

# EIDORS Version 3.12

Andy Adler<sup>1</sup> and Bartłomiej Grychtol<sup>1</sup>

<sup>1</sup>Systems and Computer Engineering, Carleton University, Ottawa, Canada, [adler@asce.carleton.ca](mailto:adler@asce.carleton.ca)

**Abstract:** This paper announces the release of version 3.12 of the EIDORS software suite. We review its new features, and discusses its growth and use.

## 1 Introduction

We proudly announce the release of EIDORS version 3.12, for the 24th Int. Conf. on Biomedical Applications of EIT, in July 2024. The software is available at [eidors.org](http://eidors.org) and licensed under the GNU GPLv2 or GPLv3. Archived versions are now available on Zenodo [1–5], and all versions available on [sourceforge.net](https://sourceforge.net) [11–15]

EIDORS provides 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. EIDORS also aims to share data and promote collaboration.

## 2 New Features

Release 3.12 of EIDORS builds upon a strong foundation in reconstruction algorithms, adding and improving a number of aspects.

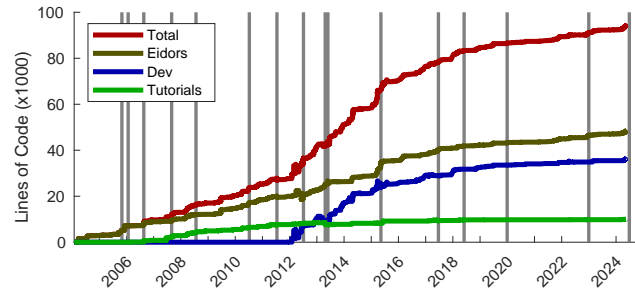
- D-bar solver with Dirichlet-Neumann estimation
- New data formats (Sciospec and HDF5)[7]
- Improved solver preconditioning
- Improved Octave support
- New faster hash (xxHash) for object caching
- Improved Control of netgen refinement
- 3D perfusion and  $\dot{V}/Q$  analysis tools[6]
- Improved FFT-based filtering functions
- Expanded data contributions (e.g. fig.2)
- Improved Instrument models
- Expanded shape library with new species shapes
- (As always) speed-ups and bug fixes

## 3 Growth

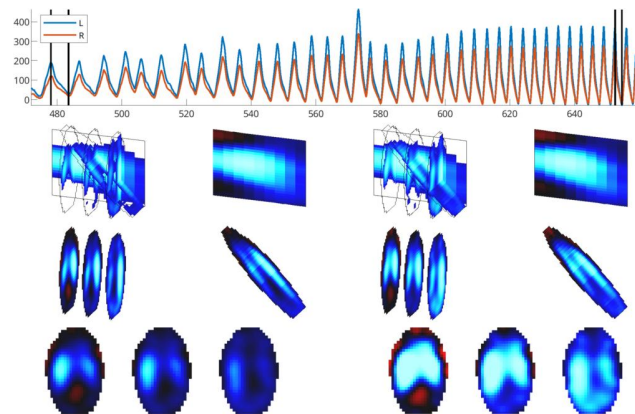
EIDORS-related citations continue to grow. Current citation results are shown in table 1. The EIDORS code-base is growing (fig. 1) with significant effort being applied to improving test coverage, refining performance and implementing new features. In 2012, a `dev` (development) staging area was created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

**Table 1:** EIDORS Citations (May 2024, scholar.google.com).

Paper	Date	Citations
[8] A MATLAB package for the EIDORS project ...	2001	336
[9] Image reconstruction algorithms for ...	2002	194
[10] A Matlab toolkit for three-dimensional ...	2002	564
[11] EIDORS: Towards a community-based ...	2005	38
[12] Uses and abuses of EIDORS: An extensible ...	2006	956
[13] Simple FEMs aren't as good as we thought ...	2008	26
[15] EIDORS version 3.9	2017	34
[15] EIDORS version 3.10	2019	5



**Figure 1:** Lines of Code (LoC) in Matlab files in the EIDORS code-base vs. time; Total (red), EIDORS (i.e. release branch, brown), Tutorials (green), development code (blue). Releases are indicated by gray bars (The 3.12 release is at the right).



**Figure 2:** Reconstruction of 3D EIT data from a horse during baseline (left) and rebreathing (right). Data are reconstructed into a parasagittal slice, modified frontal slice, and three transverse slices. Middle: normalized to the maximum in each image. Bottom: normalized to the same limit. Source: [eidors.org/data\\_contrib/db-horse3d-2024](http://eidors.org/data_contrib/db-horse3d-2024)

## 4 Discussion

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. Version 3.12 (hopefully) continues the tradition.

## References

- [1] Adler A, “EIDORS v3.11”, DOI:10.5281/zenodo.7495740, 2022.
- [2] Adler A, “EIDORS v3.10”, DOI:10.5281/zenodo.3247168, 2019.
- [3] Adler A *et al.*, “EIDORS v3.9.1”, DOI:10.5281/zenodo.1257670, 2018.
- [4] Adler A *et al.*, “EIDORS v3.9”, DOI:10.5281/zenodo.583266, 2017.
- [5] Adler A *et al.*, “EIDORS v3.8”, DOI:10.5281/zenodo.17559, 2015.
- [6] Araos J, *et al.*, “ $\dot{V}/Q$  analysis with 3D EIT”, p25, Conf EIT 2023.
- [7] Possner L, *et al.*, “HDF5-based data format ...”, p39, Conf EIT 2023.
- [8] Vauhkonen & M, *et al.*, *Physiol Meas*, 22:107–111, 2001.
- [9] Polydorides N, *Ph.D. thesis*, U Manchester, UK, 2002.
- [10] Polydorides N, Lionheart WRB, *Meas Sci Tech*, 13:1871–1883, 2002.
- [11] Adler A, Lionheart WRB, *Proc EIT2005*, London, UK, 2005.
- [12] Adler A, Lionheart WRB, *Physiol Meas* 27:S25–S42, 2006.
- [13] Adler A, Borsic A *et al.*, *Proc EIT2008*, Hannover, NH, USA, 2008.
- [14] Adler A *et al.*, *Proc EIT2015*, p.19, Neuchâtel, Switzerland, 2015.
- [15] Adler A *et al.*, *Proc EIT2017*, p.63, Dartmouth, NH, USA, 2017.