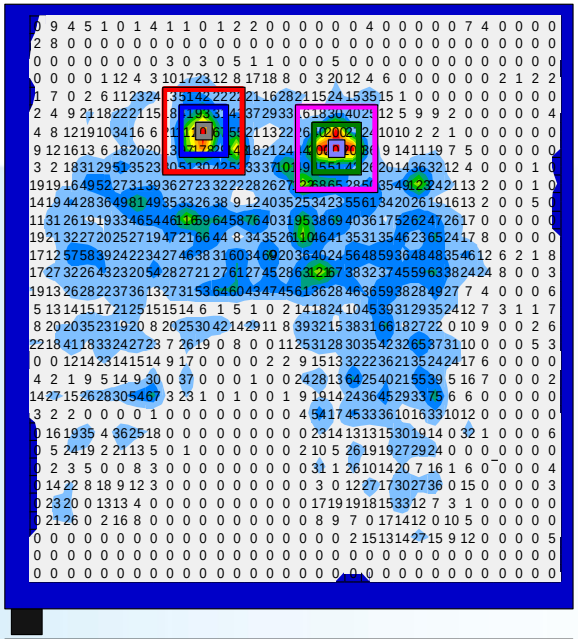


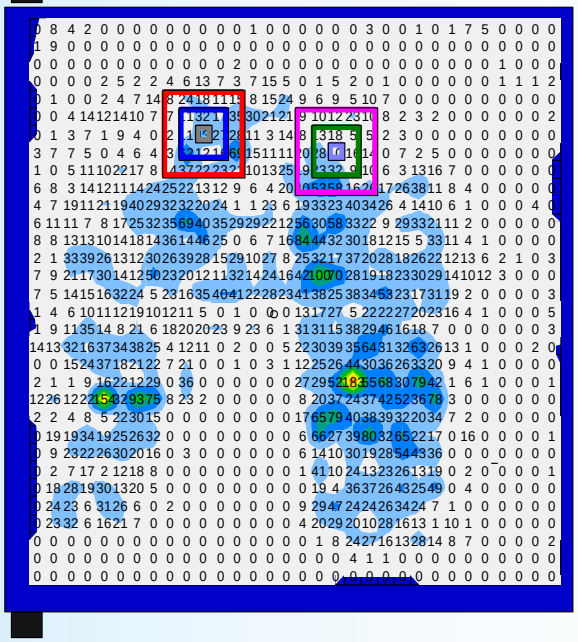


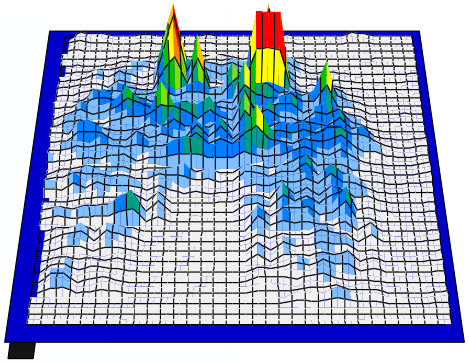
Minimum (mmHg)	0.00
Maximum (mmHg)	200.00
Average (mmHg)	11.80
Variance (mmHg²)	341.63
Standard deviation (mmHg)	18.48
Coefficient of variation (%)	156.70
Horizontal center (in)	7.81
Vertical center (in)	9.66
Sensing area (in²)	286.60
Regional distribution (%)	100.00



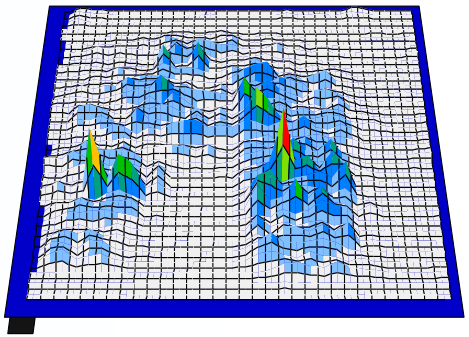
Electrical stimulation: OFF



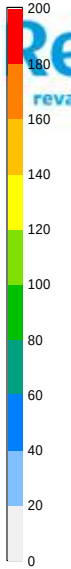


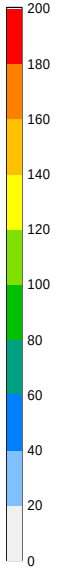


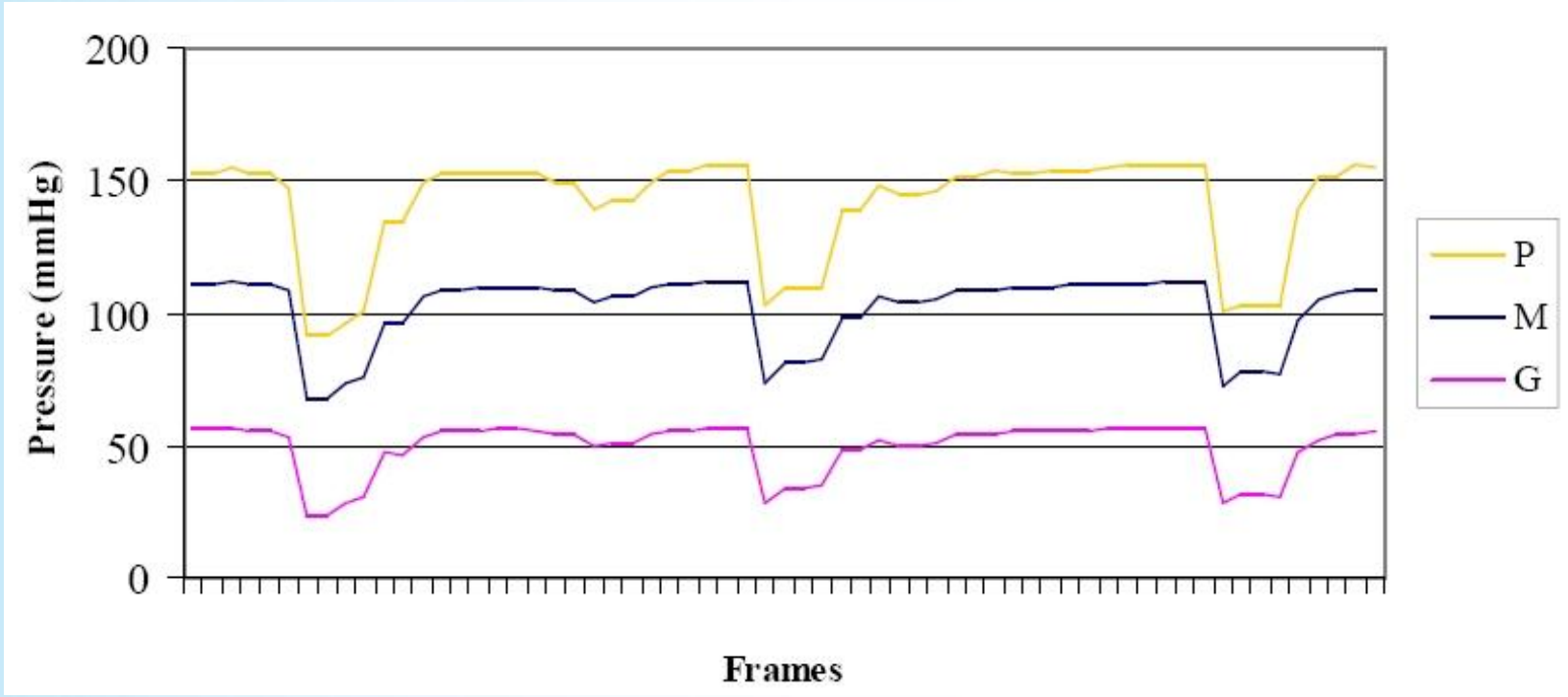
NO STIM



STIM


200
180
160
140
120
100
80
60
40
20
0
mmHg

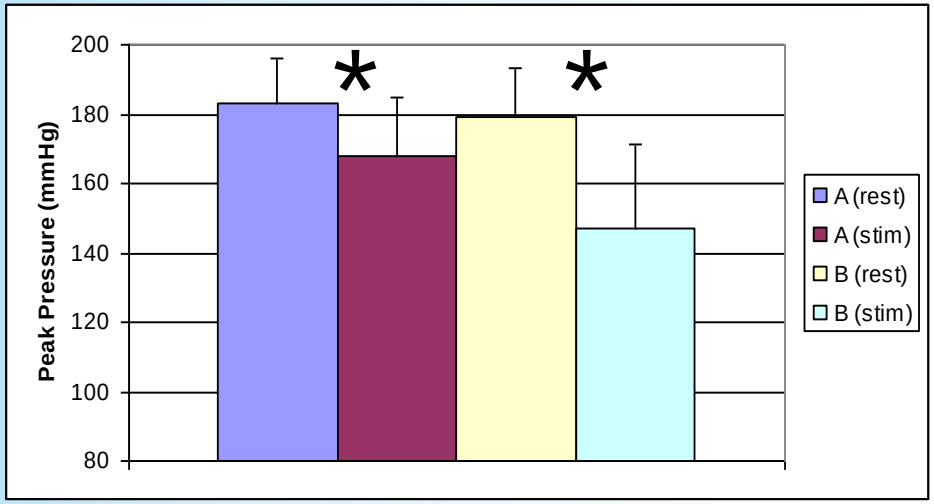

200
180
160
140
120
100
80
60
40
20
0
mmHg


200
150
100
50
0
Pressure (mmHg)
Frames
P
M
G

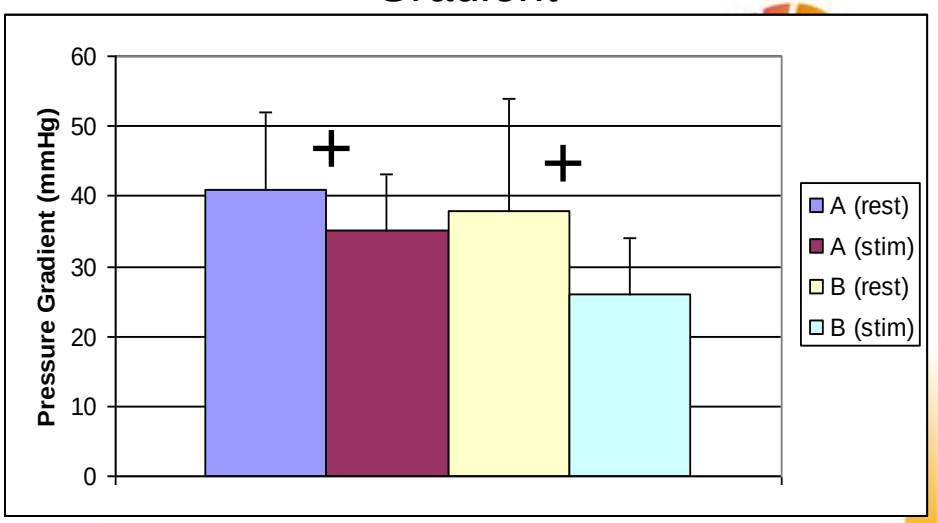
Results (2)
Group Effects

* p<0.05
+ p<0.05

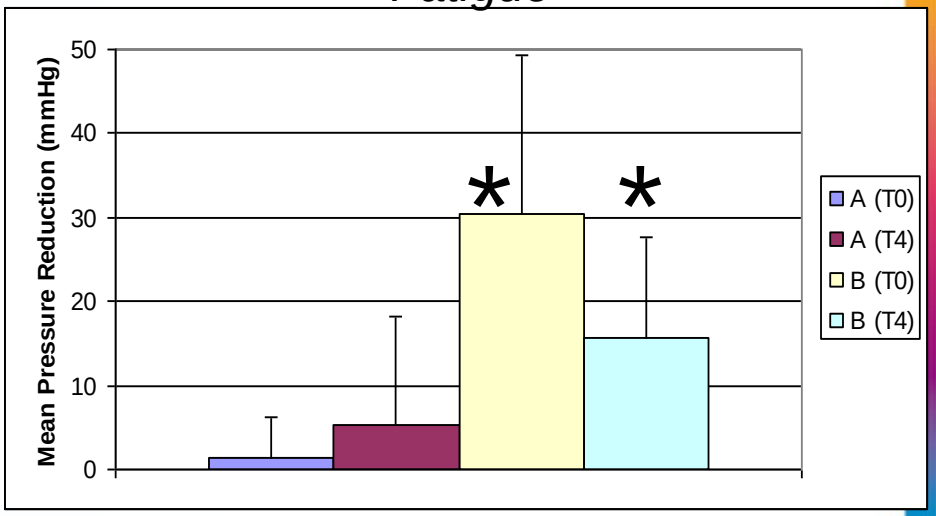
Peak Pressure



Gradient



Fatigue



Results (3)
Gluteal vs. gluteal and hamstring activation

- Mean reduction in pressure

	GluteusHamstring (mmHg)	Gluteus (mmHg)	Difference (mmHg)
G mean	-14.7 17.1 (-49.3%)	-5.3 9.2 (-18.5%)	9.45 9.69
M mean	-37.8 23.2 (-34.6%)	-11.8 11.7 (-10.2%)	25.5 18.5
P mean	-41.3 44.9 (-27.6%)	-13.0 16.1 (-8.6%)	28.28 34.97

Results (4)

- Usability of the BioShorts (N=19)

  - 6 participants were not able to put on the BioShorts my themselves

  - None remarked wearing the shorts painful

  - Nobody experienced the stimulation as painfull

  - If the BioShorts is found helpful in the prevention of decubitus, all participants will use the shorts more often

  - Use of Gel (pads) not handy

Conclusions

- 1. Both protocols A and B: decrease peak pressure and gradient
- 2. Prot B (1:4): larger effects

  Prot B: less fatigue
- 3. Gluteal and Hamstring activation more effect than gluteal activation exclusively.
- 4. This method appears practical in daily life and well tolerated

Discussion

- Pressure reduction sufficient?
- Additional effects of ES
  - Improved circulation
  - Improved oxygenation
  - Reduction of muscle atrophy

Further research (1)

- Oxygenation
  - Oxygen saturation
  - Blood flow
- Usability !

Further research (2)

- Prospective study (RCT):

  'Gluteal and hamstring muscle activation decreases the incidence of pressure ulcers in sitting individuals with a spinal cord injury'……;-).

- 3 groups recurrend PU's - → at least 2 times in 3 year?
- N= 30 → power?
  - ES (n=10)
  - No ES (n=10)
  - ES at night (n=10)
- Follow up? → 1 year?

Reade
revalidatie | reumatologie

Thank You!