



EIDORS

Simple FEMs aren't as good as
we thought:
experiences developing
EIDORS v3.3

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EIDORS

What is EIDORS?

Open Source Collaborative
software for algorithms

Electrical
Impedance and
Diffuse
Optical
Tomography
Reconstruction
Software

Goal: Software
community



Images credit: www.biosbcc.net
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Announcing EIDORS v3.3

	Version	Lines of Code
1999	1.0 (2D)	1314
2002	2.0 (3D)	3715
2005	3.0	10685
2006	3.1	14850
2007	3.2	18127
2008	3.3	23437





Web Site: eidors.org

EIDORS - Mozilla Firefox

http://ei

EIDORS: Electrical Impedance Tomography and Diffuse Optical Tomography Reconstruction Software

EIDORS (mirror)
[Main](#)
[Documentation](#)
[Examples](#)
[Tutorial](#)
[Download](#)
[Contrib Data](#)
[GREIT](#)
[Browse CVS](#)

EIDORS: Download

Released Versions

- ◆ **Download latest released version**
[eidors-v3.3rc1.zip](#)
- ◆ **Download All Versions**
[EIDORS download](#)

Developer (latest) Version

- ◆ **Browse Developer Versions**
[Browse CVS](#)
- ◆ **Read only access to Developer Version**
 Read-only, worldwide access is available via CVS using Anonymous C

```
cvs -d:pserver:anonymous@eidors3d.cvs.sf.net:/cvsroot/eidors
```
- ◆ **Access Developer Version**
 Read-write, access is available via CVS for registered developers. To

Hosted by
SOURCEFORGE.NET®

Walrus

Tutorials

Data Repository

Release Version

Developer Version



Features

- Interfaces to FEM generation tools:
- New algorithms (and faster old ones):
 - Electrode movement solver
 - Kalman filter and Temporal solvers
 - Dual model solvers
 - Total Variation PDIPM
 - Iterative CGLS
 - Better caching and memory use
- Data repository
- Improved graphics and extensive tutorials



Data Repository

EIDORS - Mozilla Firefox

File Edit View History Bookmarks Tools Help <http://eidors3d.sourceforge.net>

Contributed EIT Data:

Authors: Inéz Frerichs, Peter A. Dargaville, Taras Dudykevych, Peter C. Rimensberger

Date: 2003

Brief Description: The measurements were performed in the same pig after induction of acute lung injury, surfactant (p1130122.get). Both measurements were acquired at a rate of 13 scans/s. Data were published in Frerichs, I., Dargaville, P.A., Dudykevych, T., Rimensberger, P. [lung aeration and tidal volume distribution?](#) *Intensive Care Med.* 29:2312-2316, 2003.

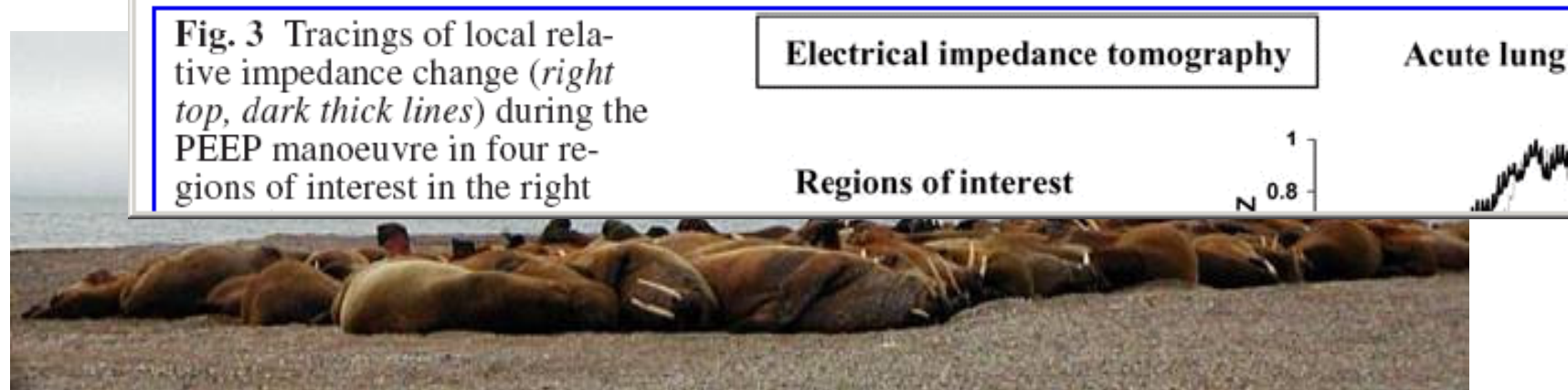
License: Creative Commons Artistic License (with Attribution)

Attribution Requirement: Use or presentation of these data must acknowledge Inéz Frerichs, and reference this Frerichs, I., Dargaville, P.A., Dudykevych, T., Rimensberger, P.M. (2003) [Electrical impedance tomography and tidal volume distribution?](#) *Intensive Care Med.* 29:2312-2316, 2003.

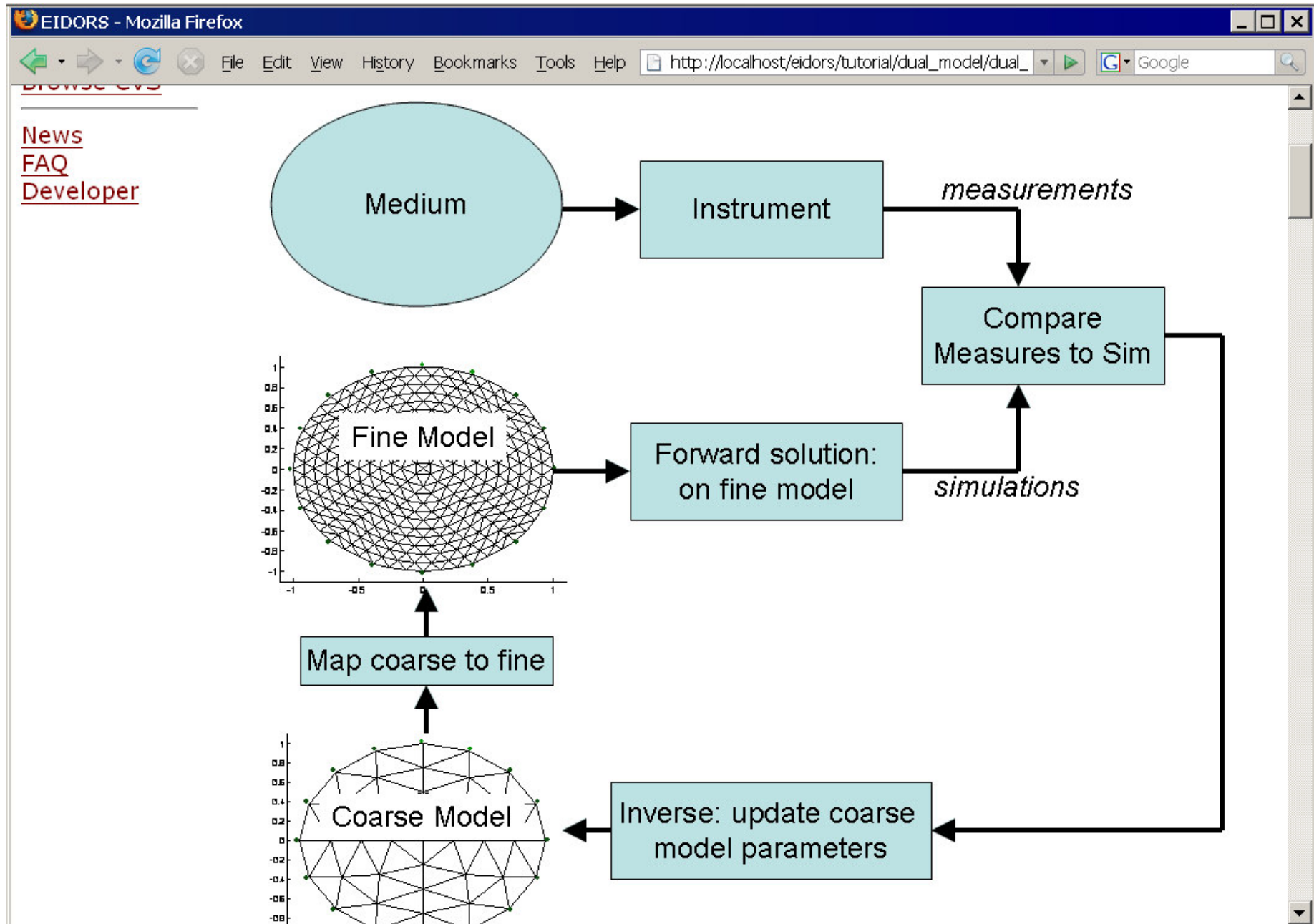
Format: Data are in *.get files encoded in a zip file

Methods: Pig torso. Single plane of 16 Electrodes numbered clockwise, with electrode #1 at the

Data: [Data \(zip format\)](#)



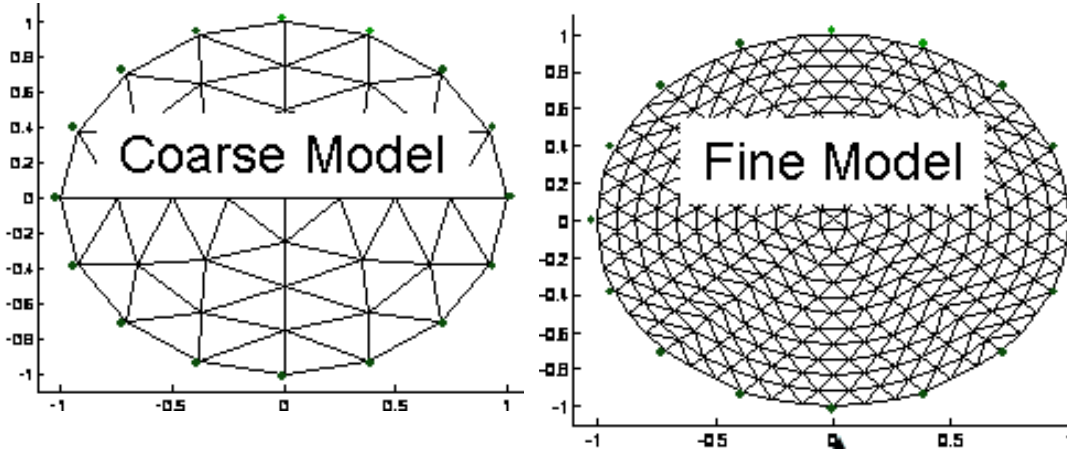
Dual Models Tutorial



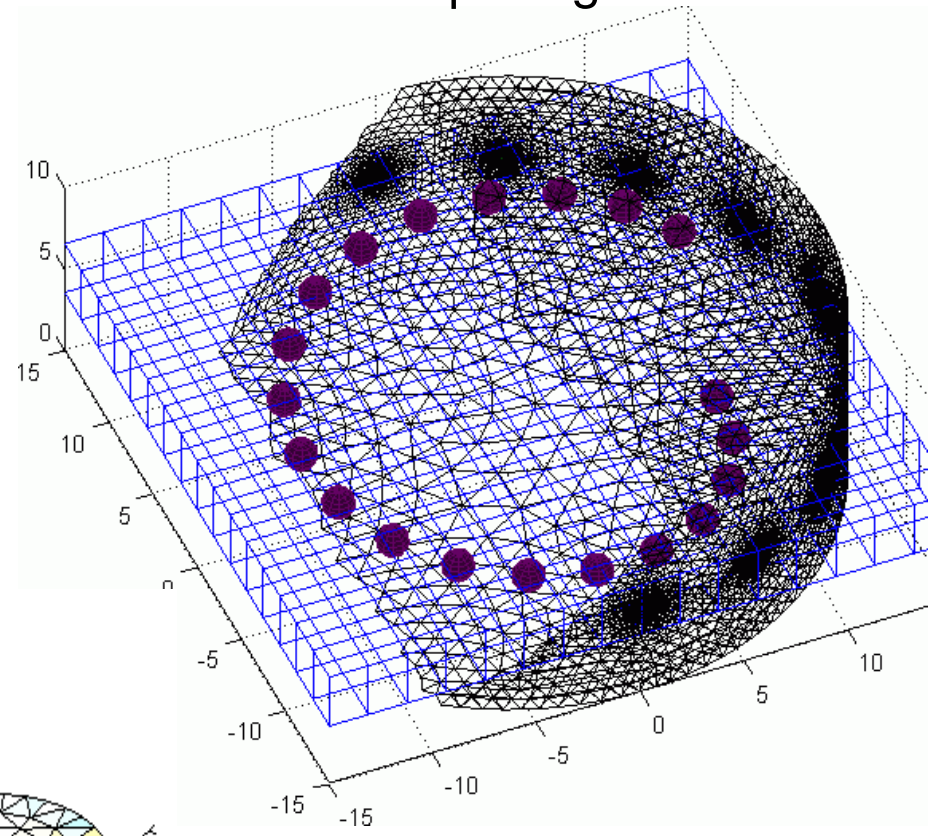


Dual Model Examples

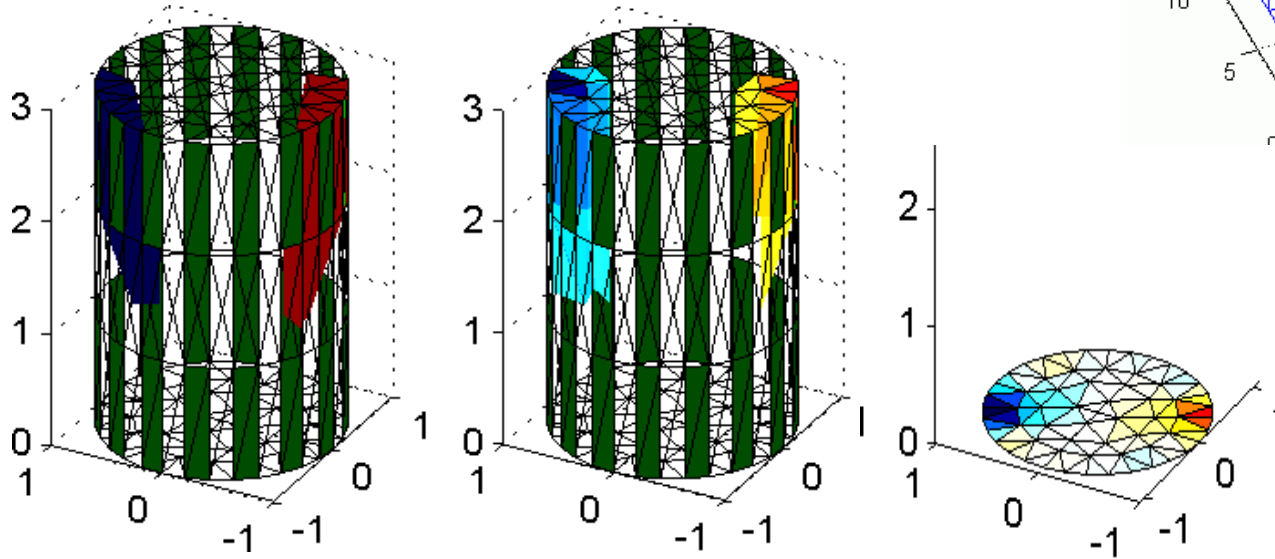
Corresponding Meshes



Reconstruction onto a pixel grid



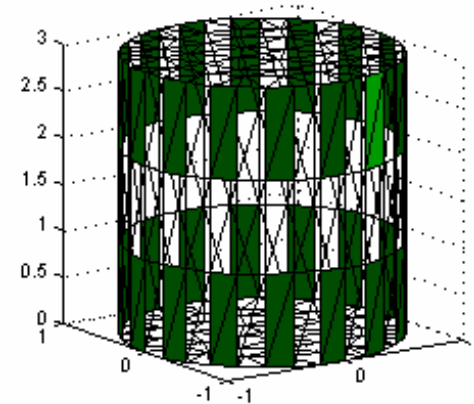
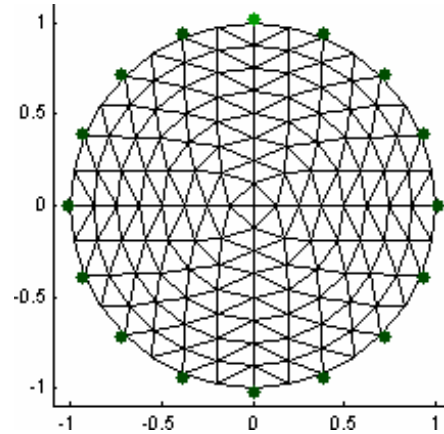
2½ D reconstruction





FEM problems

- EIT generally uses simple first-order tetrahedral models



- We're pretty relaxed about it

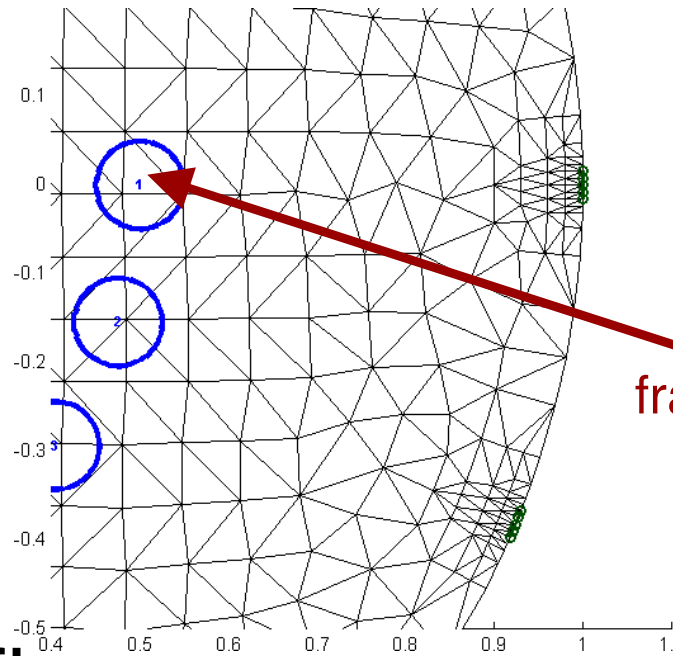
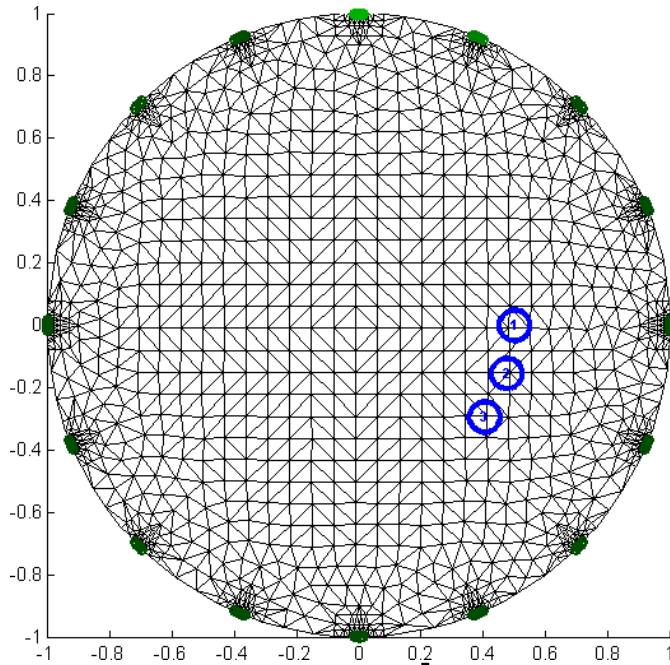




EIDORS

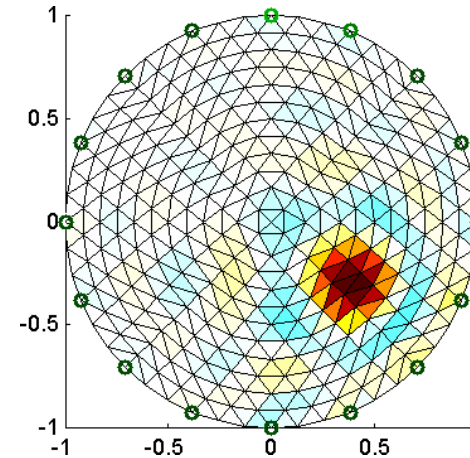
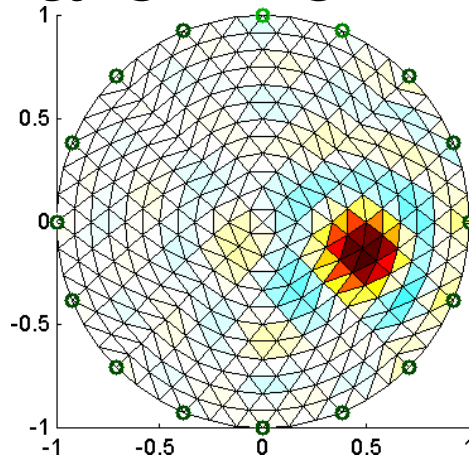
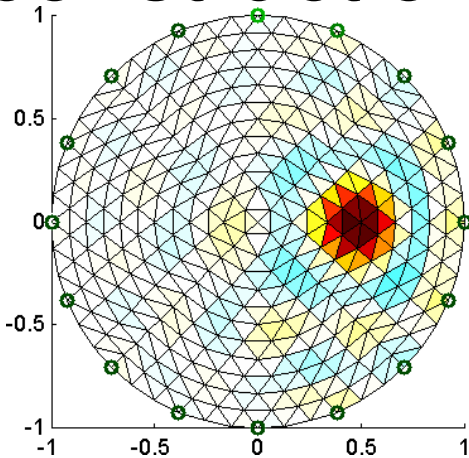
Why so relaxed??

Difference imaging – simulate a moving ball



Each element
is filled with
fraction of target

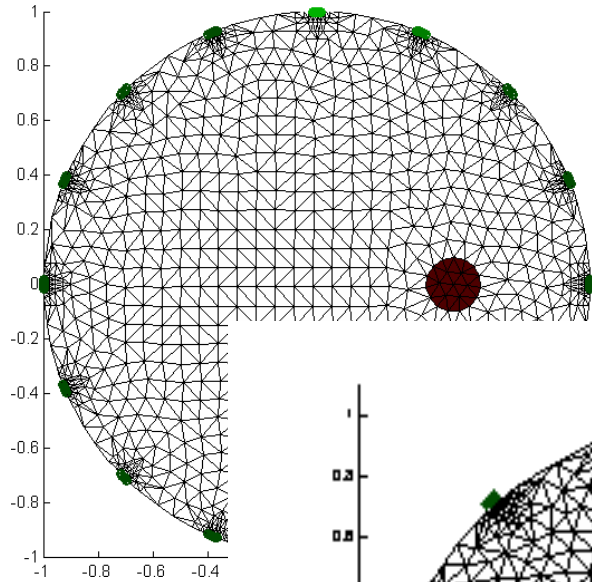
Reconstructions are fine



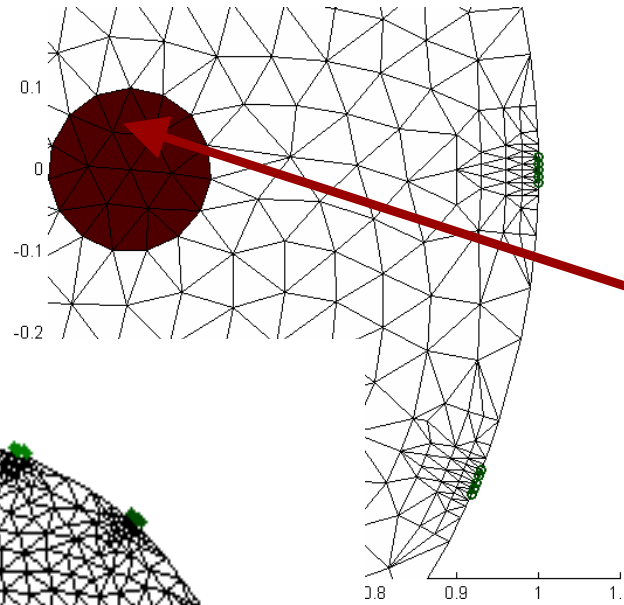


What's the problem?

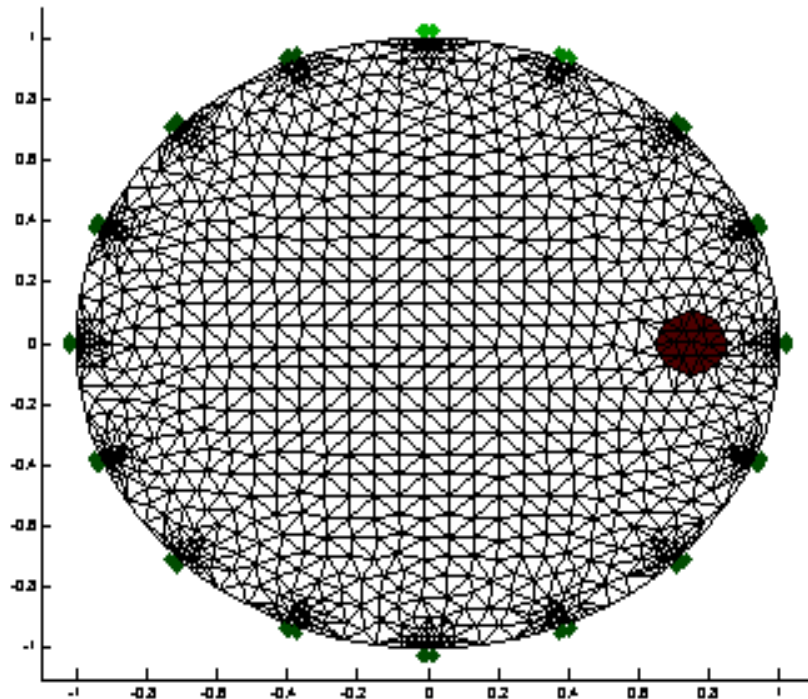
Correct simulation: remesh at each target



Animation



Geometry changes with targets



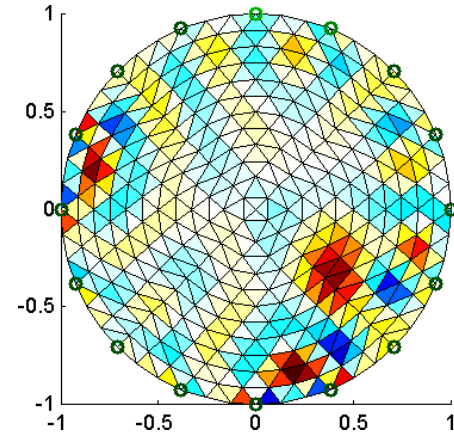
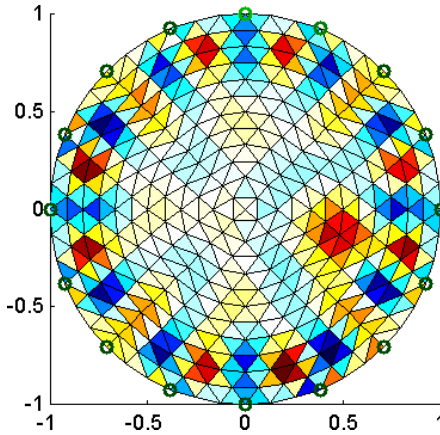
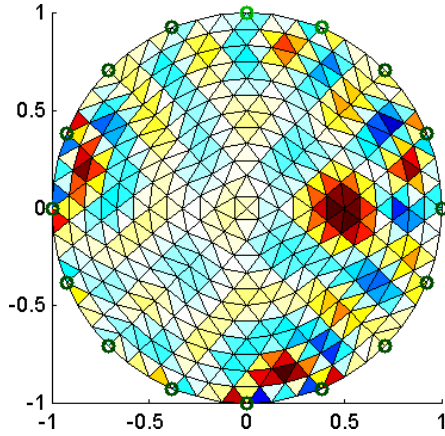
Difference imaging with changing FEM shows the model accuracy effects



What's the problem?

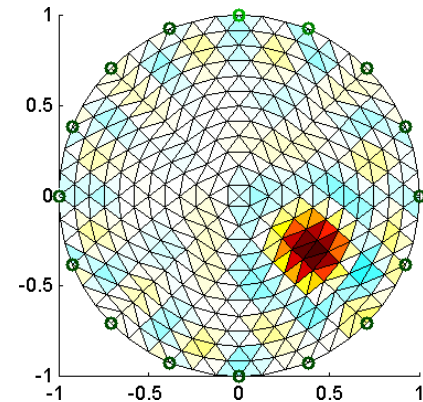
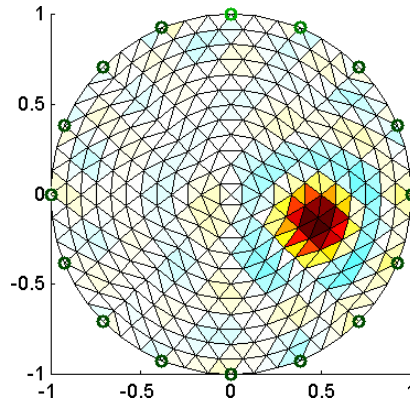
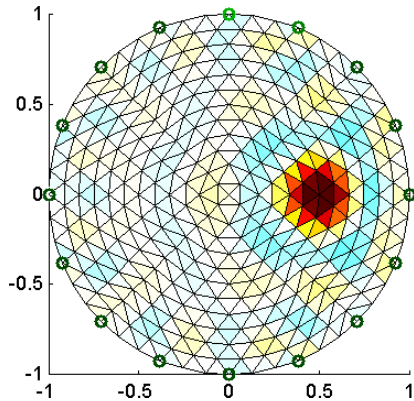
Images are awful

2000 elements



Unless you use fine FEMS

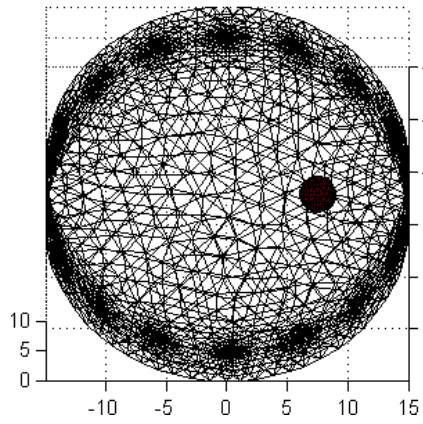
10000 elements



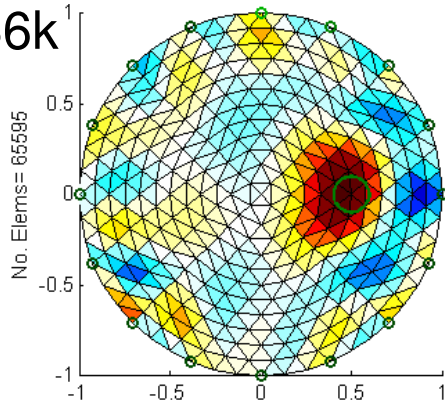


EIDORS

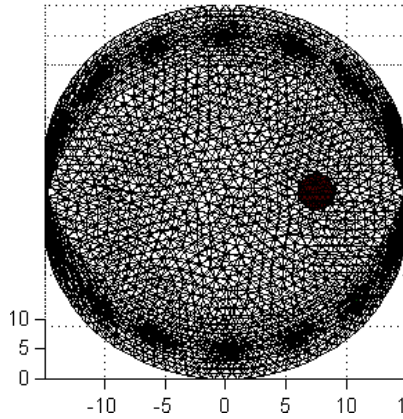
It's worse in 3D



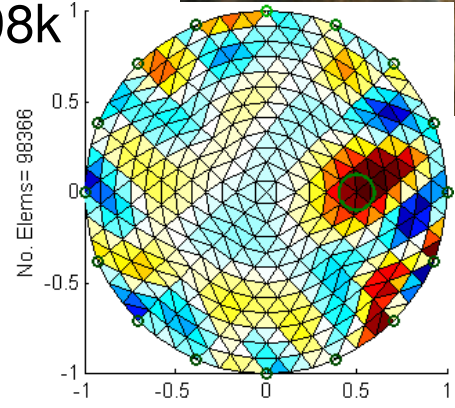
66k



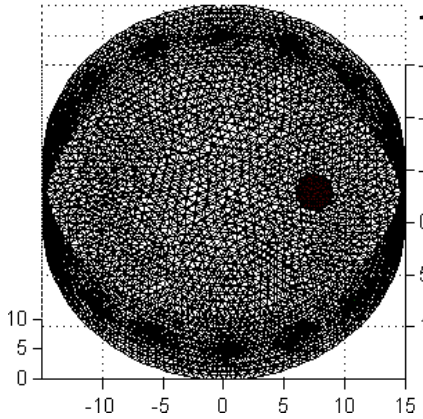
No. Elems= 66596



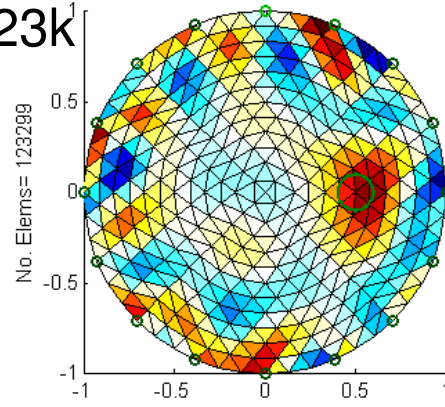
98k



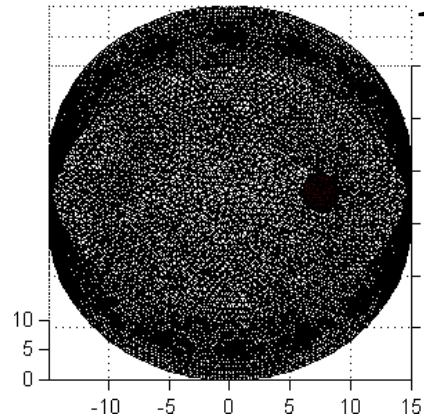
No. Elems= 98366



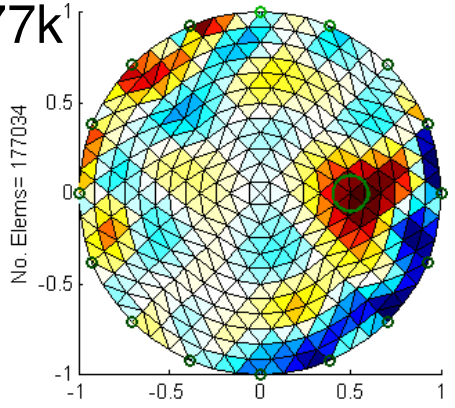
123k



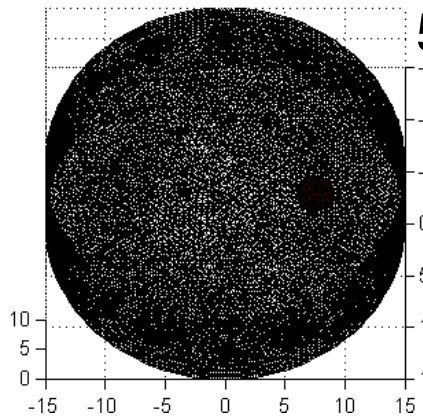
No. Elems= 123299



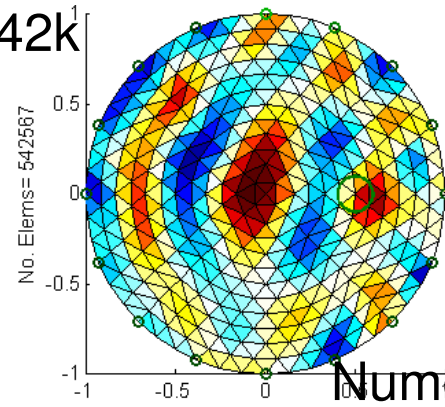
177k



No. Elems= 177034



542k



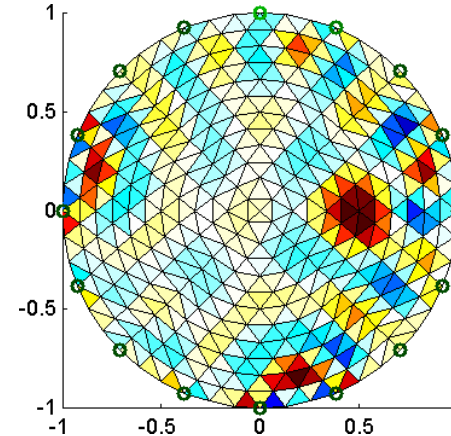
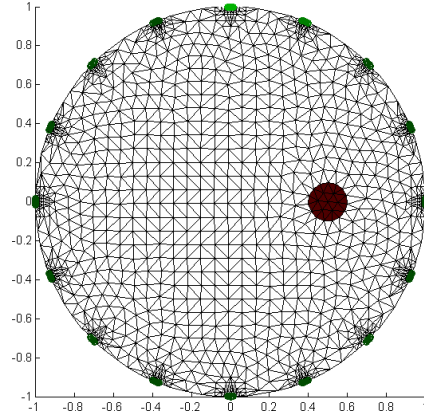
No. Elems= 542567

Numerical instability??

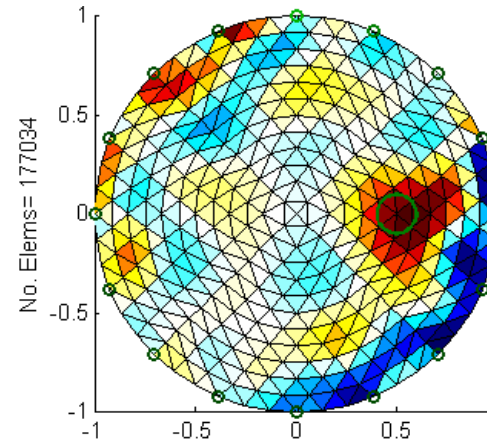
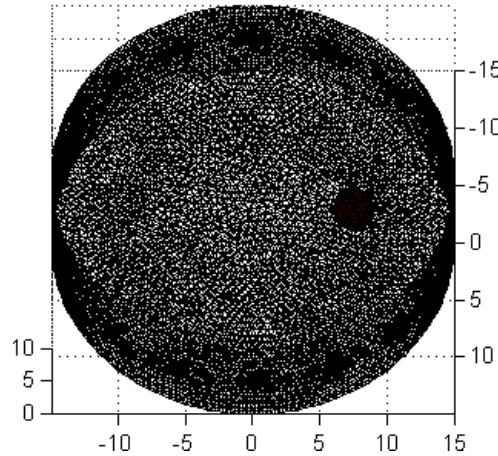


EIDORS

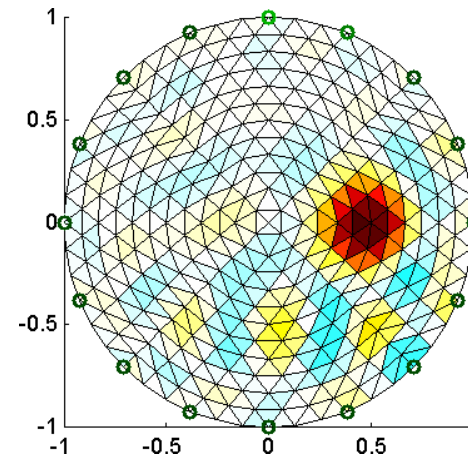
Problem:
saline
tanks
have
less
noise



2D
2k elems



3D
178k elems



Tank
IRC Korea
EIT system



Discussion

EIDORS v3.3

- Use dual models (esp. for static imaging)
- Please contribute data

FEM Meshes

- Simple FEMs are trickier than we thought
- Recommend: 10k elems for 2D
1M elems for 3D

