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
\[ R = \arg \min_R \sum_k \| \tilde{x}^{(k)} - R y^{(k)} \|_{w^{(k)}}^2 \]  

- **R**: Reconstruction matrix
- **k**: Training pairs \{\tilde{x}^{(i)}, y^{(i)}\}
- \(\tilde{x}^{(i)}\): Desired image of training disturbance \(i\)
- \(y^{(i)}\): 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 1 3 5 7 1 4 5 8 1 4 5 8
2 4 6 8 2 4 6 8 2 3 6 7 2 3 6 7
odd / even zig-zag square

- Which skip-pattern to use?

1 3 5 7 1 3 5 7 1 4 5 8 1 4 5 8
2 4 6 8 2 4 6 8 2 3 6 7 2 3 6 7
odd / even odd / even square
And now?

Electrode placement: Simulation

A

B

C
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?