

Data Simulation

Sara Simon and Andrea Zonca
03/09/21

Data Simulation Overview

- Experiment Model
 - Experiment Design
 - Sky Model
- Map-domain simulations
- Time-domain simulations
- Today: Quick status update + big questions and challenges
- Thursday: More discussion on how we will use the simulations to validate instrument performance in Technical-to-Measurement parallel

Experiment Design

- Capture a sufficient description of the experiment design including instrument parameters, scan, observation efficiency
 - Instrument parameters: Interface with technical groups
 - Scan strategy and observation efficiency: cross group meetings every other week
- Possible pitfalls:
 - Often need inputs from instrument design before they are ready on the technical side→ Advertise need for input early and more broadly? Some unavoidable?
 - DM asks technical leads for input on known design changes→ Need system for technical leads to update DM on large instrument design changes
 - Limitations on what instrument inputs can be read in from a definition file (e.g. layouts)
- Next steps to a more mature model:
 - Upgrades to instrument model to enable certain systematic studies
 - Deep dive into observation efficiency numbers
 - Possible upgrades to/integration of BoloCalc
 - Refinement of scan strategy

Sky Model

Currently relying on simple PySM 2 models extrapolated up to NSIDE 4096:

- Galactic dust, synchrotron, free-free, AME
- Extragalactic CIB, tsz, ksz from Websky
- CMB lensed with Websky potential

Next we will incorporate newer PySM 3 models being developed with support from the Pan Experiment Galactic Science group:

- See for example GNILC-based dust at <https://github.com/healpy/pysm/pull/72>

Are there other inputs we need to consider adding?

Map-Domain Simulations

Two classes of map-domain simulations:

- Full sky simulations beam-smoothed and bandpass-integrated used as input to the design simulation tool, see the [documentation of the Feb 2021 release](#)
- Design simulation tool runs:
 - Uses 10-day time domain simulations of sky, atmosphere and noise, weights them based on the instrument configuration
 - Currently in progress, available in weeks
 - [Last year's simulation documentation](#)

Time-Domain Simulations

- Short time-domain sims have been run for use in the design tool
- Verifying the models:
 - Comparison of atmospheric model to timestream data from existing instruments
 - Design tool runs scaled to existing experiments and noise performance compared, can be rescaled to match achieved performance→ No baseline for Chile SATs
- Scaling from achieved performance is critical, but may be insufficient
- We cannot rescale the larger data challenge runs→ additional challenge and complexity
 - Use design tool verification to inform larger simulations, but not straightforward
 - One observation efficiency number is not sufficient to simulate large periods of data (e.g. season dates, weather cuts, etc.)
 - Need a thorough verification plan to use these simulations for validation

Time-Domain Simulations

- Noise is not sufficient to validate performance → Systematic effects
 - Need systematic model and expected mitigation to realistically estimate residual effects
 - Need a realistic understanding of what can be modeled and what resources, input, and effort is needed for that modeling
 - How do we as a project prioritize what to model?
 - Many of the most limiting systematic effects are difficult to model (ground pickup, beam systematics) → How do we handle these?

More on discussion on systematic effects in Technical to Measurement session
(Thursday)