Swiss Accelerator
Research and
Technology

Short update on python framework activities

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Progression of functionalities of framework

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2. Include calculations of orbit and optical functions. Interface → Engine independent
3. Include tracking simulations with MAD-X, pyAT, SAD, Sixtracklib, ...
4. Further developments.

Thorough testing required after each step!

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Solid lattice description crucial for codes

Ensuring stability of lattice between different codes:

- ensures consistency when moving between codes.
- validates comparative simulation studies of different codes.
- allows alternative lattice exploration: thin/thick, alternative slicing, ..

Test and validate stability of lattice after multiple engine changes

→ Is lattice unchanged after: MAD-X → SAD → pyAT → … → MAD-X

Current developments already highlight different conventions in modelling of accelerators:

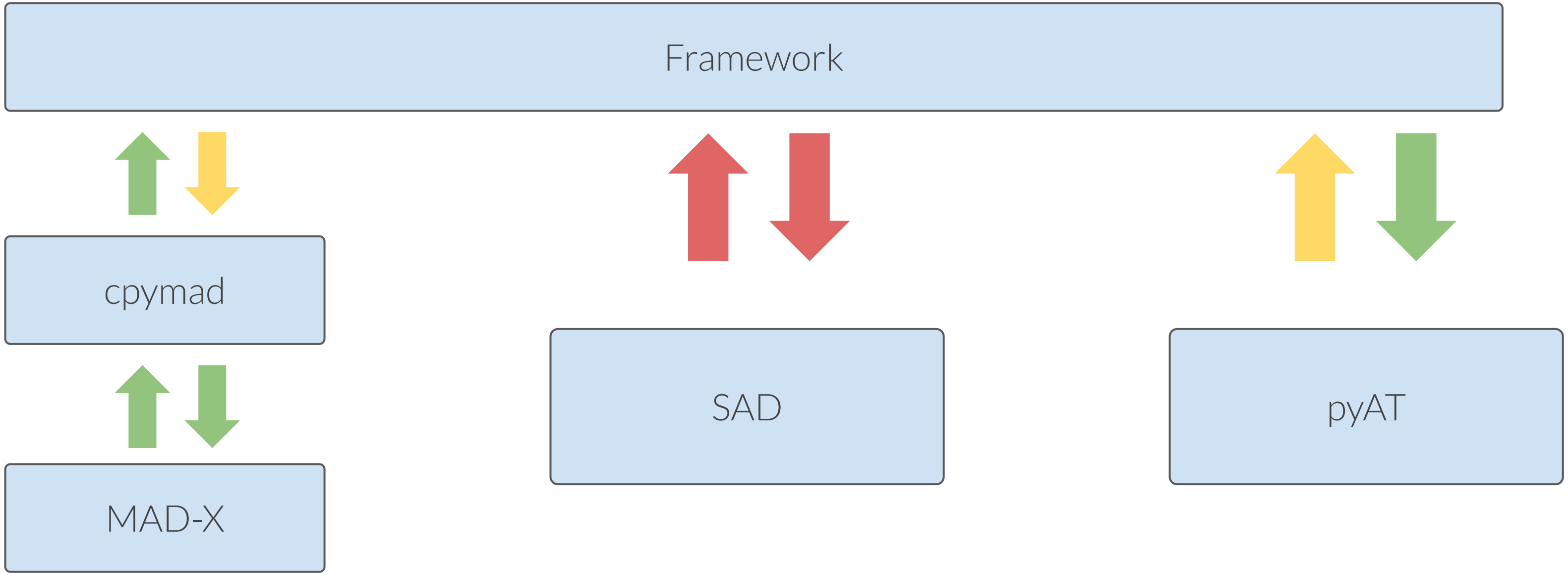
- Dipole vs. rbend/sbend
- Sequence vs. line representation
- Magnetic coefficients to arbitrary order, vs. limited representation
- RF cavities with different frequencies not accepted everywhere
- …

Import and export of lattices between codes

Only for FCC-ee lattices for the moment:

- Very basic and minimal element representations, but sufficient for FCC-ee.

Can also directly define elements and lattice in Python



FCC-ee lattice import from cpymad

Currently:

- Successfully imported lattices of FCC-ee to framework.
- Directly calculates sequence and line representations (implicit drifts)
    - Currently with negative drift tolerance of 1e-9 m
- Successfully exported lattices to cpymad (some details remain, next slide...)

Needs to be extended further:

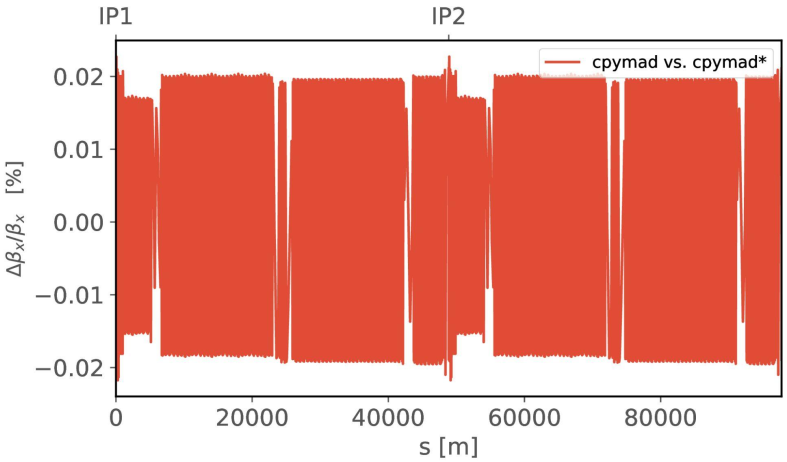
- More complicated lattices need to be tested. FCC-ee lattice does not have wide range of element types.
    - No collimators, octupoles, solenoid, beam-beam, kickers, …
- More complicated element parameters need to be tested:
    - Errors, rotations, apertures, ...

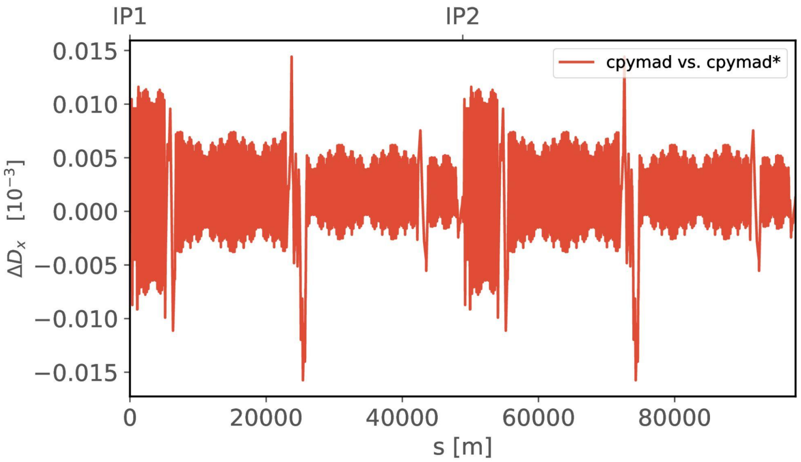
Optics not yet perfectly reproduced!

Cpymad → Framework → cpymad

Discrepancy under investigation!

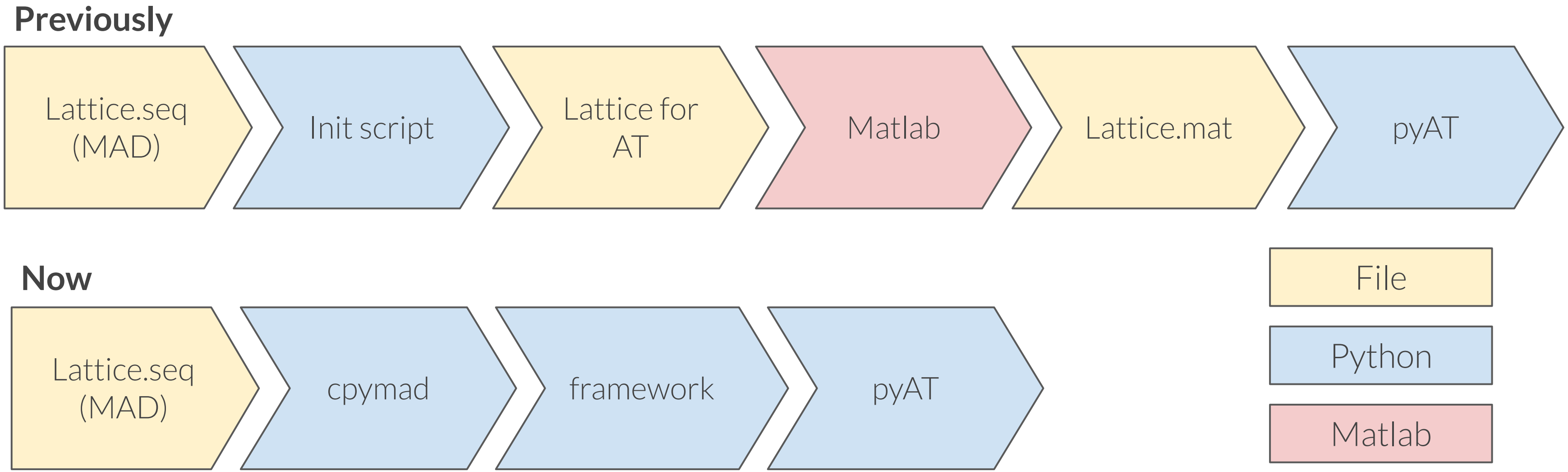
- Possible rounding errors? Drifts around sbend/rbend ?





Status of pyAT conversions

Lattice translation through framework now bypasses Matlab version of Accelerator Toolbox, and multiple file creations.



Inverse direction (pyAT → Framework) is currently being tested

Opening port to SAD

Access to SAD is currently not available and will be explored next.

Start by exploring current lattice conversion scripts between SAD and MAD-X.

Will probably have to rely on file creations and automatic script creations using templates for now.

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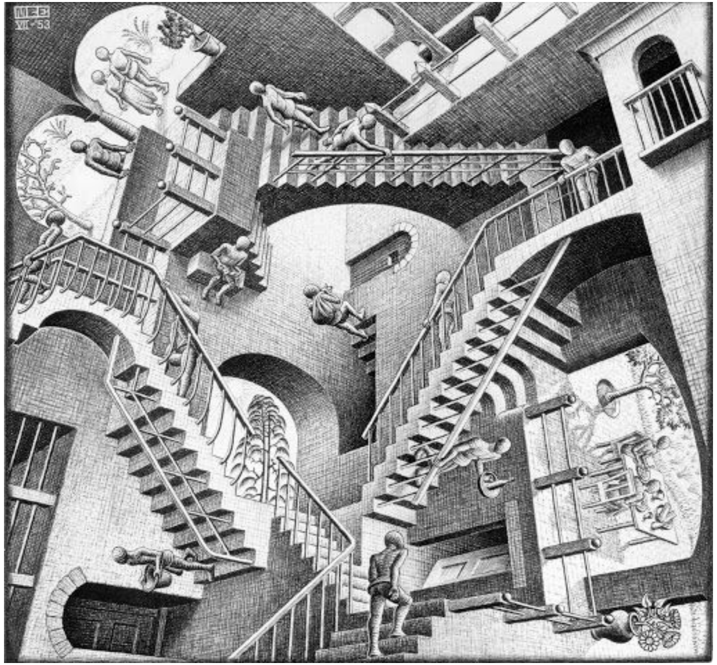
But still need to learn a lot about SAD!

Current understanding →



Next steps

- **Develop tests** for lattice import/export and elements
  → Lattice should be unchanged after: MAD-X → SAD → pyAT → … → MAD-X
  → Are elements unchanged after: MAD-X → Framework → MAD-X ?

- Explore how to include SAD to framework

- Perform comparative simulations between codes: orbits, optics
  - w/ and wo/ radiation and tapering.

- Create basic simulation functions with engine independent interface
  - i.e. lattice.optics(engine = ‘madx’)