3D Image Reconstruction with GREIT

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Motivation

Measurement setup already exists

- Swisstom Pioneer Set with 32 electrodes
- Watertank with 4 rings of connectors

GREIT in EIDORS

- Forward model 3D
- Extension of image plane to 3D
- Part of EIDORS 3.8

GREIT

$$\mathbf{R} = \arg\min_{\mathbf{R}} \sum_k \left\| \tilde{\mathbf{x}}^{(k)} - \mathbf{R}\mathbf{y}^{(k)} \right\|_{\mathbf{W}^{(k)}}^2 \tag{1}$$

- $\mathbf{R}$: Reconstruction matrix
- k Training pairs $\{\tilde{\mathbf{x}}^{(i)}, \mathbf{y}^{(i)}\}$
- $\tilde{\mathbf{x}}^{(i)}$: Desired image of training disturbance i
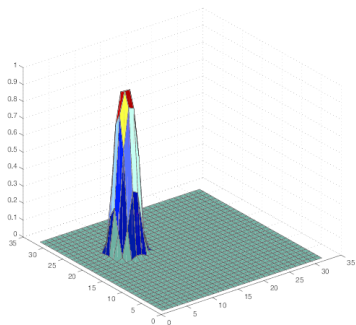- $\mathbf{y}^{(i)}$: Voltages of training disturbance i

GREIT: Voltages of training disturbances

Solve forward problem:

- 3D FEM model
- Placement of electrodes

Code available in EIDORS v3.8.

GREIT: Desired image

Main enhancements needed in EIDORS.

- Extend image plane from 2D to 3D
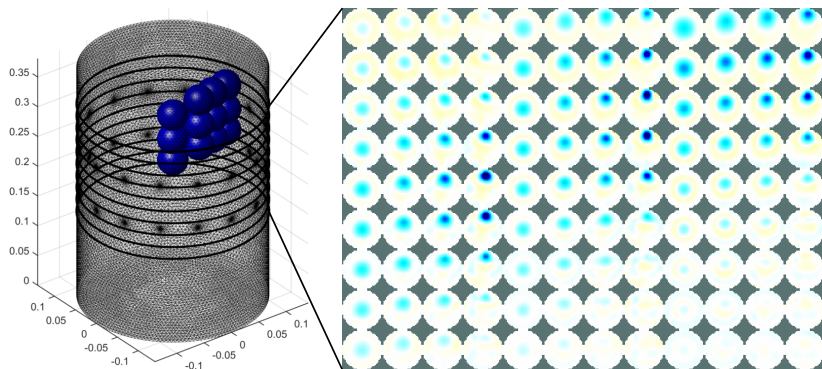- Redefine desired image

GREIT: Training disturbances

Some small extensions in EIDORS.

- Distribution over whole object
- What happens to off-plane objects?

Image plane may not cover whole FE model.

Reconstruction using real data

Left: FE model of a water tank with cut planes between voxel layers and positions of non-conductive target.
Right: images reconstructed using the proposed algorithm.
Each row corresponds to one voxel layer, and each column to a different target position.

And now?

Electrode placement:

- How many rings of electrodes?
- How to place the electrodes?

1	3	5	7
2	4	6	8

odd / even

1	3	5	7
2	4	6	8

zig-zag

1	4	5	8
2	3	6	7

square

- Which skip-pattern to use?

1 — 3 — 5 — 7
2 — 4 — 6 — 8

odd / even

1 3 5 7
2 4 6 8
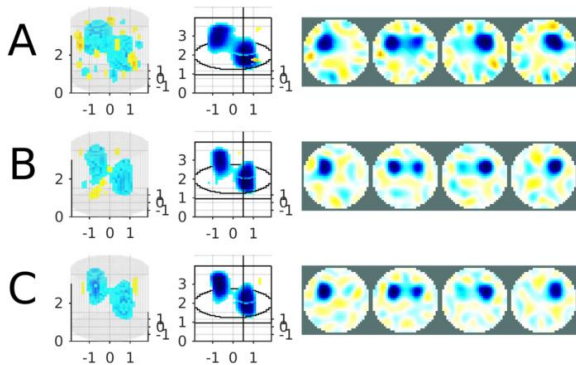
odd / even

1 — 4 5 — 8
2 3 — 6 7

square

And now?

Electrode placement: Simulation

And now?

Visualization:

- How to display the reconstructed images?

Figures of merit:

- Do they still work?
- How to visualize them?

Off-plane objects:

- How must off-plane objects taken into account?

Any questions?