
cellsino Documentation

Release 0.5.0.post4

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Cellsino is a Python library for generating sinograms (phase and fluorescence) of cell phantoms for testing tomographic reconstruction algorithms. This is the documentation of cellsino version 0.5.0.post4.

**CHAPTER
ONE**

INTRODUCTION

1.1 What is cellsino?

Cellsino is a tool for generating in-silico fluorescence and refractive index sinograms of predefined cell phantoms. The computation of the sinogram data is done with semi-analytical approaches (e.g. Rytov approximation for spheres [MSG+18]) and is thus comparatively fast and accurate.

**CHAPTER
TWO**

GETTING STARTED

2.1 Installation

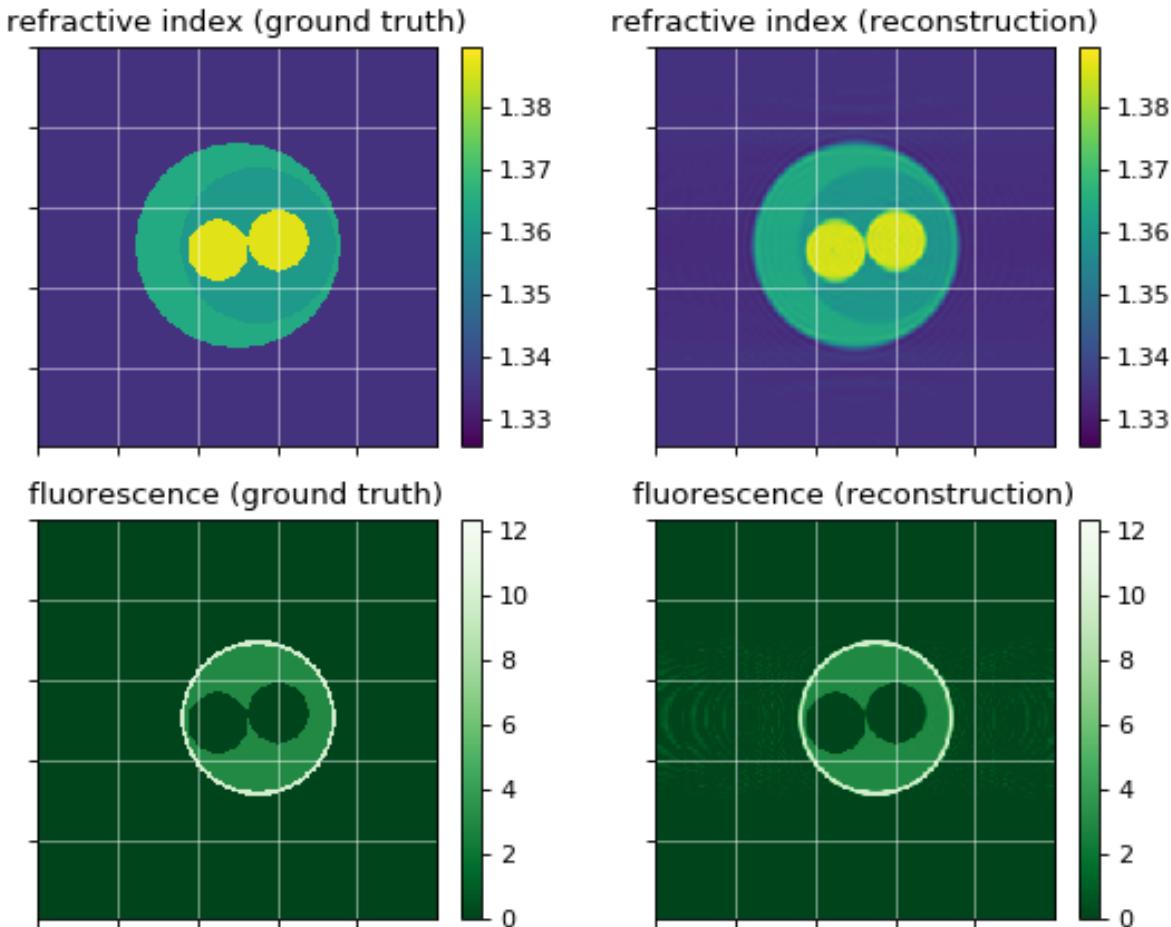
cellsino is written in pure Python and supports Python version 3.6 and later. To install, run

```
pip install cellsino
```


CODE EXAMPLES

3.1 Reconstruction of a simple cell phantom

This example uses `ODTbrain` and `radontea` for the reconstruction of the refractive index and the fluorescence sinogram of the simple cell phantom. The reconstruction is compared to the ground truth of the cell phantom.



`simple_cell.py`

```
1 import cellsino
2 import matplotlib.pyplot as plt
3 import numpy as np
4 import odtbrain as odt
5 import radonlea as rt
6
7
8 # number of sinogram angles
9 num_ang = 160
10 # sinogram acquisition angles
11 angles = np.linspace(0, 2*np.pi, num_ang, endpoint=False)
12 # detector grid size
13 grid_size = (250, 250)
14 # vacuum wavelength [m]
15 wavelength = 550e-9
16 # pixel size [m]
17 pixel_size = 0.08e-6
18 # refractive index of the surrounding medium
19 medium_index = 1.335
20
21 # initialize cell phantom
22 phantom = cellsino.phantoms.SimpleCell()
23
24 # initialize sinogram with geometric parameters
25 sino = cellsino.Sinogram(phantom=phantom,
26                           wavelength=wavelength,
27                           pixel_size=pixel_size,
28                           grid_size=grid_size)
29
30 # compute sinogram (field according to Rytov approximation and fluorescence)
31 sino_field, sino_fluor = sino.compute(angles=angles, propagator="rytov")
32
33 # reconstruction of refractive index
34 sino_rytov = odt.sinogram_as_rytov(sino_field)
35 potential = odt.backpropagate_3d(uSin=sino_rytov,
36                                   angles=angles,
37                                   res=wavelength/pixel_size,
38                                   nm=medium_index)
39 ri = odt.odt_to_ri(f=potential,
40                     res=wavelength/pixel_size,
41                     nm=medium_index)
42
43 # reconstruction of fluorescence
44 fl = rt.backproject_3d(sinogram=sino_fluor,
45                        angles=angles)
46
47 # reference for comparison
48 rimod, flmod = phantom.draw(grid_size=ri.shape,
49                               pixel_size=pixel_size)
50
51 # plotting
52 idx = 150
```

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```

54 plt.figure(figsize=(7, 5.5))
55
56 plotkwri = {"vmax": ri.real.max(),
57             "vmin": ri.real.min(),
58             "interpolation": "none",
59             "cmap": "viridis",
60             }
61
62 plotkwfl = {"vmax": fl.max(),
63             "vmin": 0,
64             "interpolation": "none",
65             "cmap": "Greens_r",
66             }
67
68 ax1 = plt.subplot(221, title="refractive index (ground truth)")
69 mapper = ax1.imshow(rimod[idx].real, **plotkwri)
70 plt.colorbar(mappable=mapper, ax=ax1)
71
72 ax2 = plt.subplot(222, title="refractive index (reconstruction)")
73 mapper = ax2.imshow(ri[idx].real, **plotkwri)
74 plt.colorbar(mappable=mapper, ax=ax2)
75
76 ax3 = plt.subplot(223, title="fluorescence (ground truth)")
77 mapper = ax3.imshow(flmod[idx], **plotkwfl)
78 plt.colorbar(mappable=mapper, ax=ax3)
79
80 ax4 = plt.subplot(224, title="fluorescence (reconstruction)")
81 mapper = ax4.imshow(fl[idx], **plotkwfl)
82 plt.colorbar(mappable=mapper, ax=ax4)
83
84 for ax in [ax1, ax2, ax3, ax4]:
85     ax.grid(color="w", alpha=.5)
86     ax.set_xticks(np.arange(0, grid_size[0], 50))
87     ax.set_yticks(np.arange(0, grid_size[0], 50))
88     ax.set_xticklabels([])
89     ax.set_yticklabels([])
90
91 plt.tight_layout()
92
93 plt.show()

```

**CHAPTER
FOUR**

CODE REFERENCE

TODO

CHANGELOG

List of changes in-between cellsino releases.

5.1 version 0.5.0

- BREAKING CHANGE: switch from longdouble to double precision in propagator
- build: migrate from travisCI to GH Actions
- build: setup.py test is deprecated
- docs: refurbish docs

5.2 version 0.4.0

- BREAKING CHANGE: revert previous breaking change, because this way the reconstruction with ODT-brain/radontea remains straight-forward
- enh: support str in *mode* when computing sinograms

5.3 version 0.3.0

- feat: new options for sinogram generation
 - measurement duration (or specific times per angle)
 - specify simulated imaging modalities
 - simulate photobleaching and background fluorescence
- BREAKING CHANGE: changed definition of angles in sinogram generation

5.4 version 0.2.1

- ref: migrate to flimage

5.5 version 0.2.0

- feat: add option to roll rotational axis (in-plane) during sinogram generation
- feat: add capability to track progress of sinogram generation
- feat: add possibility to add (random) displacements for each sinogram slice
- fix: medium index not stored in exported sinogram file

5.6 version 0.1.0

- add basic example to docs
- drawing refractive index and fluorescence phantoms
- sinogram generation
- basic functionalities (sphere element):
 - simple cell phantom
 - propagators: Rytov and projection
 - fluorescence projector

5.7 version 0.0.1

- initial setup

**CHAPTER
SIX**

BILBLIOGRAPHY

CHAPTER
SEVEN

INDICES AND TABLES

- genindex
- modindex
- search

BIBLIOGRAPHY

- [MSG+18] P. Müller, M. Schürmann, S. Girardo, G. Cojoc, and Guck J. Accurate evaluation of size and refractive index for spherical objects in quantitative phase imaging. *Optics Express*, 26(8):10729–10743, 2018.
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