STIR status and future 2024

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Thursday, 31/10/2023

Overview

- Year overview
    - STIR status
    - Other related software efforts
    - Other major events

- Future prospects

STIR 6.0 (7 Feb 2024)

Main feature: TOF

(*Nikos Efthimiou, Elise Emond, Robert Twyman Skelley, Palak Wadhwa, Nicole Jurjew, KT*)

Adaptations of data-classes, ProjMatrixByBin, various extra loops over TOF, …

Main limitations:

- ProjMatrixByBin adaptation for TOF is generic (i.e. does not rely on ray-tracing) but slow and uses lots of memory (no complete use of symmetries yet)

- Parallelproj not available yet for TOF

- Only cylindrical scanners

- No TOF scatter simulation

STIR 6.0 (7 Feb 2024)

https://github.com/UCL/STIR/releases/tag/rel_6.0.0

Other features
(Daniel Deidda, Markus Jehl, KT)

- Reading of radio-nuclide information
- Extra functionality exposed via SWIG
- Require CMake version 3.14
- Required C++-14
- Code clean-up
    - Most old work-arounds were removed
    - White-space enforcement

STIR 6.1 (16 May 2024)

https://github.com/UCL/STIR/releases/tag/rel_6.1.0

(Nicole Jurjew, KT)

- Parallelproj for TOF (CPU and GPU)
- List-mode objective function speed-up using multi-threading (no Parallelproj yet)
- Bug fixes for RDP and list-mode Hessian

STIR 6.2 (23 July 2024)

https://github.com/UCL/STIR/releases/tag/rel_6.2.0

(Nicole Jurjew, Imraj Singh, Markus Jehl, KT)

- Extra numerical methods for ProjData(InMemory)
- Array classes normally use contiguous memory and have some operations multi-threaded
- CUDA RDP
- TOF-bin mashing
- Higher precision for sum() and some value() functions.
- Bug fixes for BlocksOnCylindrical
- Require C++-17

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Synergistic Image Reconstruction Framework (SIRF)

- Layer on top of STIR, but also Gadgetron (MR) and NiftyReg (registration).

- Unified experience for different modalities/problems.

- https://github.com/SyneRBI/SIRF/

SIRF status

- 3.6.0 SIRF and SIRF-SuperBuild (15 Feb 2024)
  - Compatibility STIR 6.0 and hence TOF
  - Complex images for registration
  - Major Docker updates, including automatic building
- 3.7.0 SIRF and SIRF-SuperBuild (29 May 2024)
  - Expose STIR's list-mode reconstruction and Hessian computations
- 3.8.0 SIRF and SIRF-SuperBuild (25 July 2024)
  - Use STIR 6.2's speeded-up Array calculations
  - Expose STIR's CUDA RDP
  - Numpy 2.0 minor fix
  - Parallelproj 1.9.1
  - CIL 24.1.0

Common Imaging Library (CIL)

- Python library with advanced optimisation algorithms and penalties (including many prox-based algorithms)

- Wraps ASTRA/Tigre for CT, SIRF for PET/MR/SPECT

- https://github.com/TomographicImaging/CIL

Recent major update:

- Stochastic optimisation for sum of objective functions ("subsets").

Emission Tomography Standardization Initiative (ETSI):
PET ETSI Raw Data (PETSIRD)

- Standardisation for PET list-mode data and associated "calibration" files (e.g. normalisation, dead-time, etc) via "generated" SDK

- See https://etsinitiative.org/ and IEEE MIC talk M-04-06

- STIR interactions
  - Use STIR listmode readers and PETSIRD-SDK to create converter into PETSIRD
  - Add PETSIRD listmode reader

https://etsinitiative.org/2nd-etsi-hackathon-november-3-4th-2024-tampa-fl-usa/

E T S I — *RAW DATA STANDARD*

Emission Tomography Standardization Initiative (ETSI)
Initiative for the standardization of emission tomography raw data

🔍 **SEARCH**

Home   Features   ⊕   Events   ⊕   Announcements

HOME ▸ **2ND ETSI HACKATHON, NOVEMBER 3-4, 2024, TAMPA, FL, USA**

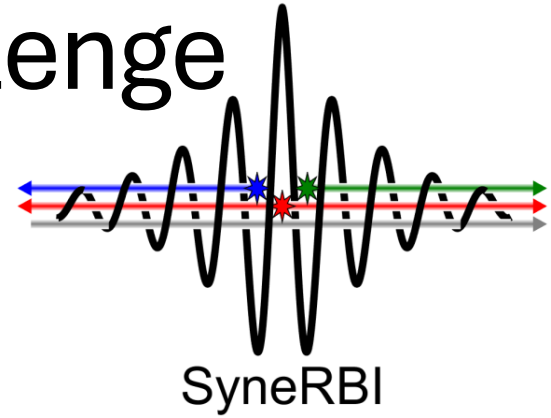# 2nd ETSI Hackathon, November 3-4, 2024, Tampa, FL, USA

Welcome to the official page of the 2nd ETSI Hackathon!

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PET Rapid Image Reconstruction Challenge (PETRIC)

Aims

- *Primary aim:*
  create a ground for comparisons of different reconstruction algorithms in terms of computational effort.

- *Secondary aim:*
  generation of a collection of phantom PET raw data.

Outcomes

- sample OSS implementations of fast MAP reconstruction algorithms

- creation of data-validation and processing scripts
  for automatic processing

PETRIC

Image Reconstruction Problem

- MAP with a smoothed version of the RDP
- Reach MAP solution within e.g. 1% of the target image quality metrics in smallest computation time

More information and data

- https://github.com/SyneRBI/PETRIC/wiki
- **PET Rapid Image Reconstruction Workshop on Saturday**
  WS-05, 14:00-18:00
  Ballroom A

SyneRBI Awards 2023-2024

Nikos Efthimiou
contributions to STIR and SIRF, especially PET Time of Flight, and assistance with our training schools

Evangelos Papoutsellis
CIL on stochastic optimisation algorithms

Nicole Jurjew
for improvements of PET Time of Flight, and assistance with our training schools

Imraj Singh
integration with machine learning tools

STIR

STIR moves into the clinic!

Uses STIR for reconstruction

FDA cleared and CE marked!

Positrigo regularly contributes to STIR, does extensive testing, and funds PhD students

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STIR 6.3 (December 2024?)

https://github.com/UCL/STIR/milestone/12

- Minor fixes and improvements
  - Issue identified in scatter estimation for cylindrical scanners leading to wrong unexpected scale factors (roughly ~ num_segments too small), and possibly sub-optimal scatter estimates.

STIR 7.x (PRs in progress)

- GE RDF8 support
  Huanzhe Wei, KT

- SPECT Channel-edge modelling
  Tommaso Ferri

- Multiple energy window support for PET
  Ludovica Brusaferri, KT
  - Data structures
  - Scatter simulation
  - gradients of projector and scatter estimator w.r.t. emission and attenuation image
  => MLAA using energy information

- Alternative MCIR implementation (using adjoint warping as opposed to inverse)
  Richard Brown, KT

- Multiple bed position support
  Ashley Gillman, KT.

- Siemens Vision listmode data
  Viet Dao

STIR 7.x

- Replace Array CPU memory with CUDA managed pointer (via [CuVec](#))

- Change projector set-up and distributable_computation to remove overhead for GPU

- PETSIRD support
  - output to PETSIRD is in progress

Other things that we want/need

- Finalise calibration to obtain kBq/ml
- Include dead-time modelling for scanners
- TOF scatter (alternative strategy is being investigated)
- Multi-detector layer support
- Extra deployment options
    - Pip
    - Docker/VM (done via SIRF-SuperBuild, but could be made STIR-specific)
- Updating of STIR-Exercises (recent progress made)
- Transfer of web-site and wiki from SourceForge
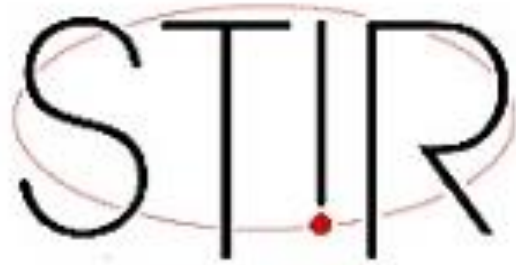
Conclusion

STIR releases

History of public releases of the STIR software

- version 6.2.0 (dated 23 July 2024)

- version 6.1.0 (dated 16 May 2024)

- …

- version 1.0 (dated 20 Dec 2001)

History of public releases of the PARAPET software

- version 0.92 (dated 12 Jan 2001)

- version 0.91 (dated 19 Jul 2000)

- version 0.9 (dated 22 Jun 2000)

Contributing to STIR, SIRF ...

- Ask questions
- Answer questions
- Test new (and old) functionality
- File bug reports
- Add use cases to wiki
- Participate in discussions on code, design etc
- Solve some small "issue"
- Join in a (virtual) hackathon
- Contribute a feature

Why contribute to STIR?

- Join a friendly community

- Advance STIR and therefore science

- Feel good about yourself

- Get credit for your work and advance your CV

- Get citations for your contributions

- Get funding for travel and exchanges

- Get one of the yearly SyneRBI awards (£400, £200, £100)

Main publication:

Thielemans, Tsoumpas, *et al* (2012) STIR: Software for Tomographic Image Reconstruction Release 2, *Physics in Medicine and Biology*, 57(4):867-83.
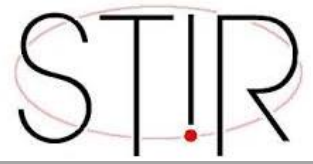
But **please** cite

- relevant papers on STIR features that you use.

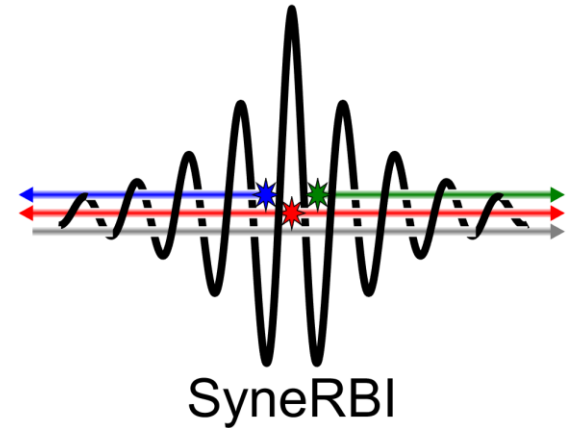- version specific DOI (includes all authors who contributed up to that version)

https://doi.org/10.5281/zenodo.4733457

Acknowledgments

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File formats
- GE Healthcare
- Siemens Healthineers

SyneRBI

EPSRC