

EIDORS Version 3.8

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Abstract: This paper announces the release of version 3.8 of the EIDORS software suite. We review its new features, and discusses recent successes and challenges.

1 Introduction

We are pleased to announce the release of EIDORS 3.8 (fig. 1)[1]. The software is available at www.eidors.org licensed under the GNU GPLv2 (or GPLv3).

EIDORS aims to provide free software algorithms for forward modelling and inverse solutions of Electrical Impedance and (to some extent) Diffusion-based Optical Tomography, in medical, industrial and geophysical settings and to share data and promote collaboration.

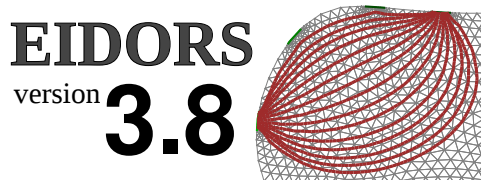


Figure 1: EIDORS 3.8: featuring flexible parametrization, meshing, absolute solver and visualization improvements. Image shows current streamlines on a thorax-shaped finite element model.

2 New Features

Release 3.8 of EIDORS builds upon a strong foundation in reconstruction algorithms, adding and improving a number of aspects.

1. More stable iterative absolute inverse solvers (both Gauss-Newton and Conjugate-Gradient).
2. Greater flexibility in parametrization choices.
3. Native handling of unit scaling (10^x , e^x , $\ln x$, $\log_{10} x$), and arbitrary units. Natural limits for $\sigma > 0$.
4. GREIT reconstructions in 3D
5. Speed optimizations: improved Jacobian calculation, faster cache handling, and faster forward solutions.
6. Improved interfaces to NetGen and visualization. Compound and point electrodes in NetGen.
7. Analytic calculation of dual-mesh interpolations (coarse to fine)
8. Support for second and third order mesh elements.
9. Support for Dräger and Swisstom file formats
10. Expanded shape library

3 Growth

EIDORS-related citations continue to grow. Current citation results are shown in table 1. The EIDORS code-base is stable with significant effort being applied to improving test coverage, refining performance and implementing new features (fig. 2). In 2012, a dev staging area was created for contributions in progress.

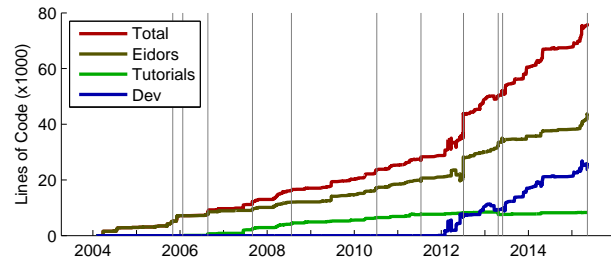


Figure 2: Lines of Code (LoC) in Matlab files in the EIDORS code-base vs. time; Total (red), Eidors (i.e. release branch, yellow), Tutorials (green), development code (blue). Releases are indicated by gray bars.

Table 1: EIDORS Citations (May 2015, scholar.google.com).

Paper	Date	Citations
[2] A MATLAB package for the EIDORS project ...	2001	159
[3] Image reconstruction algorithms for ...	2002	88
[4] A Matlab toolkit for three-dimensional ...	2002	293
[5] Uses and abuses of EIDORS: An extensible ...	2006	184

4 Successes

The structure of EIDORS has been relatively stable due, in part, to some early design choices: a modular framework and data structure, cross-platform support, integration of meshing, tutorials, and the contributed data repository. These aspects, along with an open source code-base, have enabled EIDORS to maintain research relevance.

5 Challenges

A number of challenges inherent in the implementation of EIDORS as a Matlab-based toolkit continue to recur. There is no real Object Oriented framework: no reflection, protection, or automatic management of errors. Versions of Matlab frequently vary in confounding ways that make maintaining a toolkit across multiple Matlab versions difficult. This is particularly prevalent for Windows users and “mex” file compilation. The data structure and subfunction complexity in EIDORS are a source of confusion for beginners. Despite these challenges, EIDORS continues to develop and grow: presenting version 3.8!

Acknowledgements

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References

- [1] Adler A, Boyle A, Crabb MG et al, *EIDORS v3.8*, Zenodo, DOI:10.5281/zenodo.17559, 2015.
- [2] Vauhkonen M, Lionheart WRB, Heikkinen L et al, *Physiol Meas*, 22:107–111, 2001.
- [3] Polydorides N, *Image Reconstruction Algorithms for Soft-Field Tomography*, Ph.D. thesis, University of Manchester, UK, 2002.
- [4] Polydorides N, Lionheart WRB, *Meas Sci and Tech*, 13:1871–1883, 2002.
- [5] Adler A, Lionheart WRB, *Physiol Meas*, 27:S25–S42, 2006.