GERMAN
CANCER RESEARCH CENTER

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# Electrode mesh refinement in EIDORS

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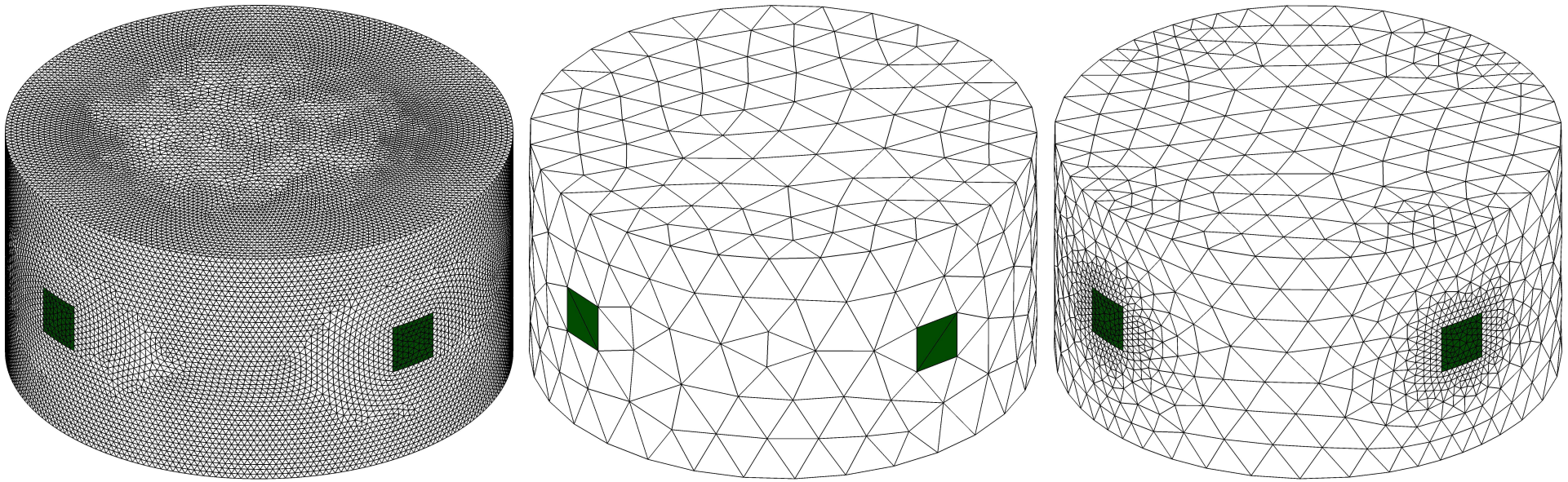
# Outline

# Effects of electrode refinement in EIT



(a) C0 (b) C7 (c) R7

Figure: Examples of (a) fine, (b) coarse and (c) refined meshes.

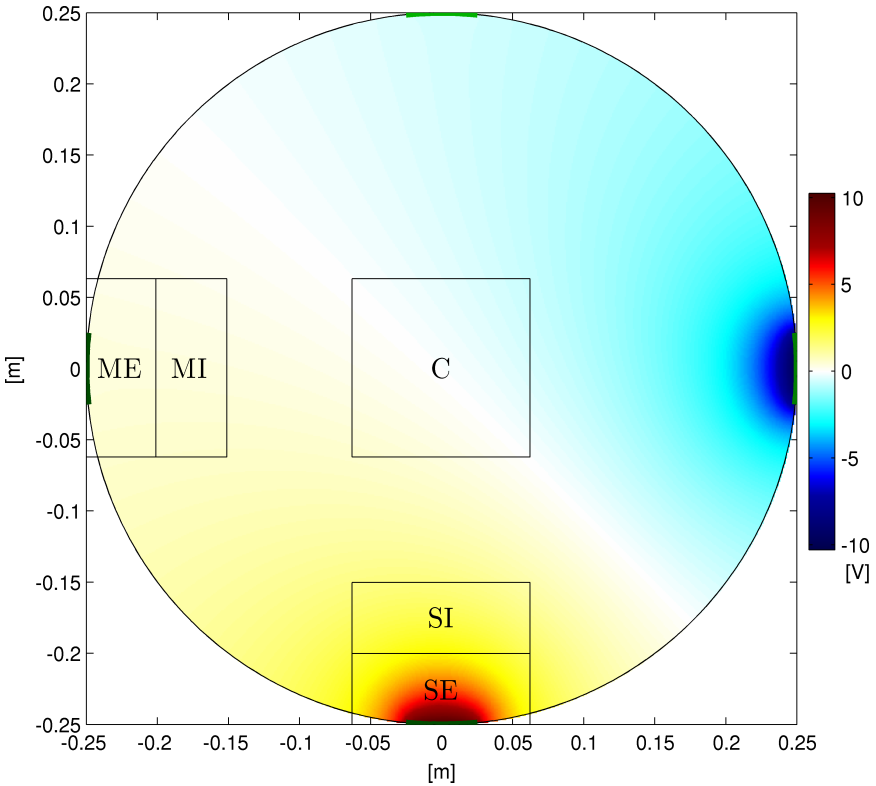
# Models overview

Table: Mesh characteristics

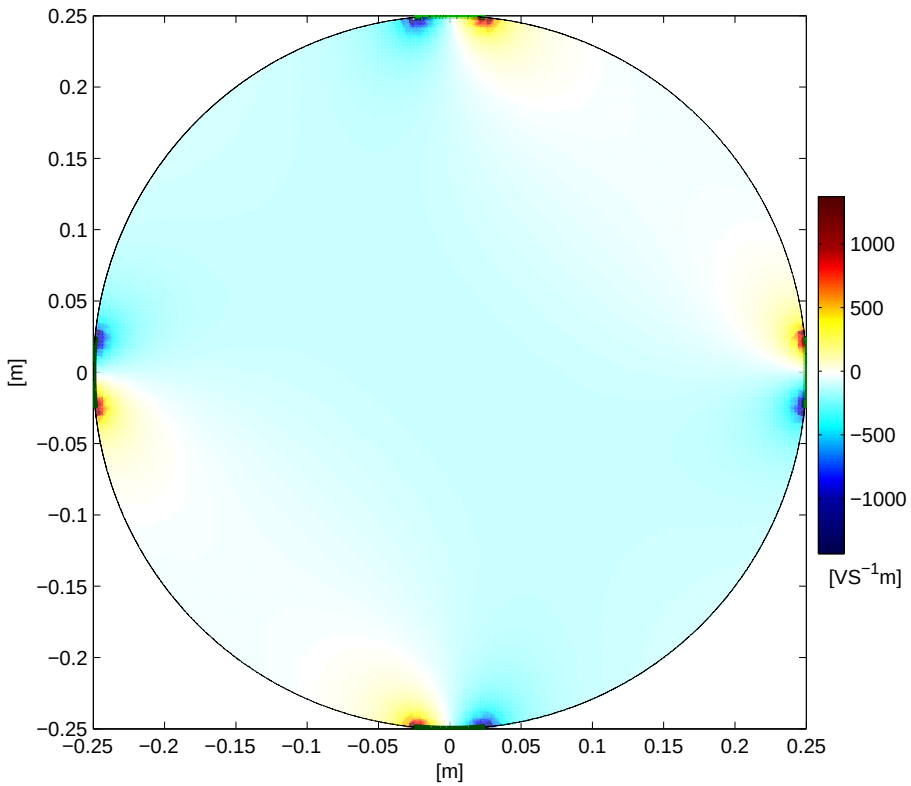
| Model | C0 | C1 | C2 | C3 | C4 | C5 | C6 | C7 | R1 | R2 | R3 | R4 | R5 | R6 | R7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| global maxh [mm] | 6.25 | 7.14 | 8.33 | 10 | 12.5 | 16.7 | 25 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| elec. maxh [mm] | 6.25 | 7.14 | 8.33 | 10 | 12.5 | 16.7 | 25 | 50 | 25 | 16.7 | 12.5 | 10 | 8.33 | 7.14 | 6.25 |
| # elem. per elec. edge | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| # elements | 1291473 | 1254681 | 633324 | 230947 | 160323 | 79787 | 19033 | 1983 | 3705 | 7893 | 14538 | 17778 | 23423 | 31188 | 38244 |
| # nodes | 233640 | 224963 | 114363 | 43941 | 30642 | 15290 | 4047 | 524 | 874 | 1712 | 2956 | 3601 | 4692 | 6098 | 7436 |
| # elec. elem. | 138 | 110 | 74 | 56 | 36 | 22 | 6 | 2 | 6 | 22 | 28 | 50 | 72 | 86 | 104 |
| minEL[a] [mm] | 3.37 | 3.55 | 3.95 | 5.53 | 6.7 | 9.1 | 13.9 | 35.4 | 17.9 | 11.9 | 8.2 | 6.76 | 5.34 | 4.94 | 4.25 |
| maxEL[b] [mm] | 15.4 | 15 | 19.1 | 25.2 | 30.9 | 41.4 | 52.3 | 103 | 96.1 | 84.2 | 85.5 | 82.7 | 75.3 | 73.5 | 74.4 |
| minEV[c] [$cm^3$] | 0.00825 | 0.00888 | 0.0146 | 0.0407 | 0.0565 | 0.139 | 0.514 | 8.03 | 1.55 | 0.303 | 0.123 | 0.0814 | 0.034 | 0.0234 | 0.0131 |
| maxEV[d] [$cm^3$] | 0.159 | 0.159 | 0.405 | 0.739 | 1.14 | 3.62 | 8.67 | 71.2 | 59.7 | 46.1 | 28.3 | 31 | 25.4 | 26.5 | 25.2 |

[a] length of the shortest edge; [b] length of the longest edge; [c] volume of the smallest element; [d] volume of the largest element.

# Simulation



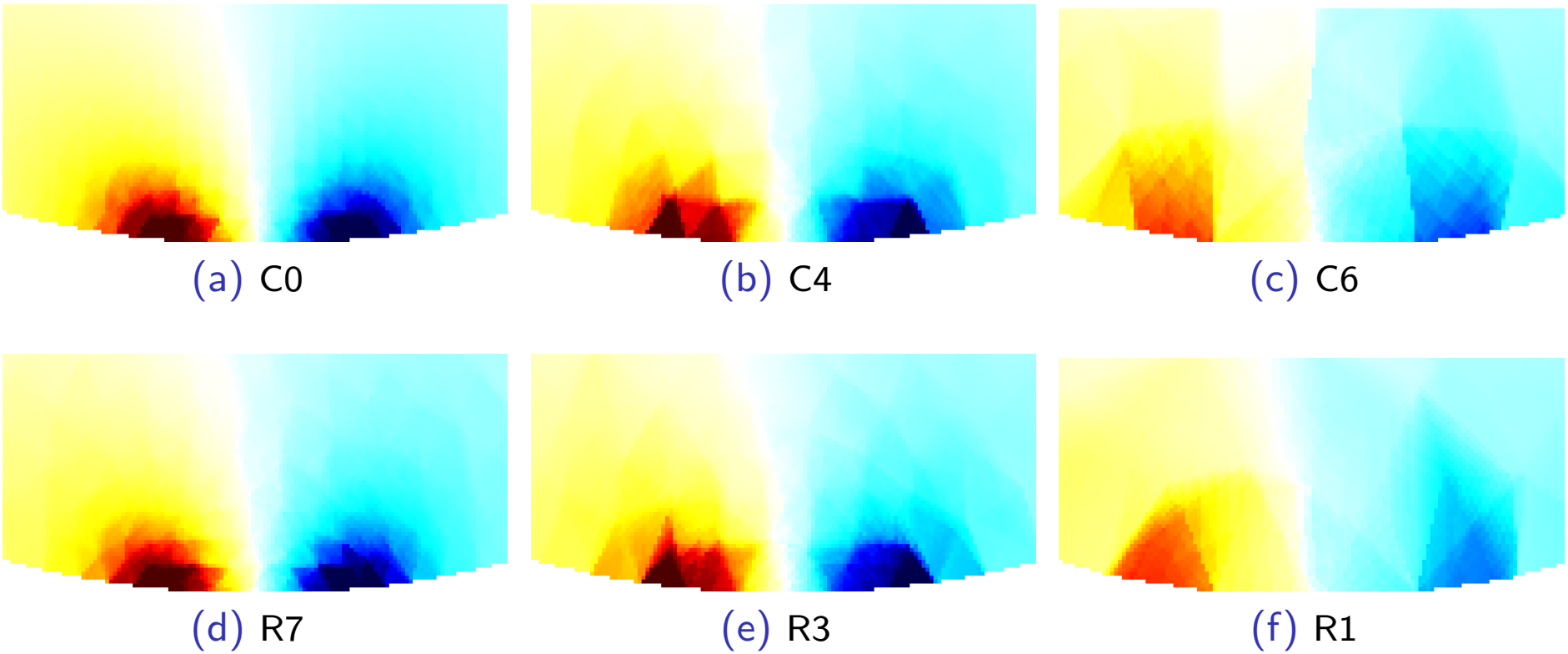

(a) Potential distribution




(b) Sensitivity distribution

Figure: Reference results obtained on model C0.

# Sensitivity



(a) C0 (b) C4 (c) C6

(d) R7 (e) R3 (f) R1

Figure: Average sensitivity in the electrode plane in the vicinity of an electrode (ROIs SE and SI). All images use the same color scale.

# Sensitivity

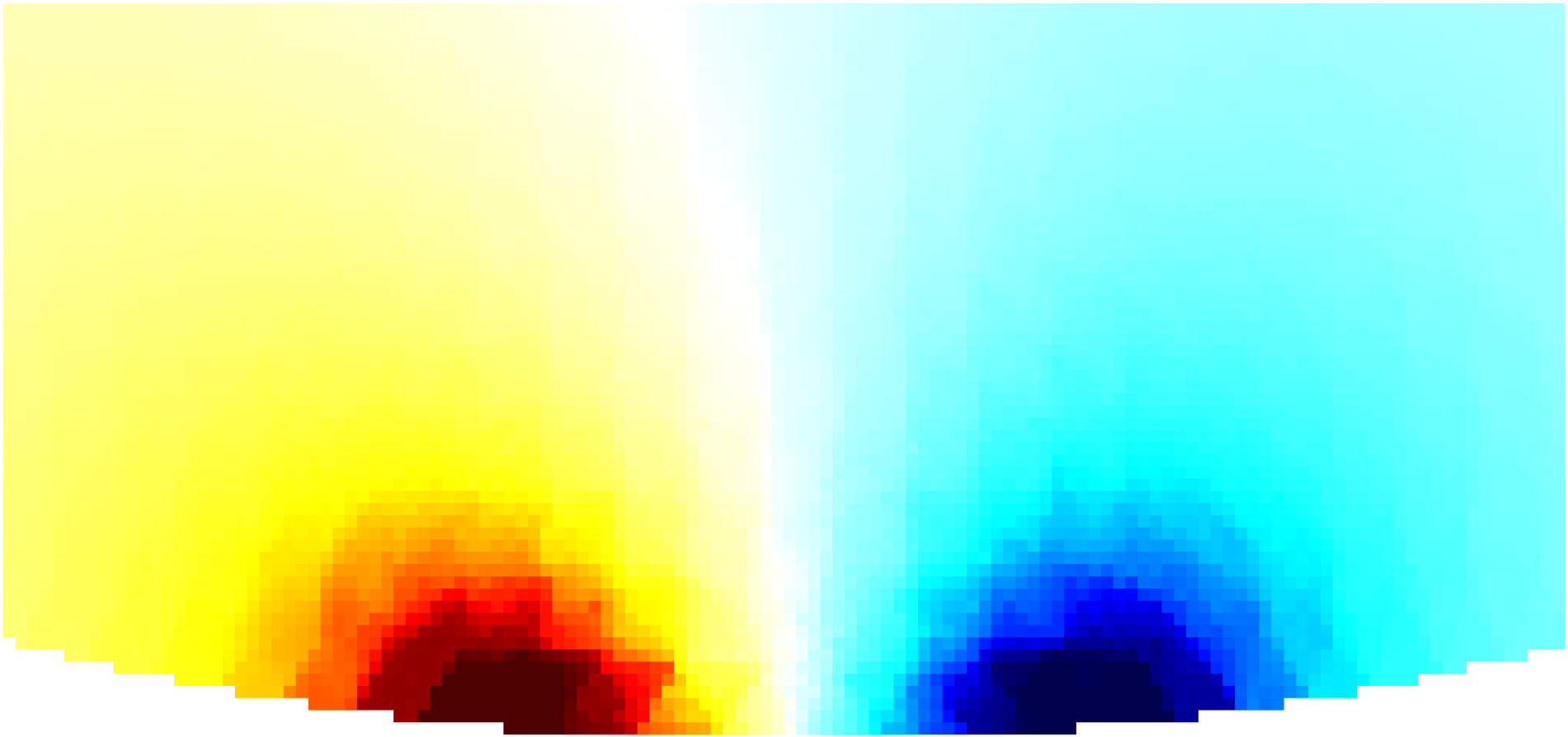


Figure: C0

# Sensitivity

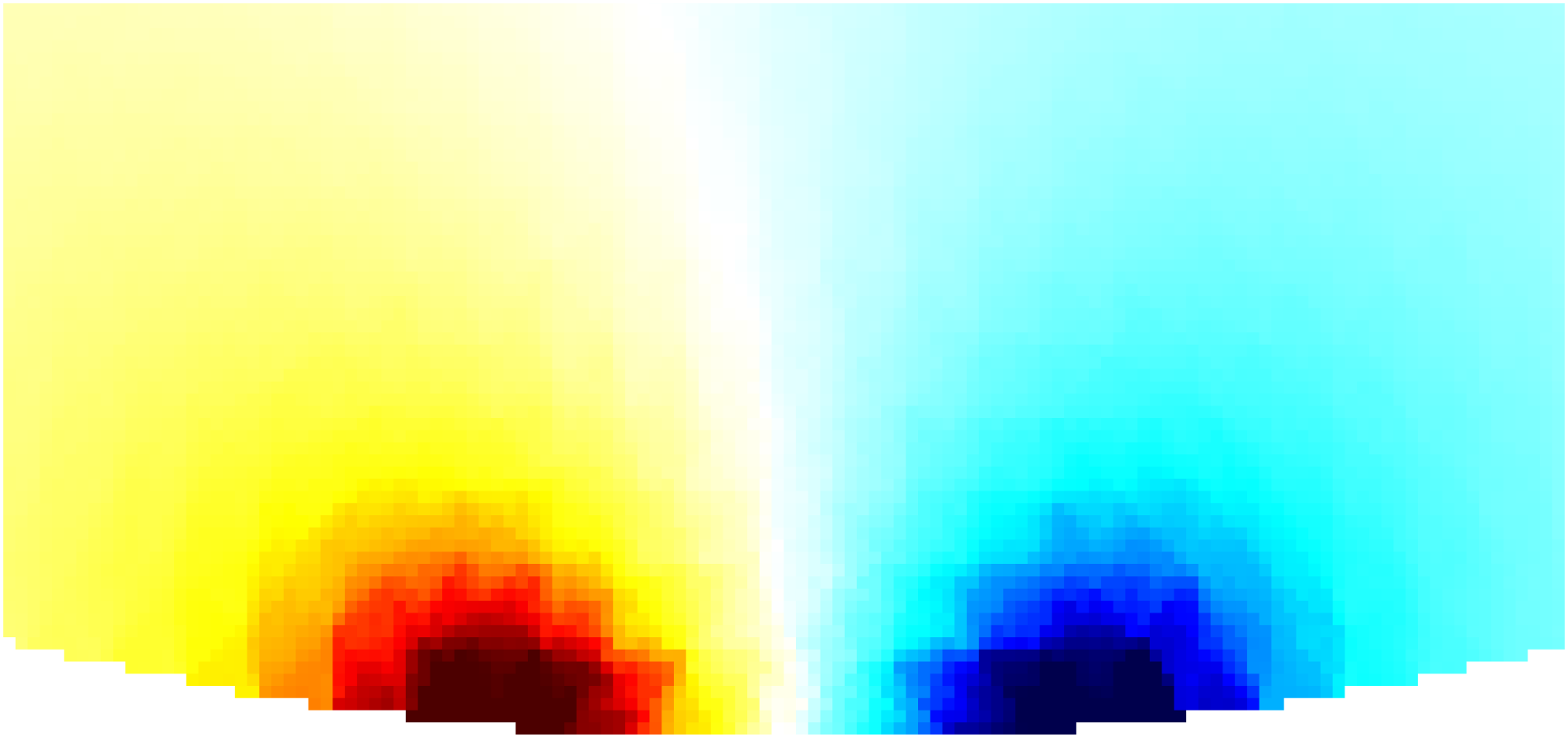


Figure: C1

# Sensitivity

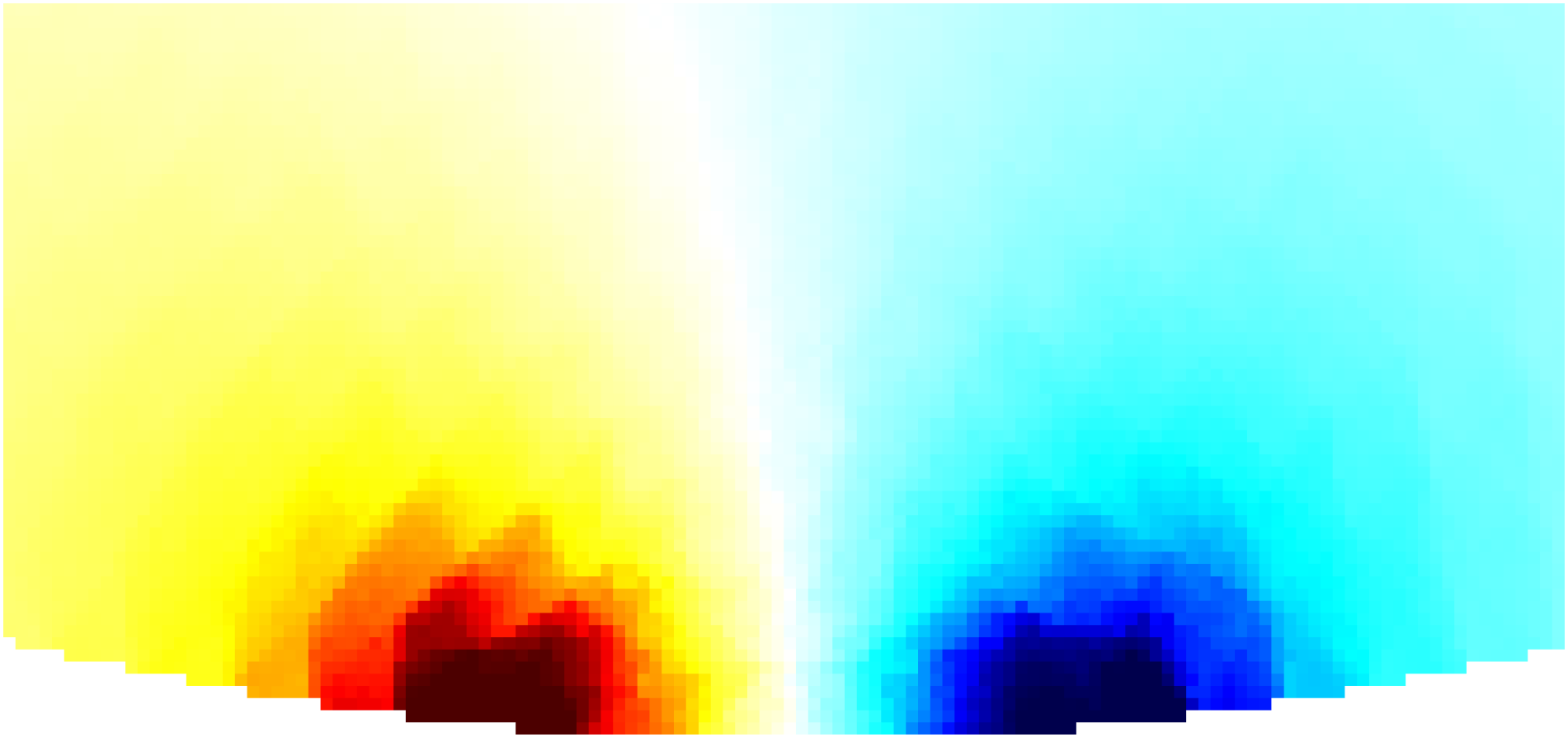


Figure: C2

# Sensitivity

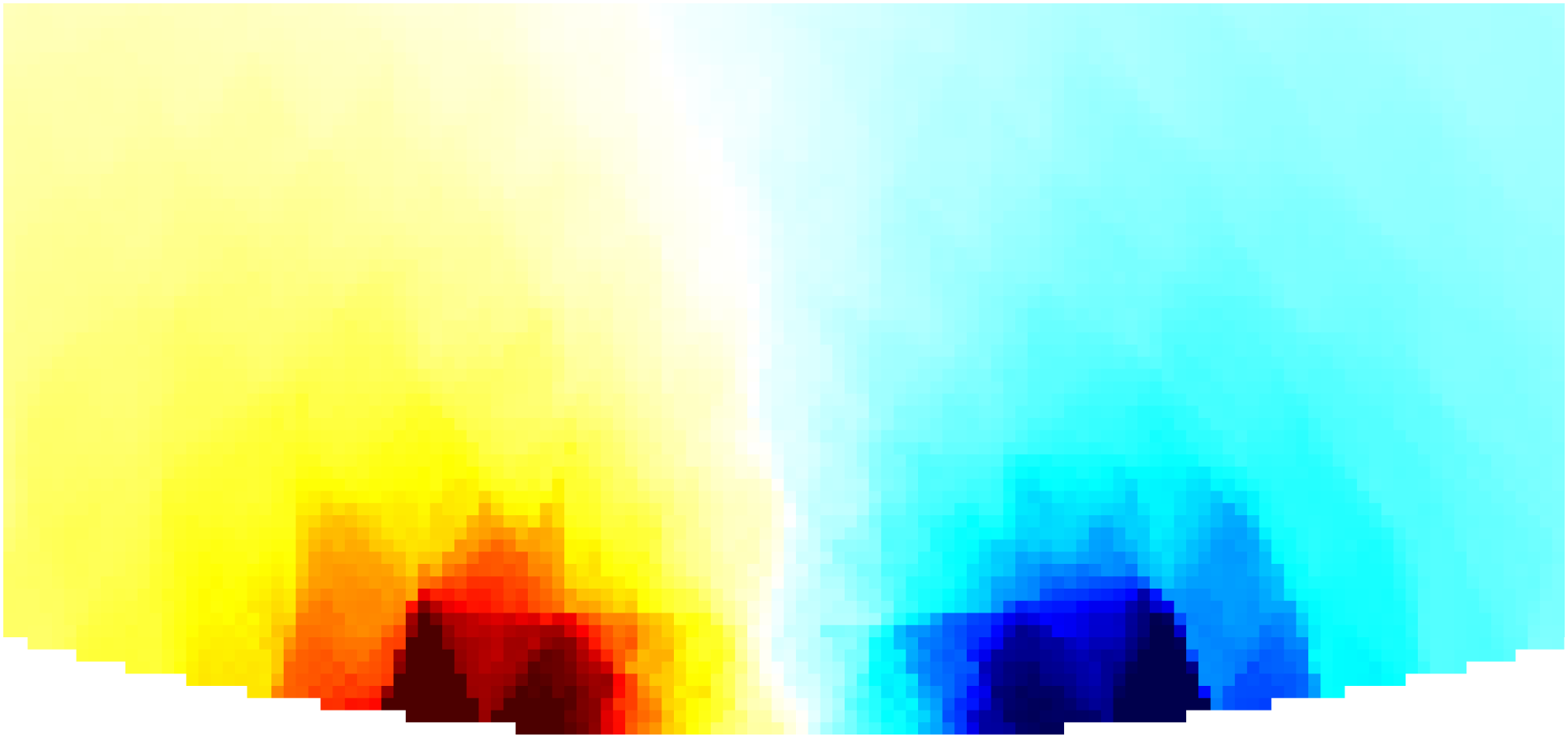


Figure: C3

# Sensitivity

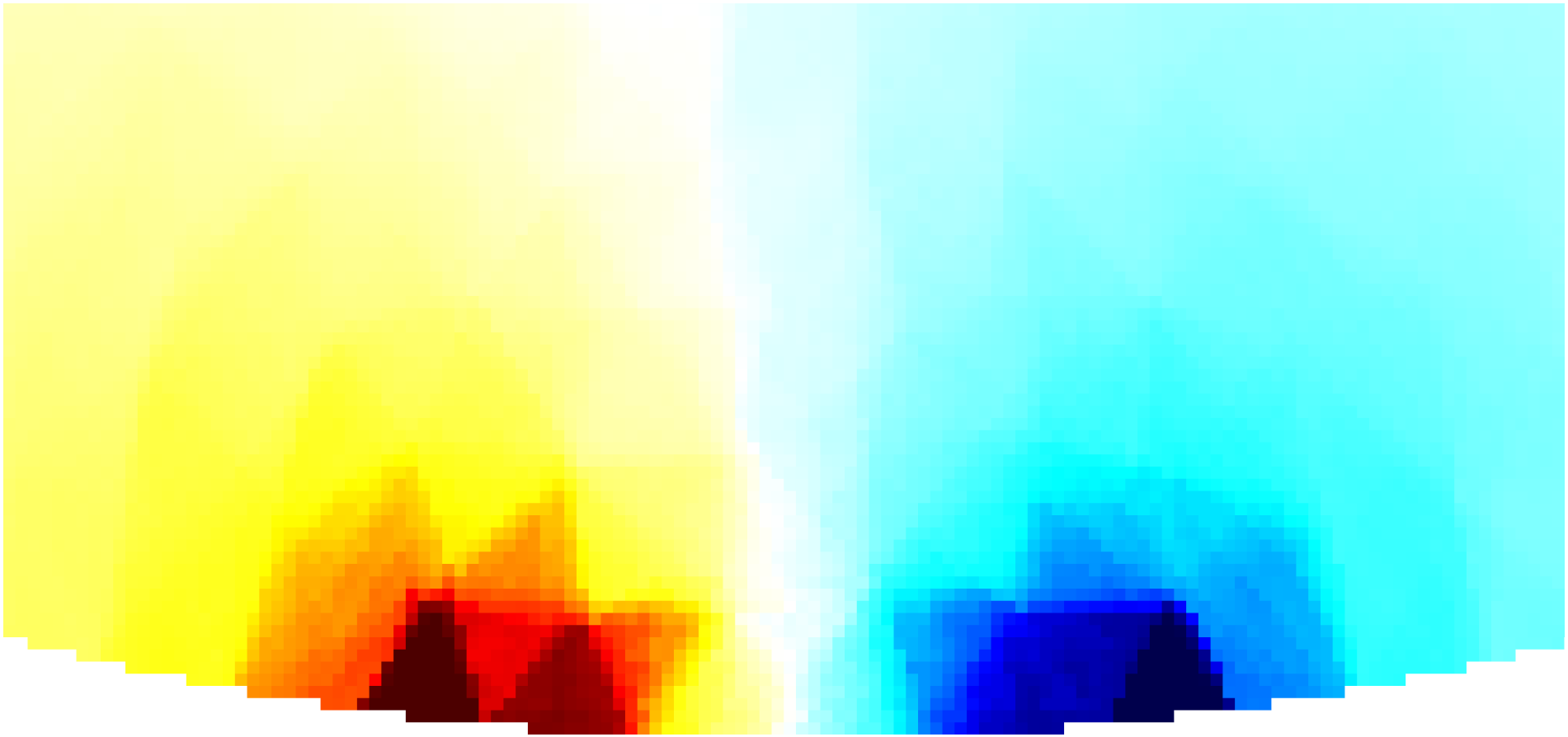


Figure: C4

# Sensitivity

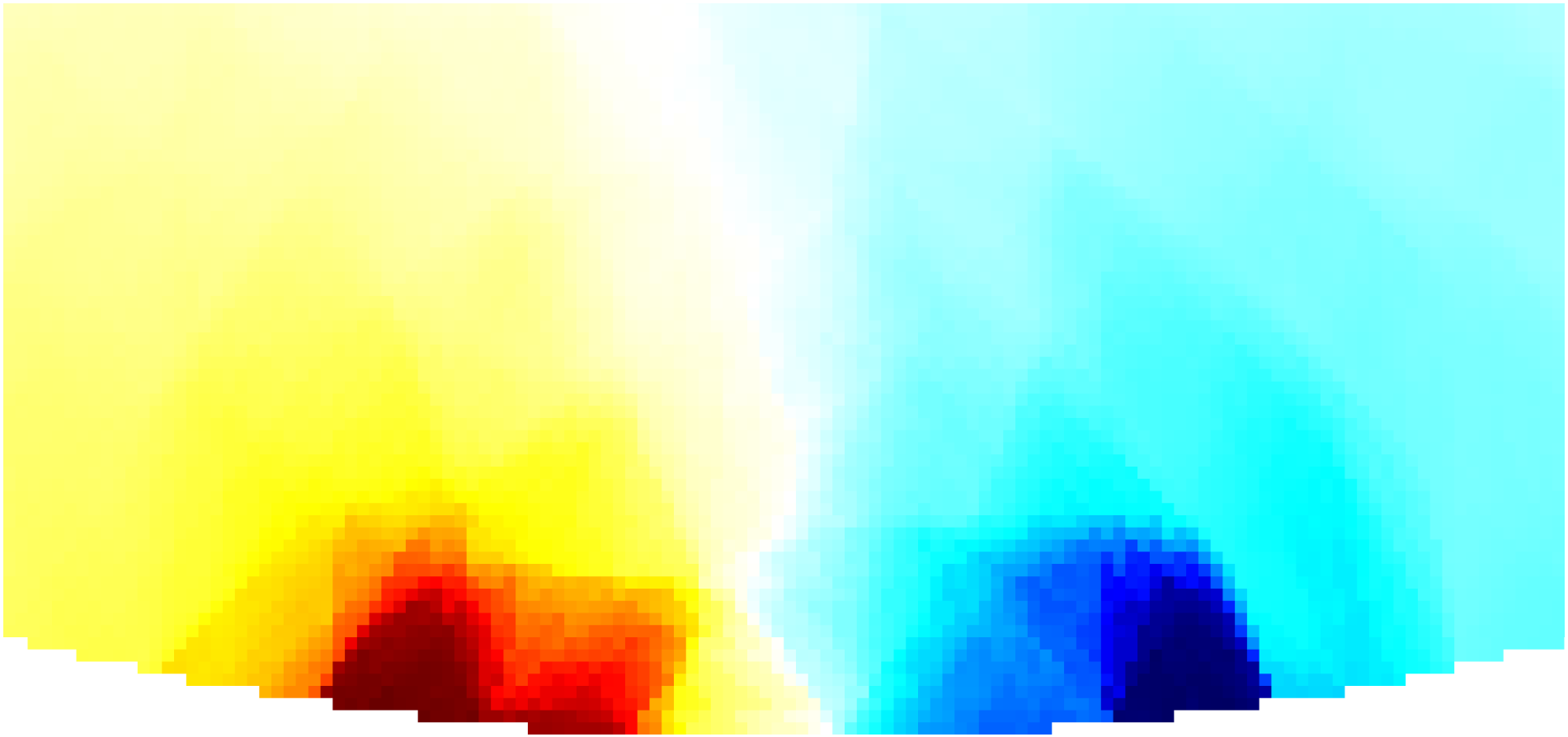


Figure: C5

# Sensitivity

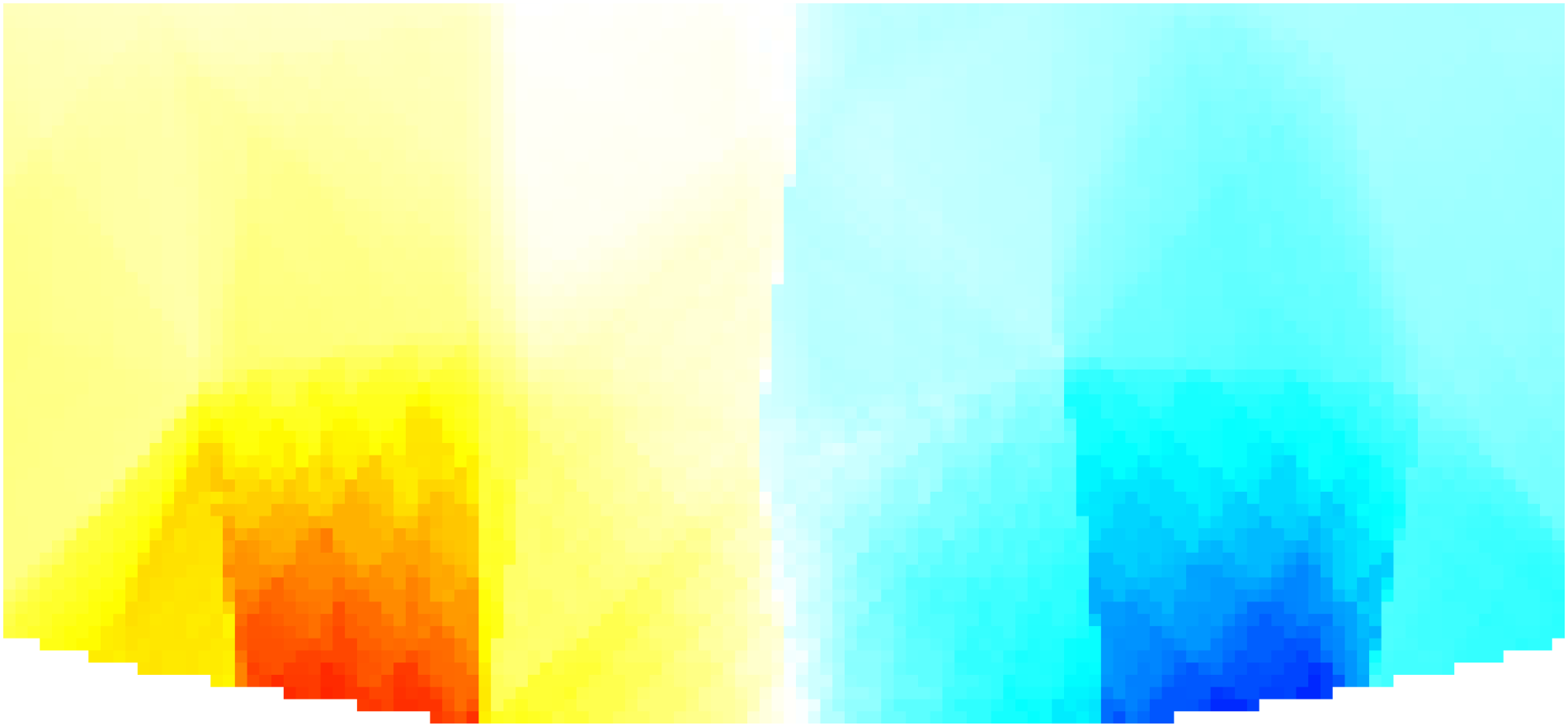


Figure: C6

# Sensitivity

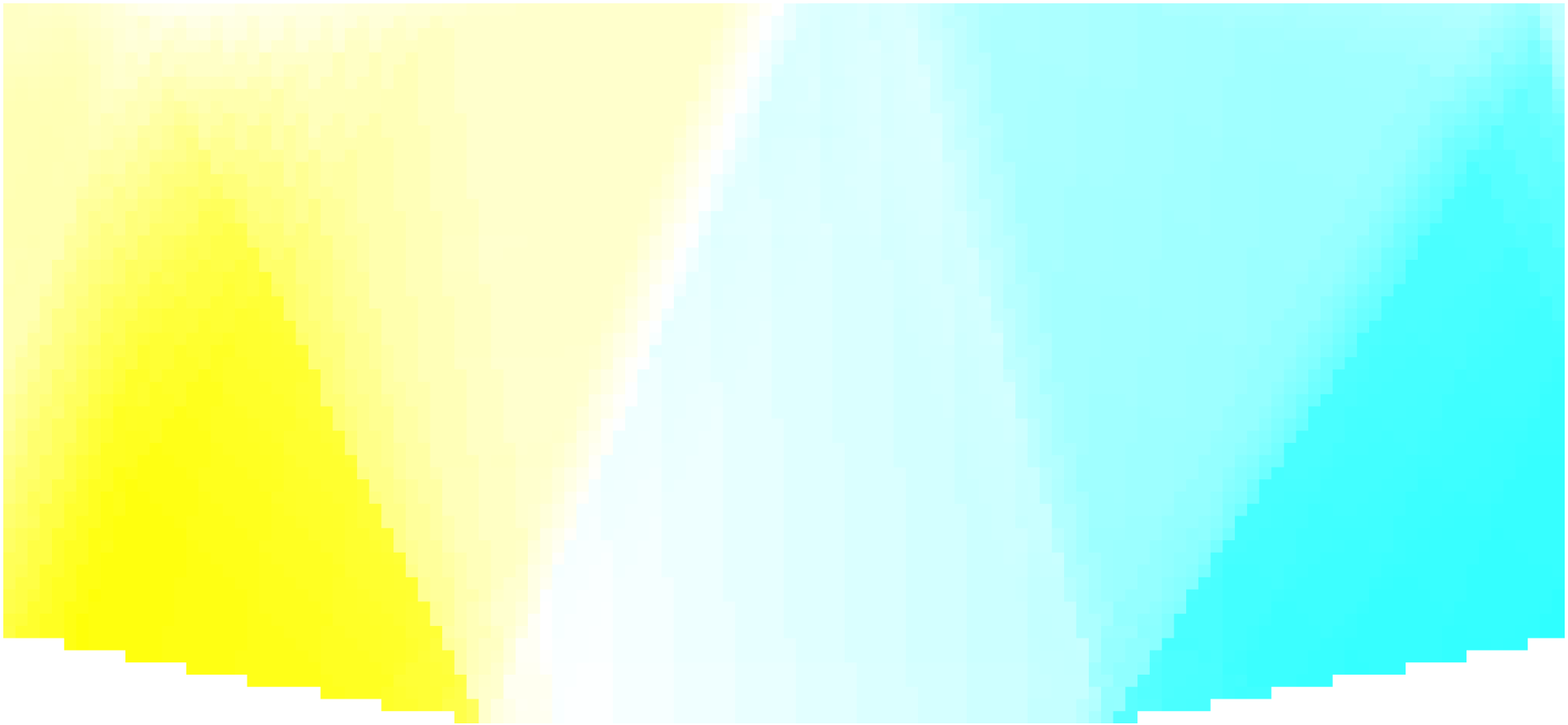


Figure: C7

# Sensitivity

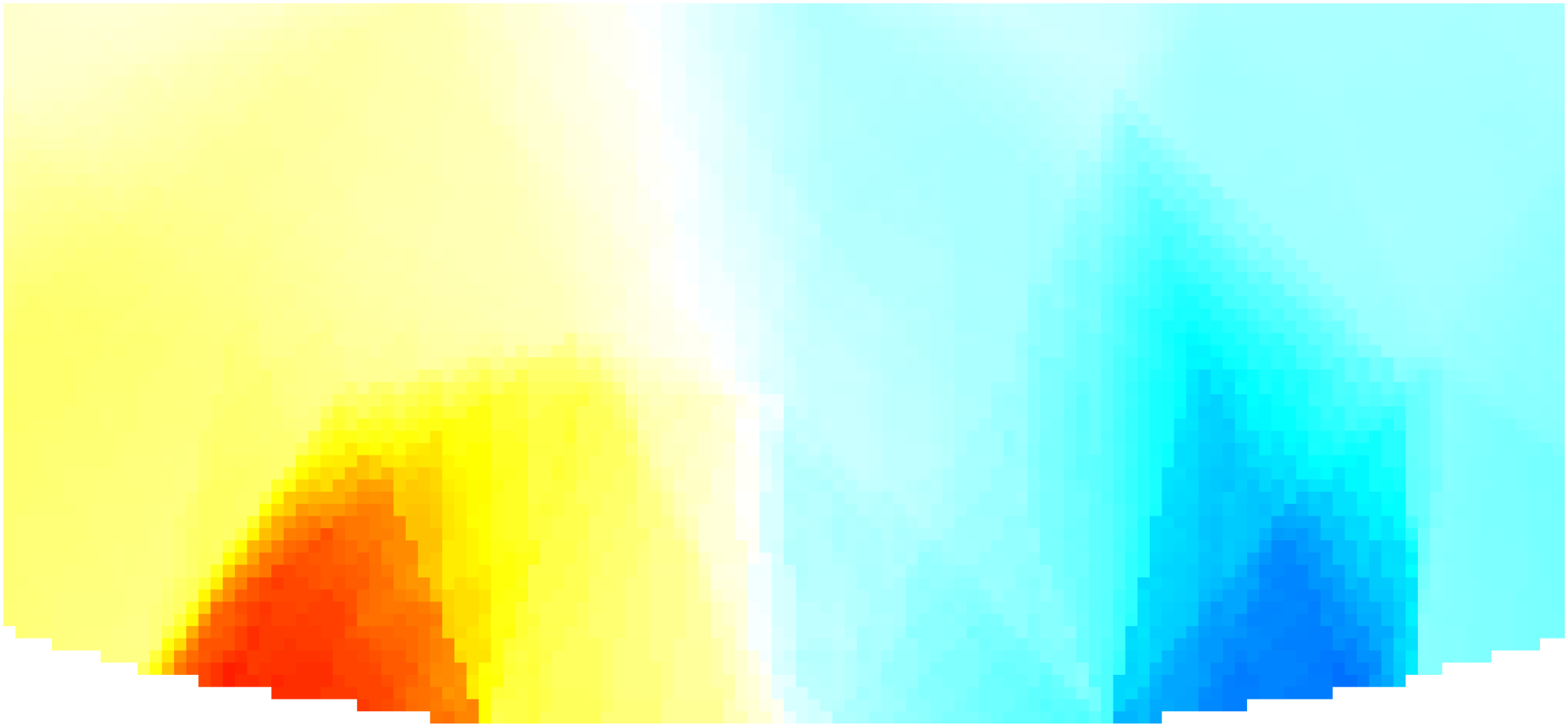


Figure: R2

# Sensitivity

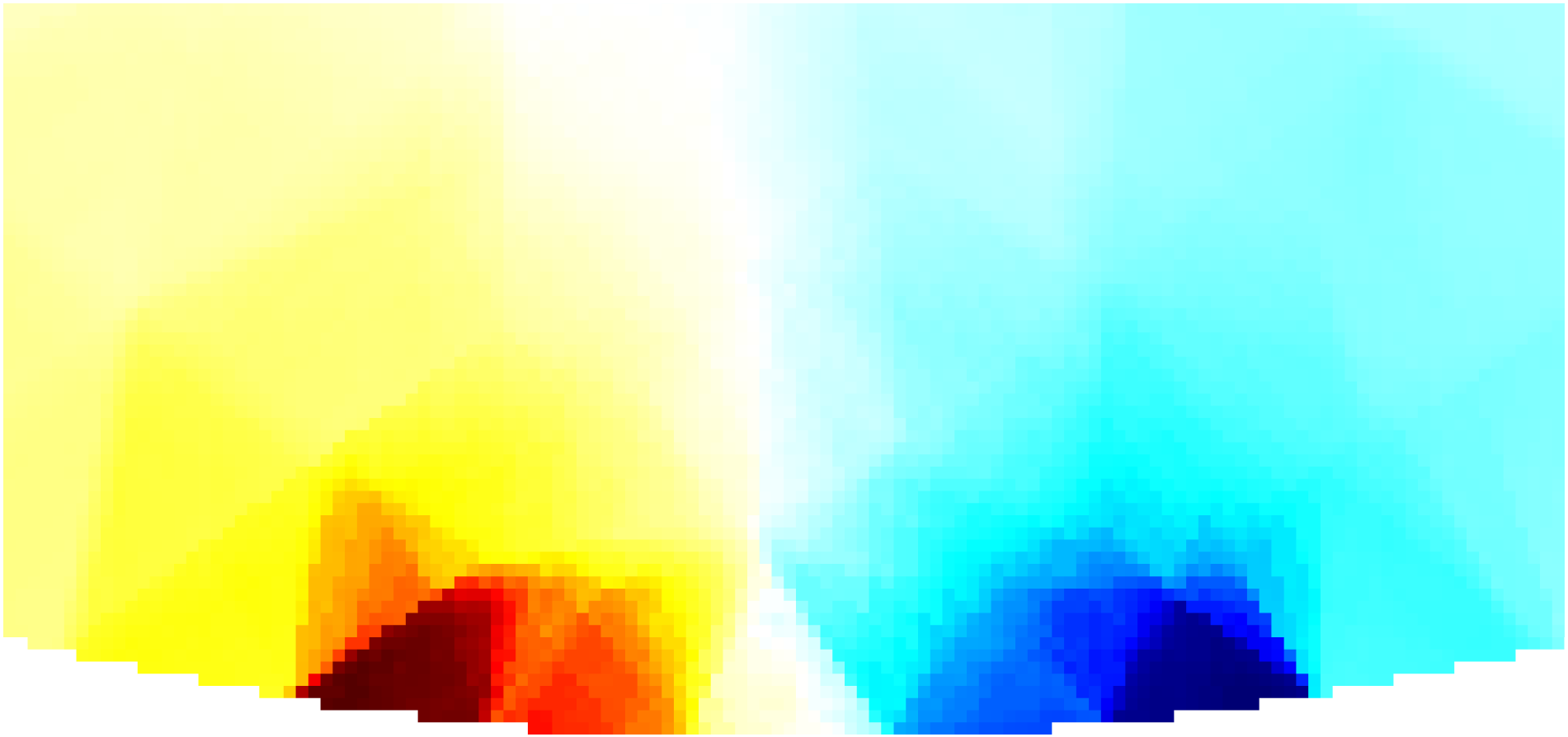


Figure: R3

# Sensitivity

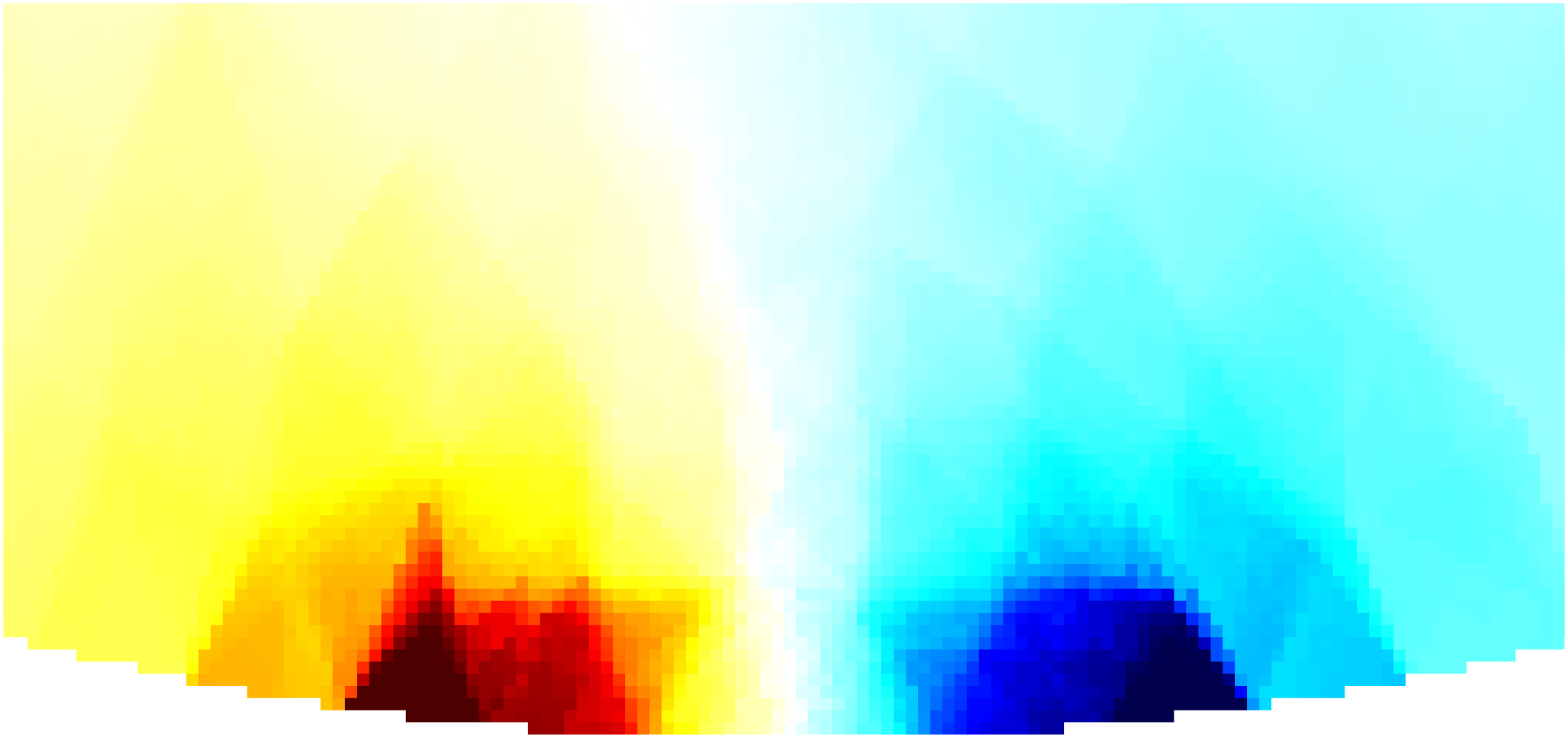


Figure: R4

# Sensitivity

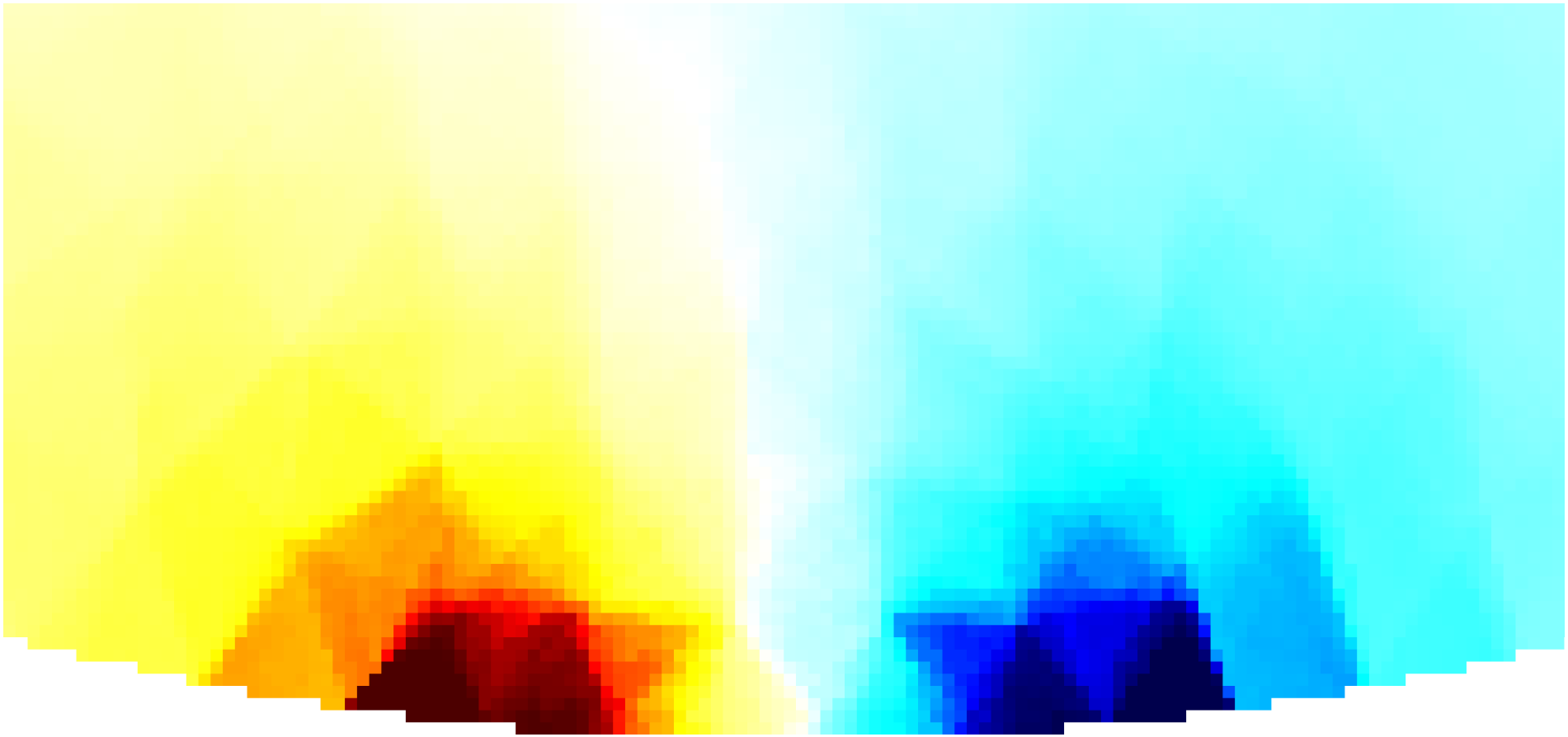


Figure: R5

# Sensitivity

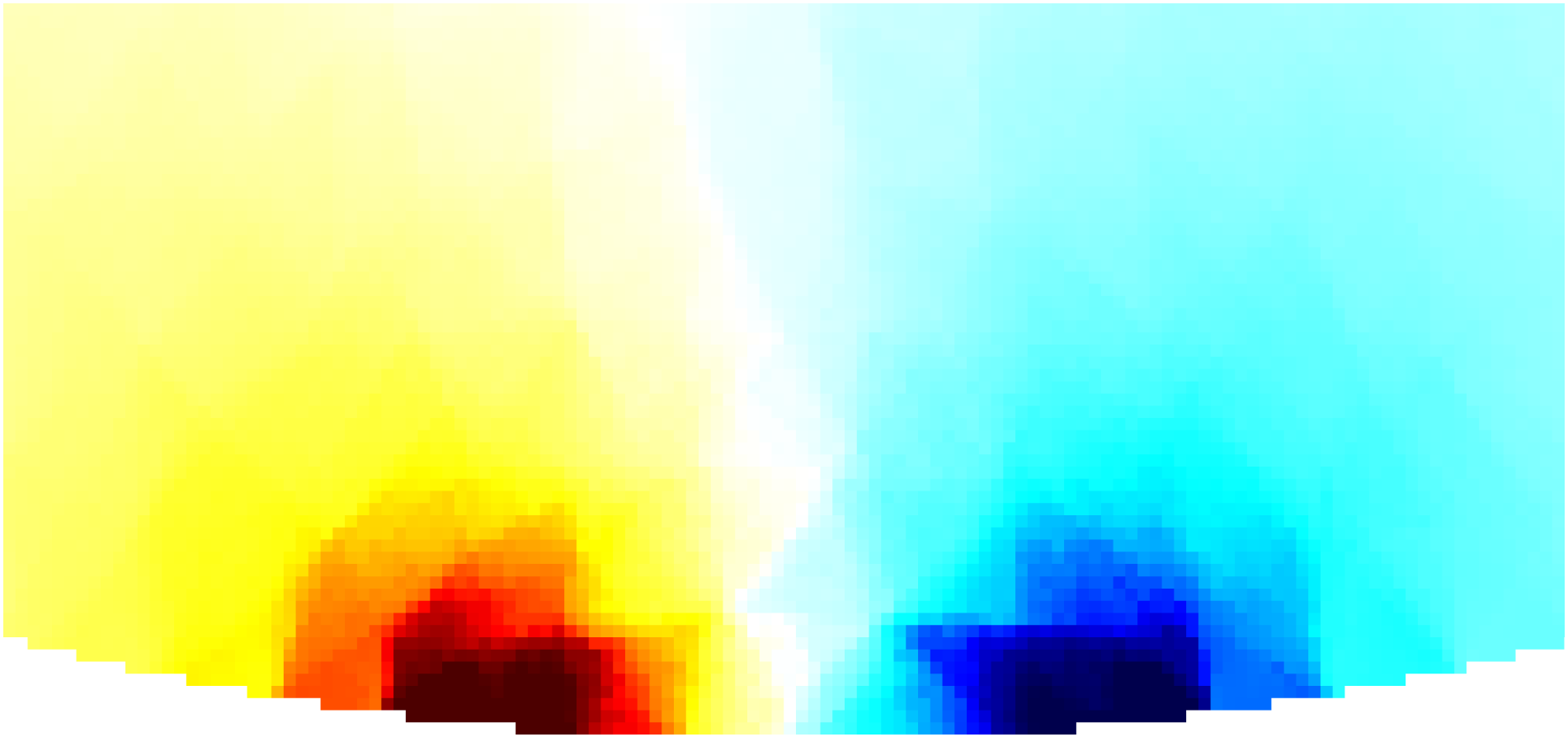


Figure: R6

# Sensitivity

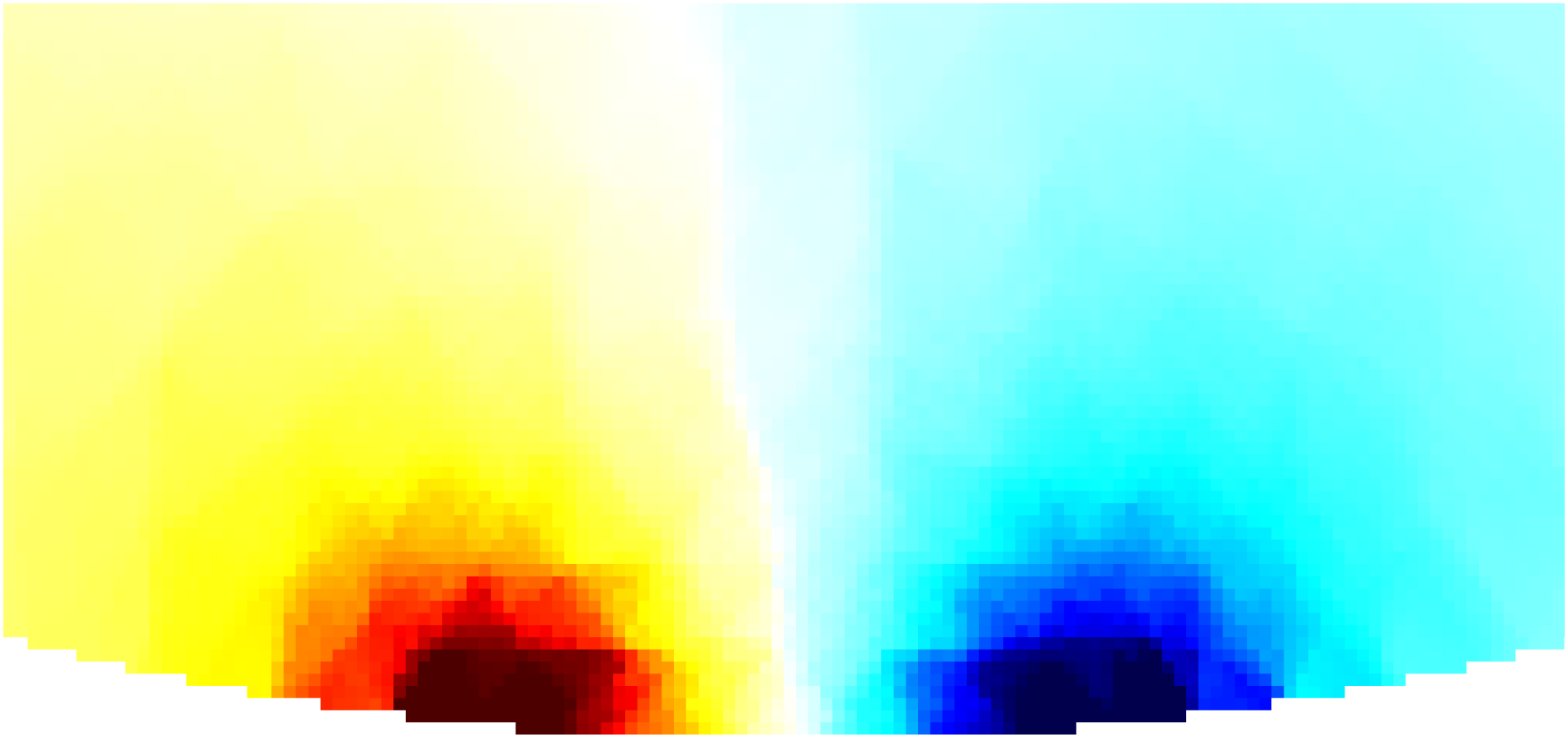


Figure: R7

# Sensitivity

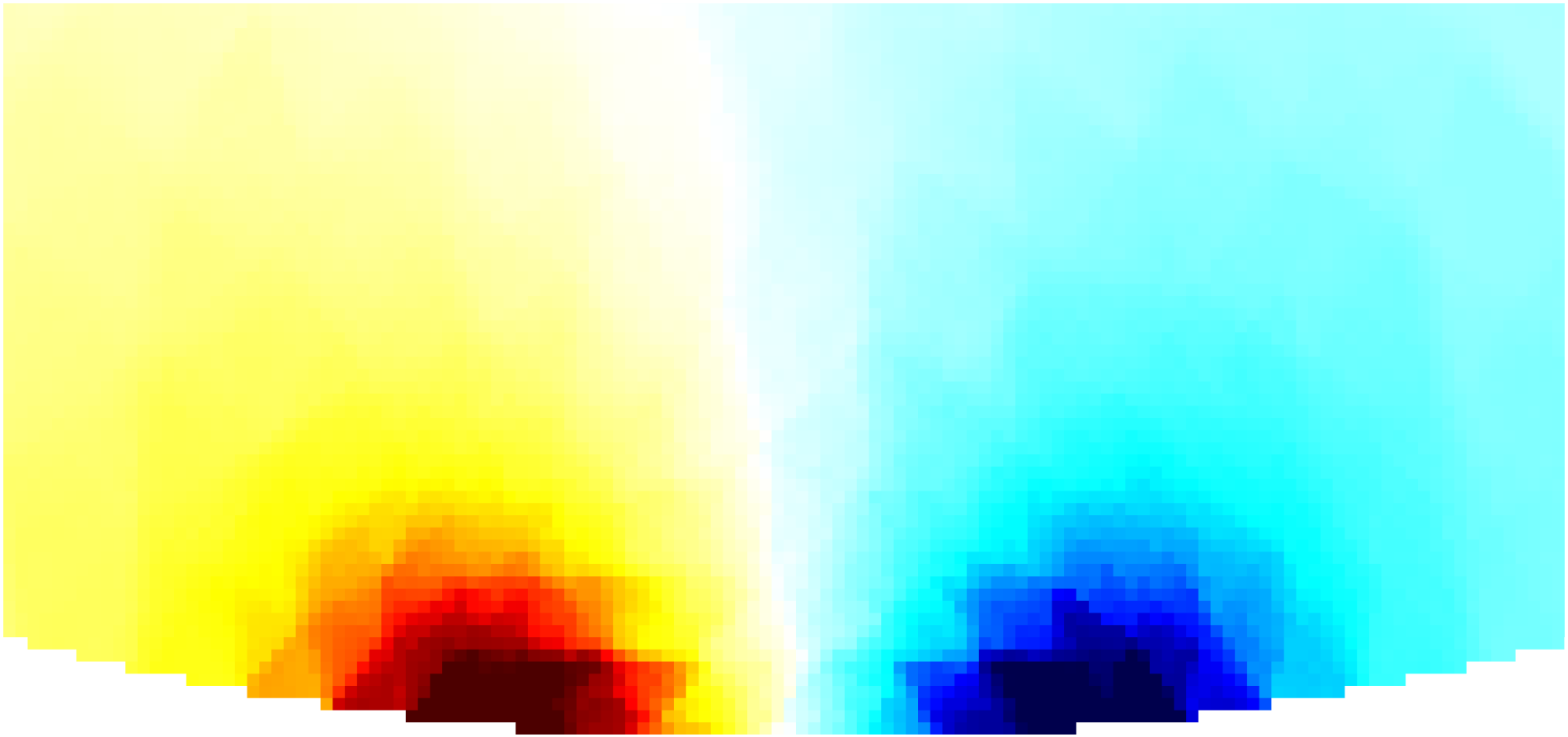
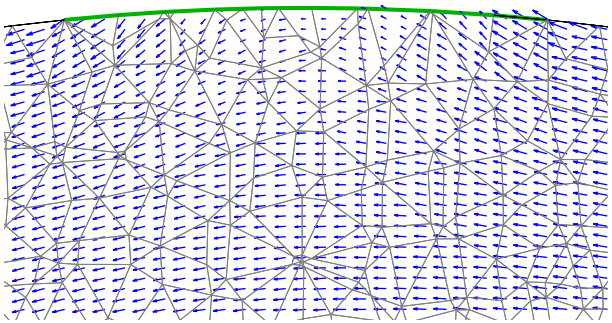
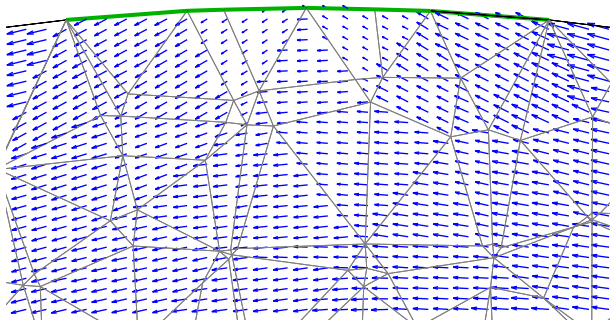


Figure: R8

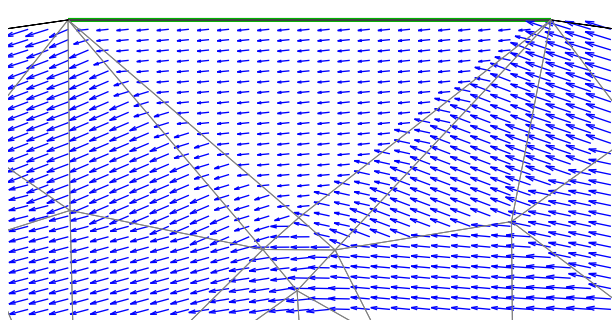
# Current near electrode



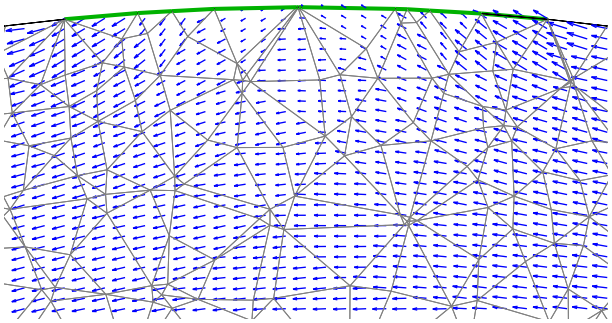
(a) C0



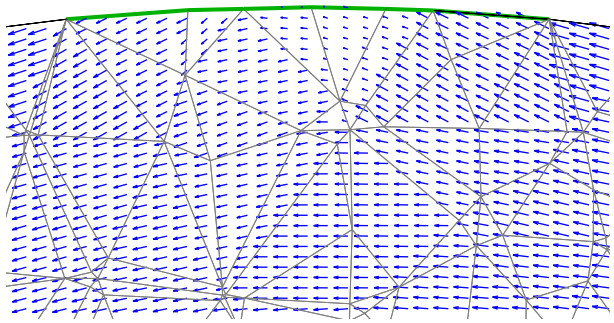
(b) C4



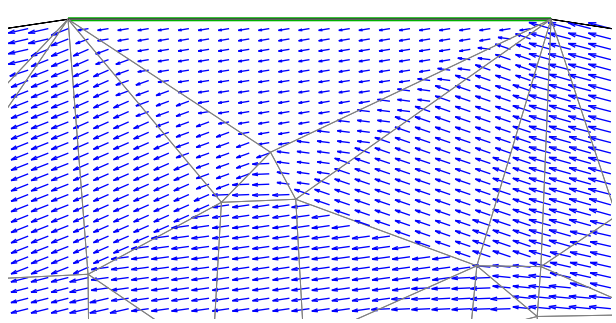
(c) C6



(d) R7



(e) R3



(f) R1

Figure: Current flow in the electrode plane (ROIs ME and MI). Arrows in each image are scaled individually.

# Results

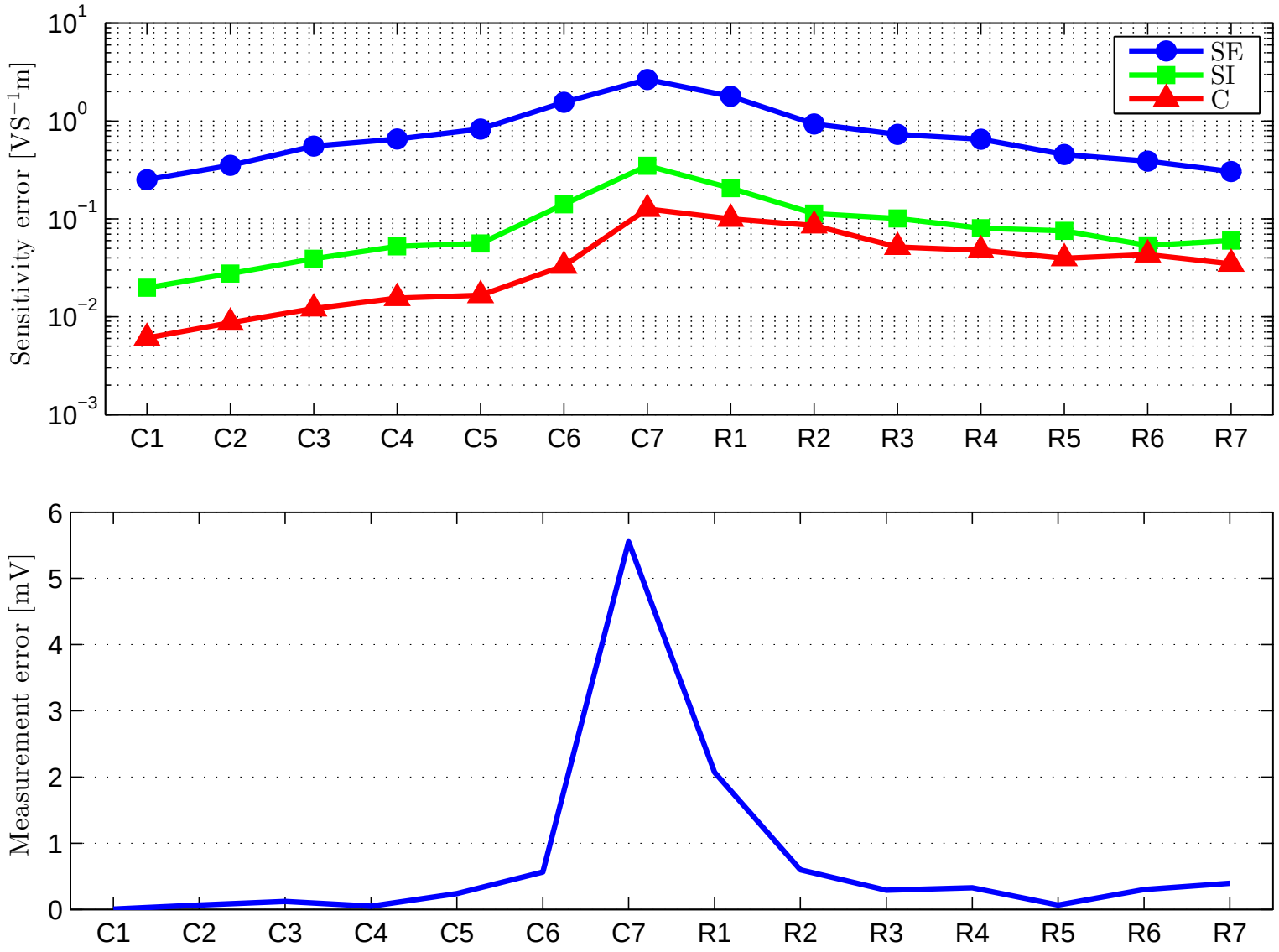
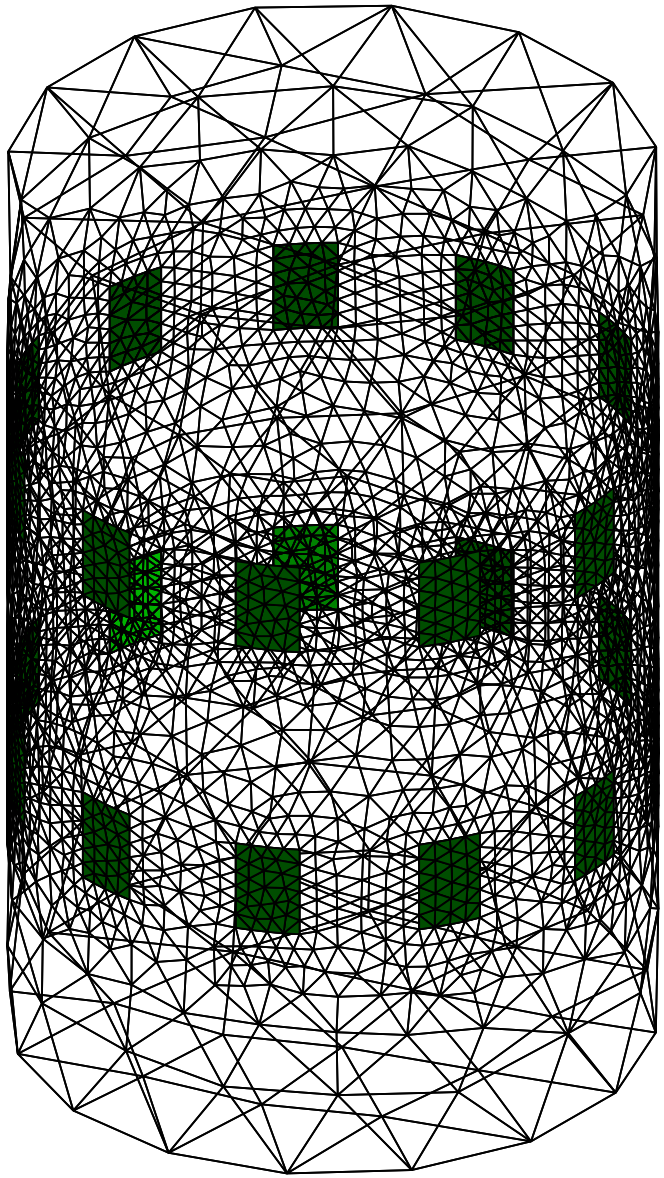



Figure: Errors with respect to model C0.

# Electrode refinement in EIDORS 3.7

## Functions

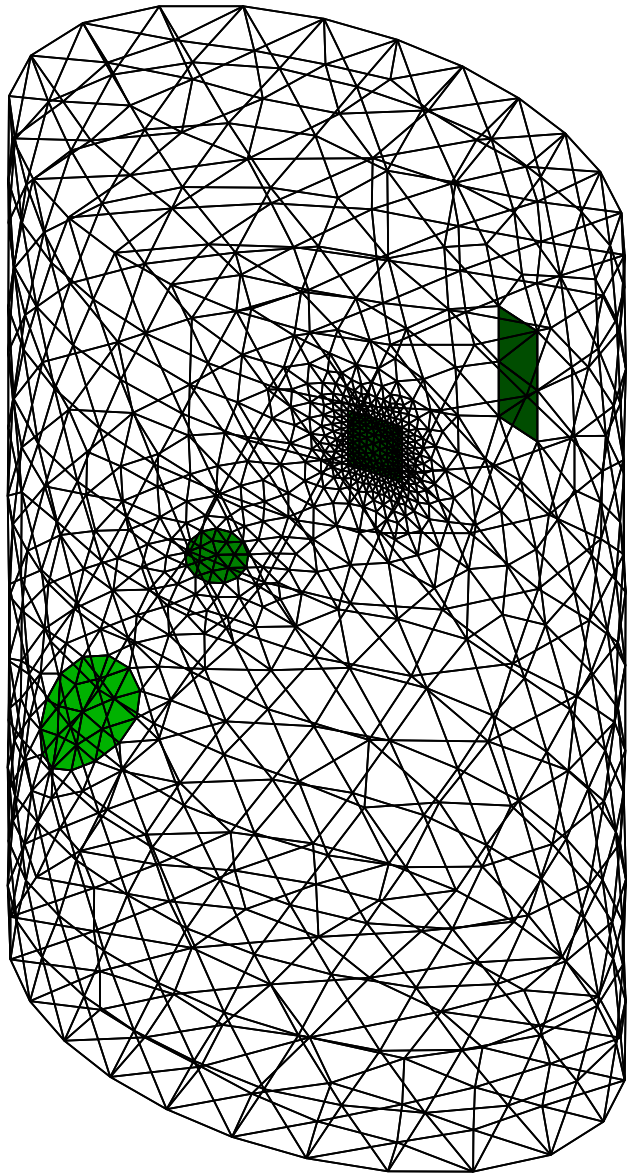
- `ng_mk_cyl_models`



# Electrode refinement in EIDORS 3.7

## Functions

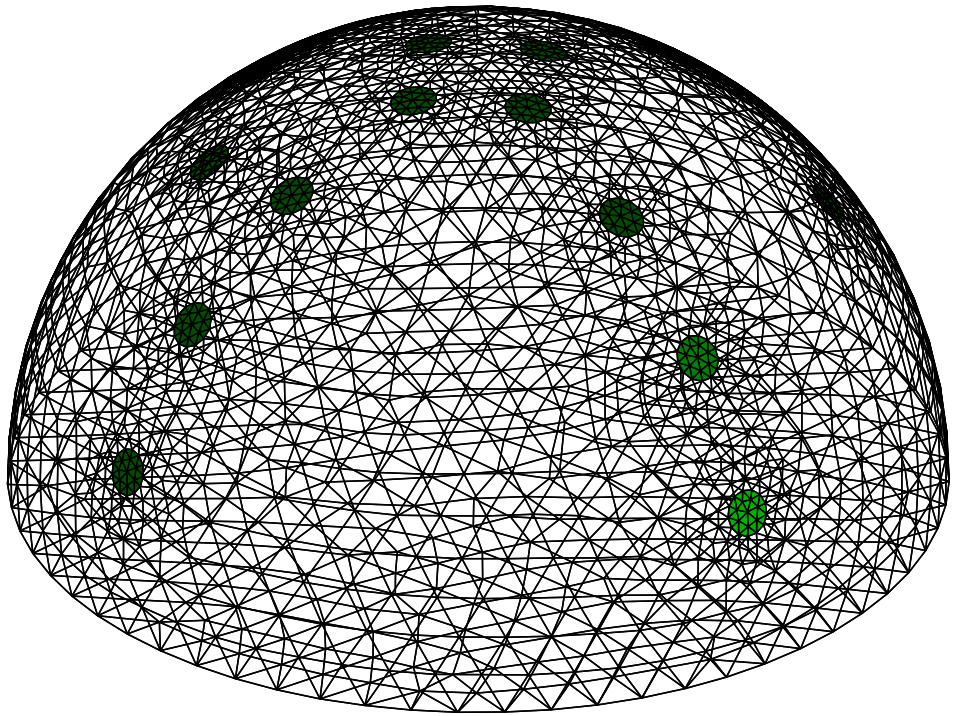
- `ng_mk_cyl_models`
- `ng_mk_ellip_models`



# Electrode refinement in EIDORS 3.7

## Functions

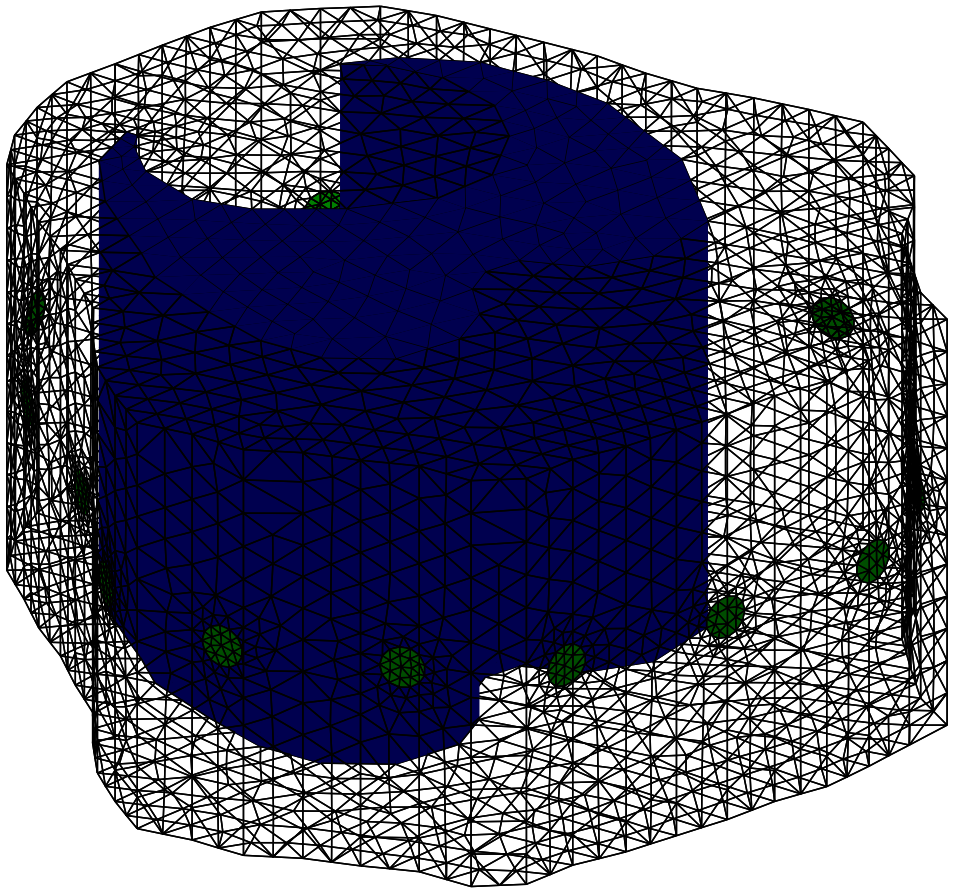
- `ng_mk_cyl_models`
- `ng_mk_ellip_models`
- `ng_mk_gen_models`



# Electrode refinement in EIDORS 3.7

## Functions

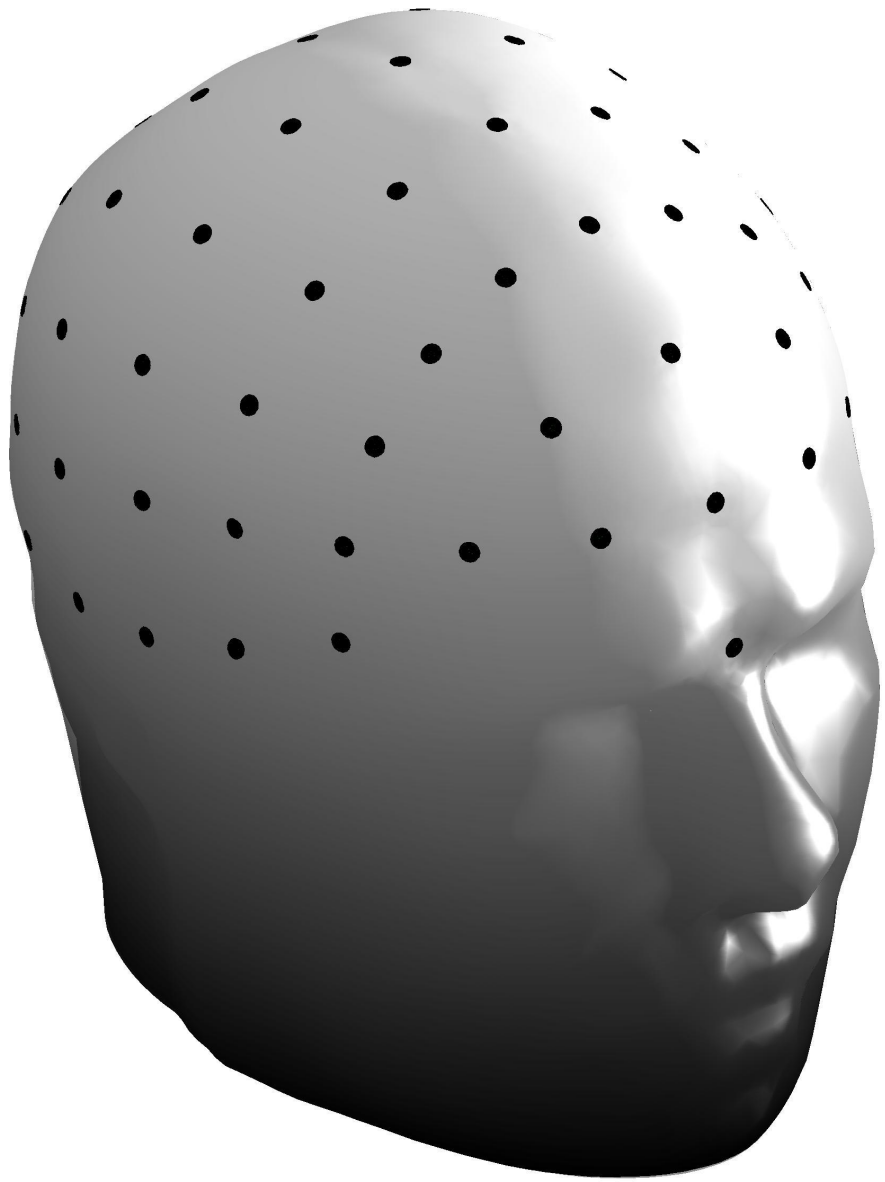
- `ng_mk_cyl_models`
- `ng_mk_ellip_models`
- `ng_mk_gen_models`
- `ng_mk_extruded_models`



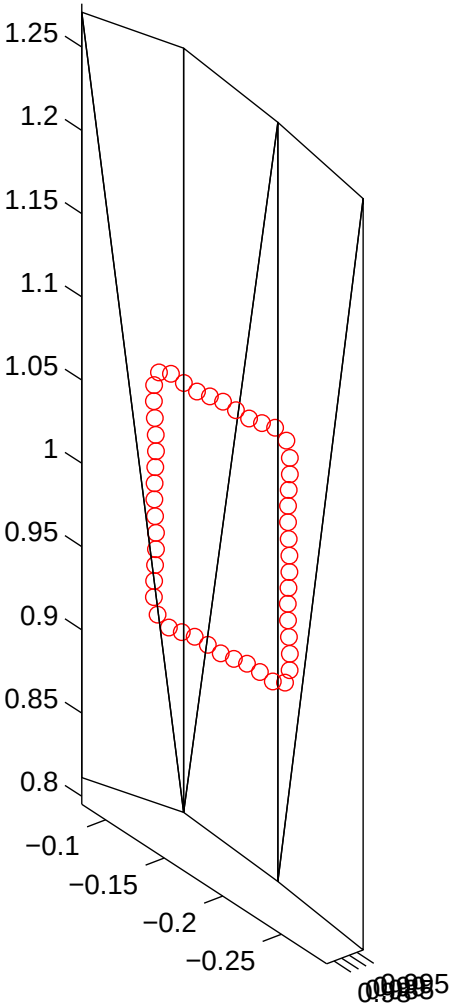
# Electrode refinement in EIDORS 3.7

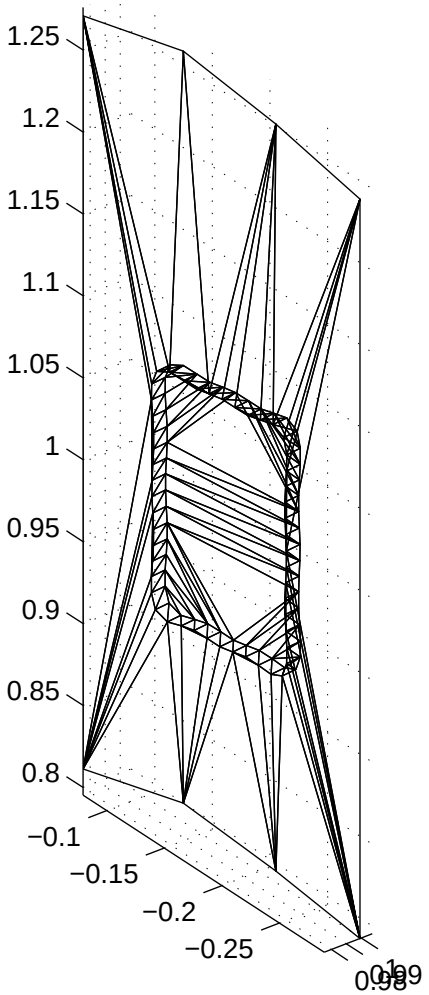
## Functions

- `ng_mk_cyl_models`
- `ng_mk_ellip_models`
- `ng_mk_gen_models`
- `ng_mk_extruded_models`
- **place_elec_on_surf**

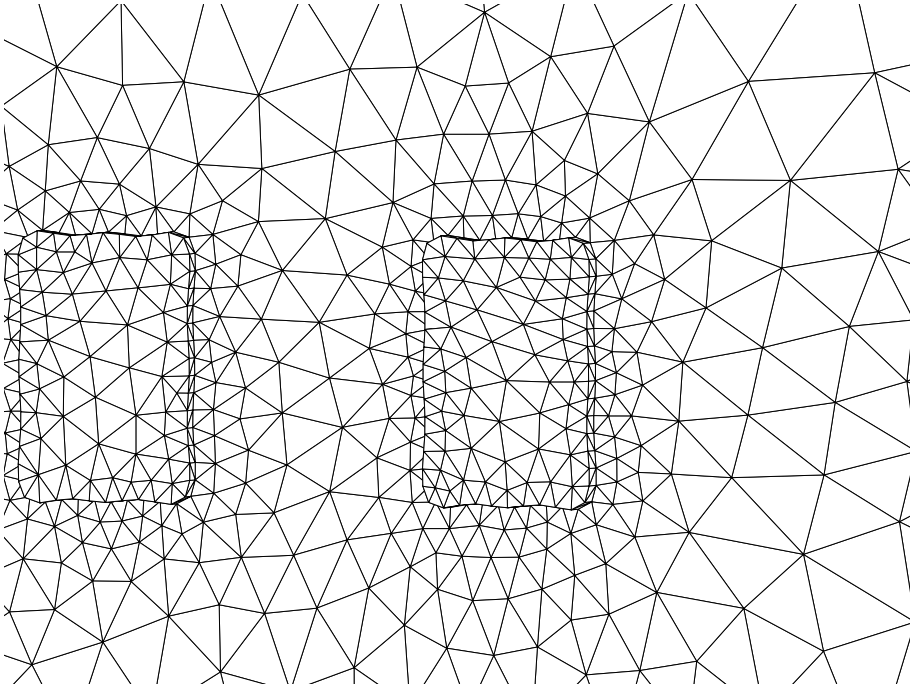


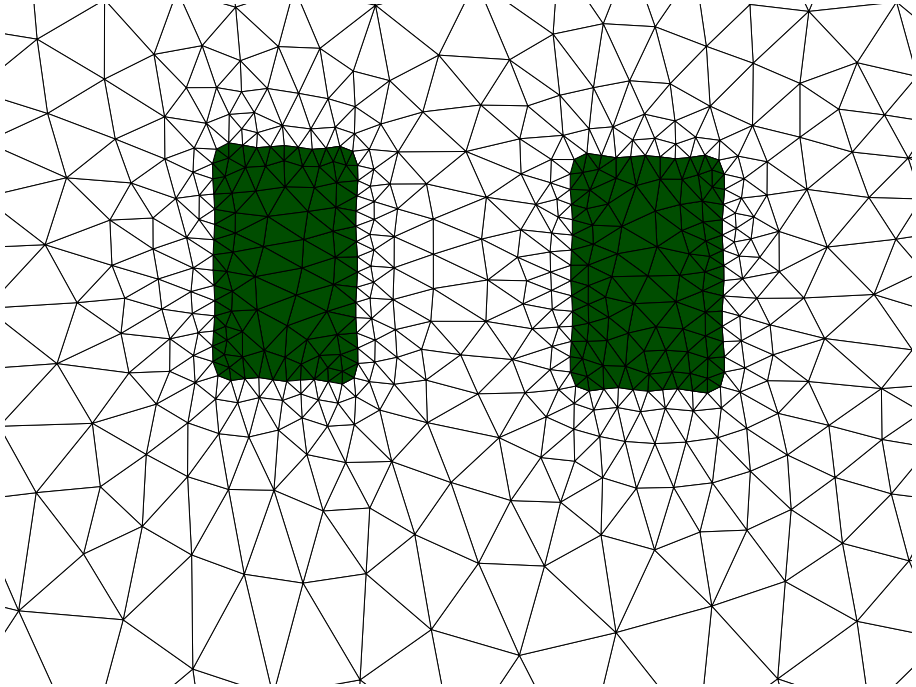
# place_elec_on_surf



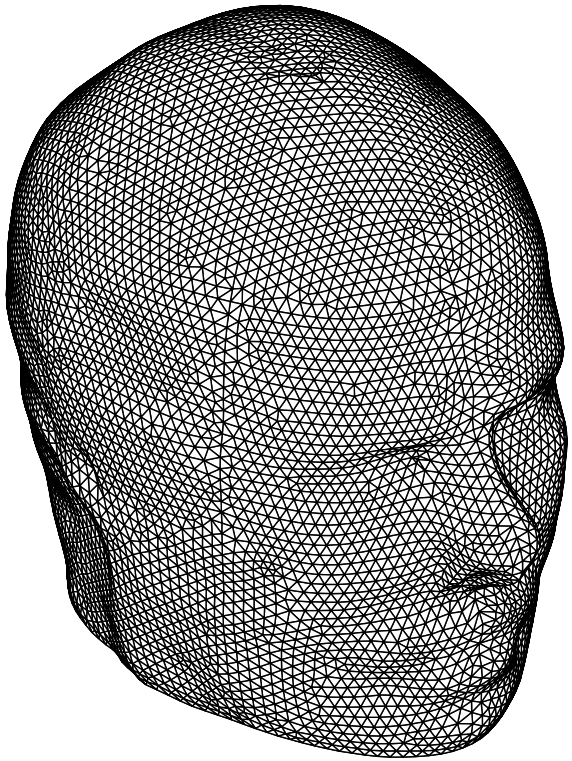



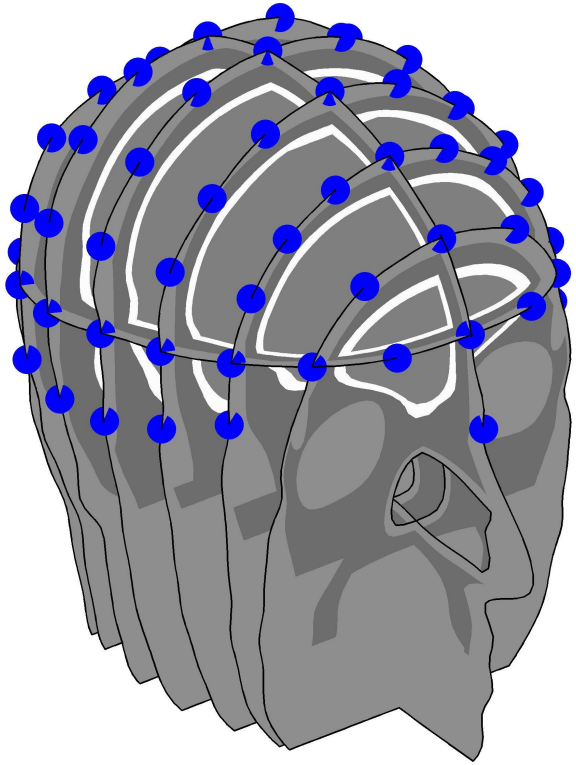
# place_elec_on_surf

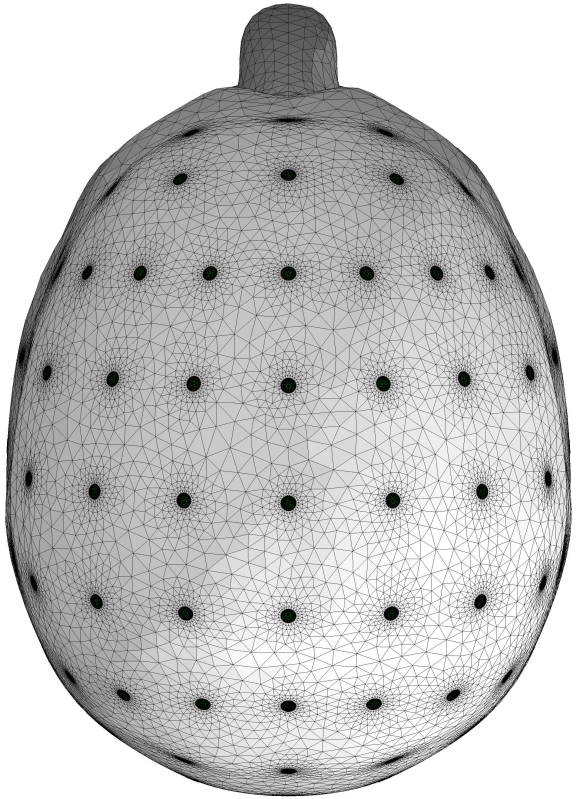




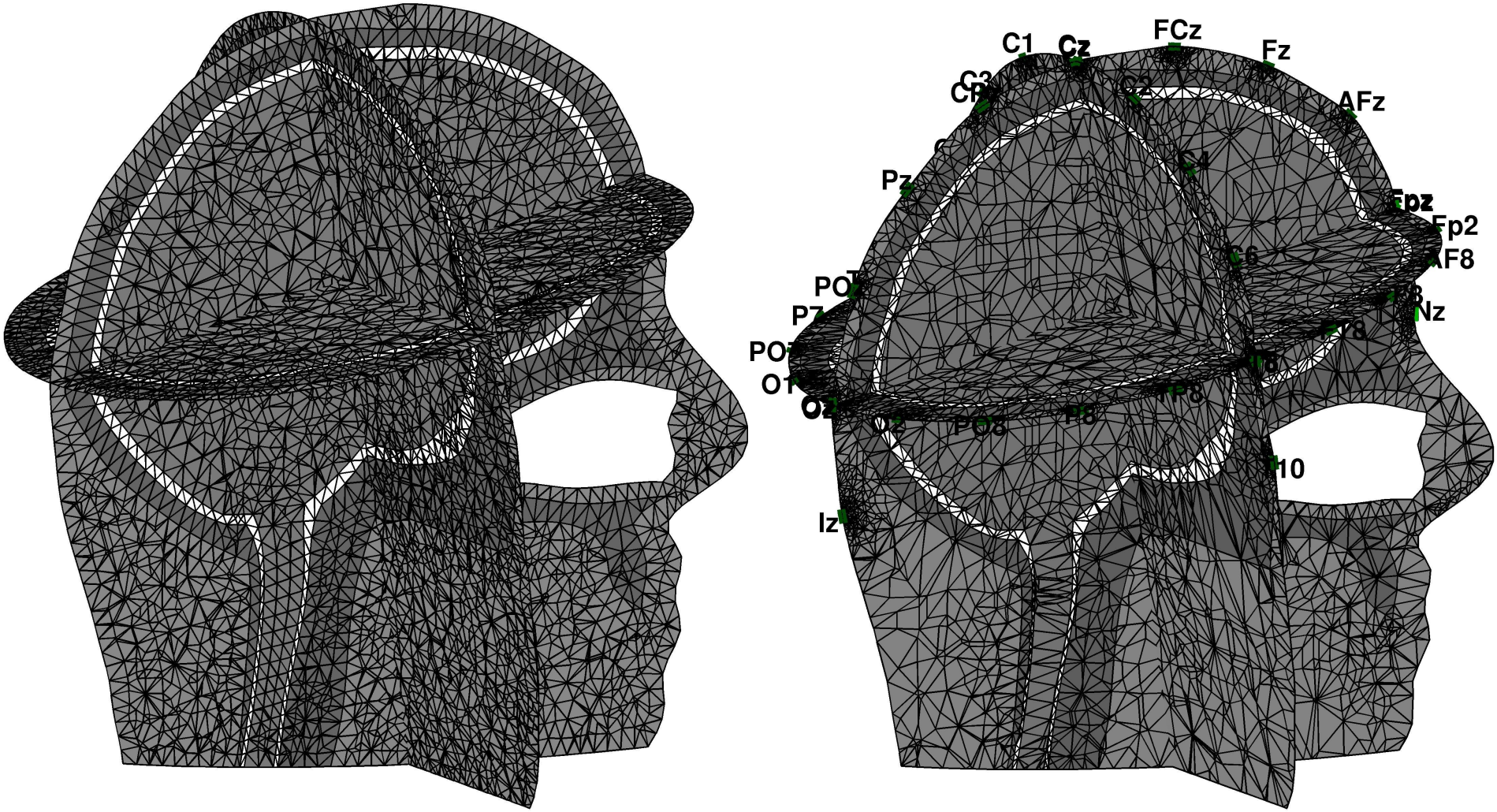
# Building the head mesh



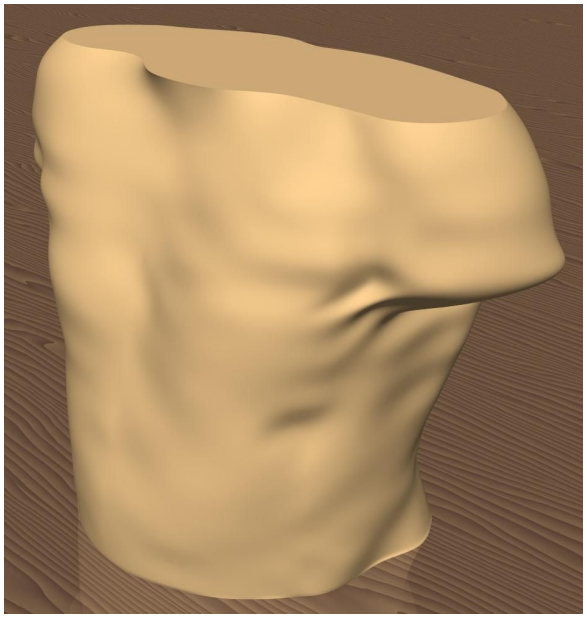


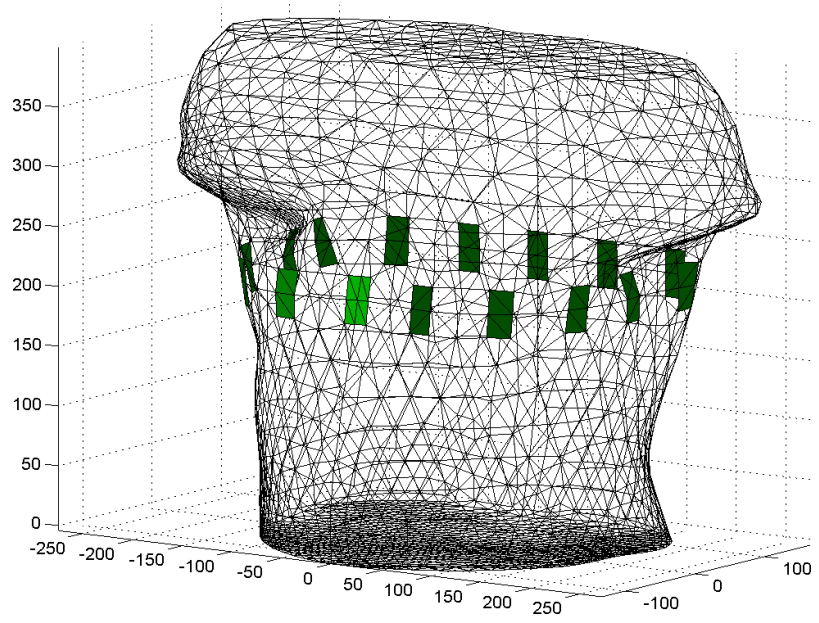


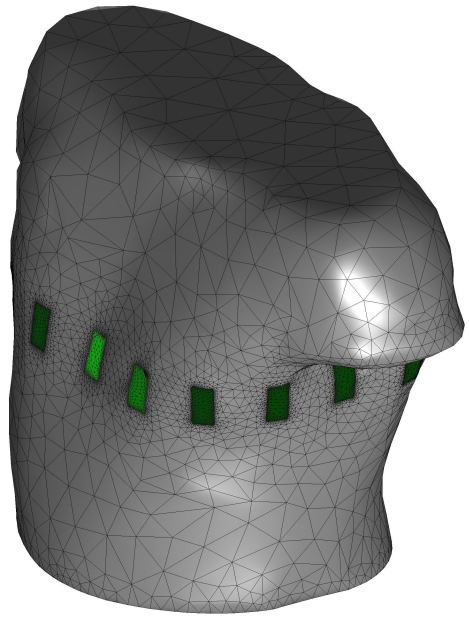
# Before & After



# Before & After



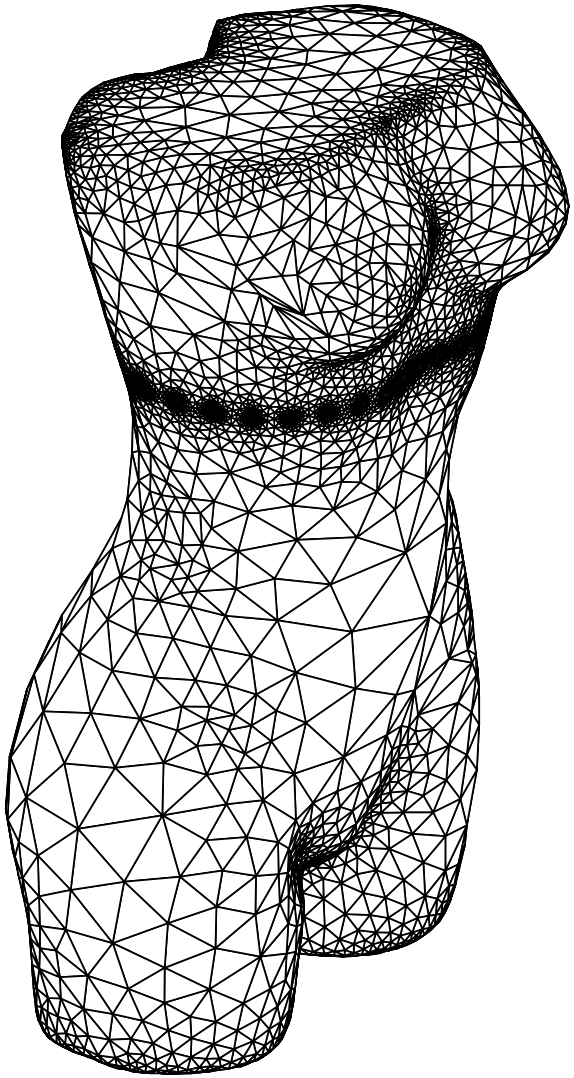


# Conclusions

- Electrode refinement improves accuracy
- Electrode refinement decreases computation cost
- But, how much electrode refinement is required?
- EIDORS provides a free tool for electrode refinement on arbitrary shapes
- It's not ideal, but we have a money-back guarantee.

# Conclusions



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