Out of the Lab and Into the Market

Preliminary Evaluation of STIR for Commercial SPECT Reconstruction Software

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Who we are

- We're a **Software as a Medical Device (SaMD)** manufacturer based out of Ottawa, Canada.
  - Operating since ~2007
  - Our primary product (**UniSyn Molecular Imaging**) is a radiology and nuclear medicine workstation used for reading and processing diagnostic images.
  - Commercial partnerships/integration with several PACS vendors and SaMD manufacturers.

Why STIR?

- Expanding our software portfolio to include SPECT image reconstruction.
  - Clinics with older scanners no longer receiving software support/upgrades
  - Clinics with scanners from multiple vendors looking for a harmonized solution.
- We don’t have in-house expertise needed to start from scratch so we turned to open-source solutions.
- Considered:
  - **PyTomography**
  - **CASToR**
  - **STIR**

Why STIR?

- Our customers are largely non-academic image centers.
  - Interested in **standard functionality,** that is **reliable** and **high-performing.**
  - Require I/O in DICOM format.
- For SPECT recon, PyTomography, CASToR and STIR have similar capability.
  - PyTomography and STIR seem to have the most complete solution
    - recon algos,
    - data correction,
    - support for DICOM format
- STIR Advantage
  - Code maturity (stability)
  - Active user group (You!)

Challenges (Opportunities?) With STIR

- We requirement for projection data and reconstructed images in DICOM format.
  - Limited support for parsing DICOM projection data
  - No support for outputting reconstructed images in DICOM format.

Current Status

- Support for attenuation corrected SPECT reconstruction.
  - STIR requires mu-map the same spacing/extents as the SPECT image.
  - Such mu-maps are not provided by most scanners / CT images rarely have the same extents/spacing as the SPECT image.
  - Mu-map generation is laborious.

- Support for modern 3D resolution recovery techniques.
  - SPECTUB utility supports 2D and 3D resolution recovery.
  - 2D approach introduces banding artifacts
  - 3D approach more accurate but can be very slow for some scanners/collimators.
  - Gaussian approach not well suited for high-energy emitters (I-131, Y-90)

Conversion of DICOM Projection Data to Interfile

See ***SPECT_dicom_to_interfile*** utility (B. Thomas, D. Deidda & K. Theilemans).

Limited support for multi-head SPECT system (See Issues: #1102, #1184).
Various attributes were calculated corresponding only to one-detector head

- *num_of_projections*
- *rotation_radius*
- *extent_of_rotation*

- These issues were addressed by modifying the DICOM read to loop over all items (detector heads) in the *DetectorInformationSequence* and extracting the information for all heads.

Conversion of DICOM Projection Data to Interfile

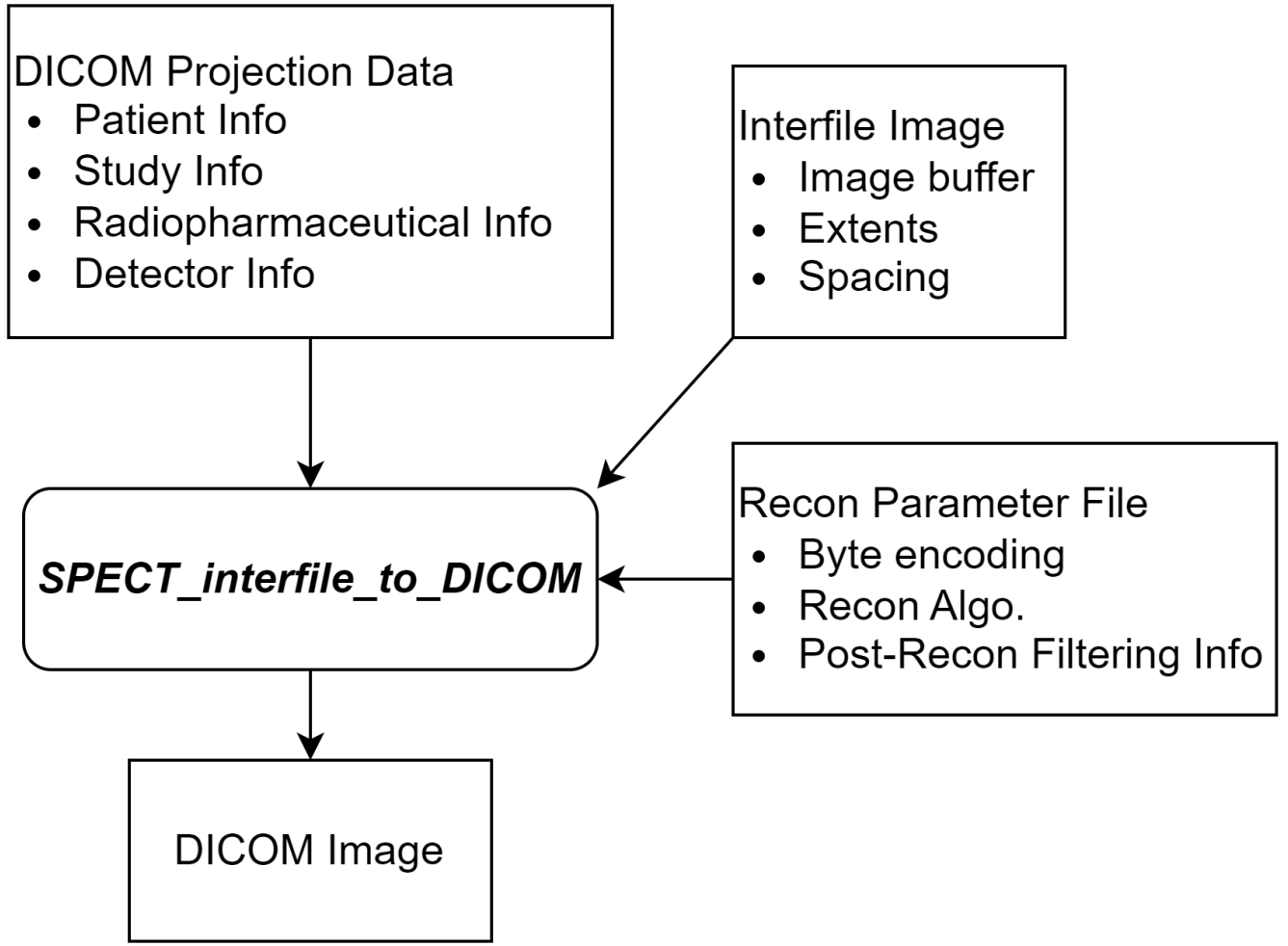
Failed to parse DICOM data written using *Transfer Syntax* that included compression (Issue #1474).

- Issue was a non-starter for DICOM dataset produced using this syntax as the utility would fail.
- Modified the DICOM file read to detect compressed files, rewrite them using a non-compression transfer syntax and re-read.

Converting Interfile Images to DICOM

STIR has no existing utilities to produce a DICOM image following reconstruction.

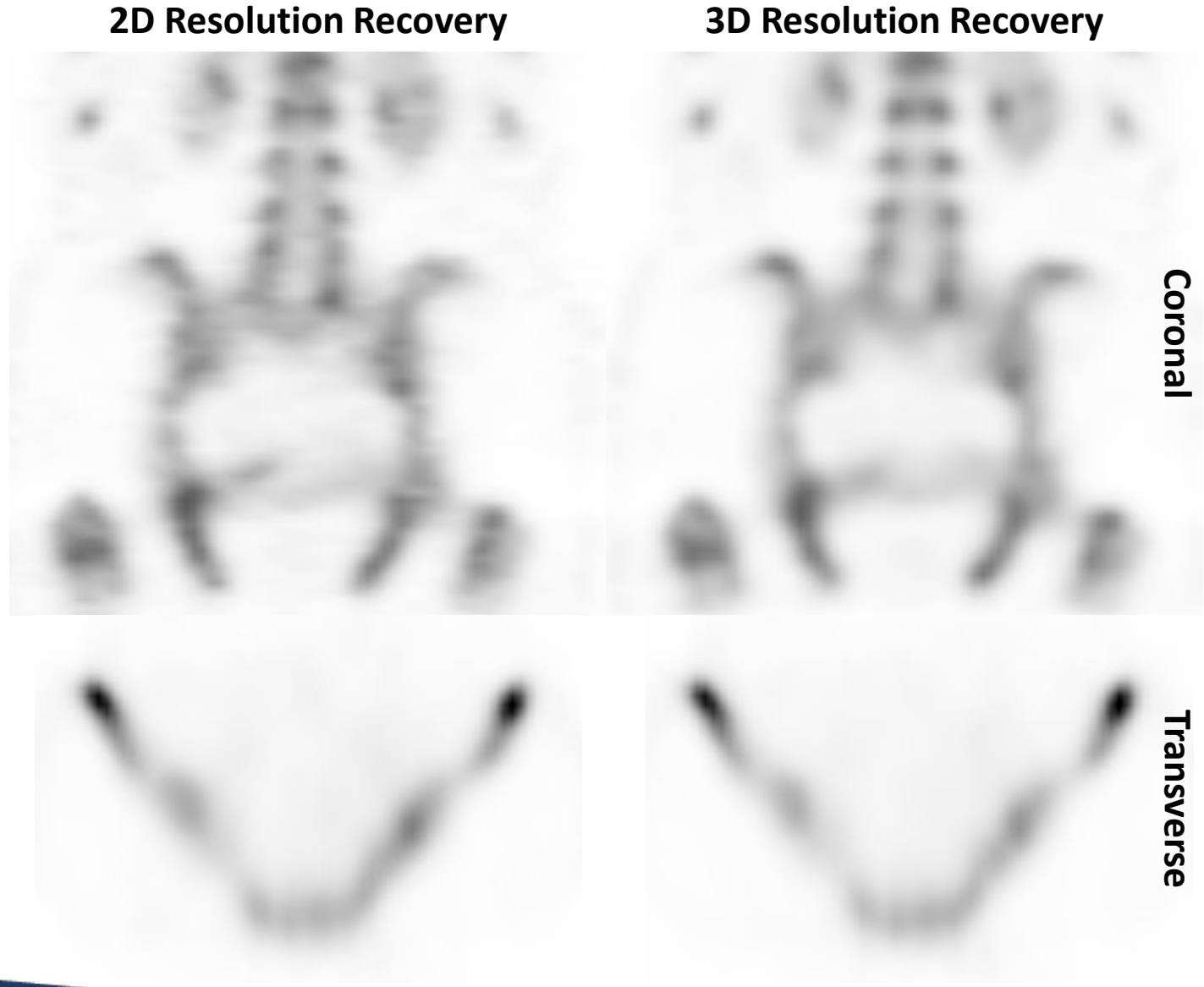
- We're developing a new utility ***SPECT_interfile_to_DICOM.cxx*** to handle this task.
- Some information still missing (Issue #1436):
  - The create time of the reconstructed image
  - Series Description
  - Image ID



Example Recon Image 2D vs 3D Resolution Recovery

Tc-99m MDP Bone Scan
From a Siemens Symbia SPECT/CT

- OSEM 16i 16s, CTAC, TEW, RR
- Increased noise seen on the coronal view but not on the transverse for 2D vs 3D RR.



Looking ahead…

- Wrap up our work towards completing DICOM I/O support with STIR
  - Pull requests are coming – sorry Kris!
- Streamline the process of mu-map creation
  - Hopefully ease the STIR restrictions on matching image extents/spacing
- Investigate acceleration techniques for pre-computing projection matrix, especially in the presence of 3D resolution recovery.
- Build a UI component to wrap the reconstruction code.
- Validation in collaboration with our users.

Thank you!

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