Unfolding with RooUnfold

- Unfolding is the determination of estimators for the true distribution of a measurement.
- It is not ‘corrected data’
  - Dependent on the detector model and MC used to generate unfolding
  - Not trivial to perform combinations.
  - Correlations between systematics are hard to evaluate.
- Most unfolding algorithms are equivalent to maximum likelihood solution with an additional term.
- Systematic uncertainties are applied by propagating varied samples or bootstraps through the unfolding framework.
- Typically unfolding works on 1D histograms only.

RooFitUnfold and the Likelihoods

- RooFitUnfold is common framework of metrics for Unfolding performance across methods and parameters
- Published in: *Int.J.Mod.Phys.A* 35 (2020) 24, 2050145
  https://arxiv.org/abs/1910.14654
- Statistical Modelling with RooFit for improved variance calculations (including systematics), statistical coverage, internal bias calculation.
- RooFit integration allows mapping of systematics to be stored in RooWorkpaces for combination with any HistFactory style measurement or to unfold fitted distributions.
- Estimating covariance of an unfolded measurement by inverting the hessian of the log-likelihood is a good way to evaluate systematic effects in the presence of data however this is not strictly correct in the case of an explicit regularisation term.
  https://arxiv.org/abs/2110.09382

Unbinned unfolding

- Allows rebinning, and re-parameterization, preserves multidimensional relationships.
- Published results are either data or data and corrections.
- Two general approaches: classifier based (provide truth+weights), and density based (events sampled from learned distribution).
- Propose submission YAML file containing, for each (sampled) event features, weights and weight uncertainty. https://arxiv.org/abs/2109.13243
- Lightweight python based extension to RooUnfold in development to allow users to try unbinned unfolding (and publication) with minimal setup changes.

Future developments

- RooUnfold is in a new stage of active development with a focus on precision, accessibility, portability.
- A full workshop including both tutorials and discussion on systematics, algorithms, computing, and interpretation currently being planned for early 2022. We would love you all to be involved.
- Please contact: roounfold-support@cern.ch to contact dev team.