Comparison of codes

Five codes, which differ only in details:

Method	ARU	GURU	RUN	ResCon	TUnfold
input: matrix	?	✔		✔	✔
n-tuple	?		✔		
discretization	B-spl	hist	B-spl	hist	hist
dimension: true	1	1	1	1	≤ 3
meas	1	1	≤ 3	1	≤ 3
Kernel	fcn	MC	MC	MC	MC
statistical meth	ML-Pois	LS	ML-Pois	LS	LS
lin. algebra	diag	SVD	diag	SVD	solution
regularization	entropy	derivative	derivativ.	trunc/Max Ent	derivatives
parameter	n_{eff}	$n_{1/2}$	n_{eff}	n	L-curve
covar. matrix	propag.	propag.	propag./MC	propag.	propag.
automat. binning			✔		
MC reweighting			✔		

RUN (Fortran), converted to C++ TRUEE by Natalie Milke (Uni Dortmund) natalie.milke(at)tu-dortmund.de

Types of unfolding problems

Parametrized unfolding:

parameterized expression with few parameters: no regularization necesssary – using normal fit program.

Parameter-free unfolding: bins (or classes)

- Classification problems, small number: no reduction of number possible;
- Correction of distributions with small migration effects;
- Structureless distributions (small number of Fourier coefficients):
  - Smooth distribution: regularization with possibility to reduce number of bins;
  - Steeply falling: try transformation to remove steepness, evtl. use parametrization
- Unfolding with transformation, evtl. > 1 measured distribution;
- Distributions with narrow structures, peaks: try to use parametrization e.g. Gaussian peaks – using normal fit program.

Open questions

- discretization: continuous B-splines of higher order (necessary for re-weighting of MC – RUN) instead of simple discontinuous bins
- input of n-tuples instead of vectors/matrices
- strategies for steeply falling distributions and for class data (e.g. 2- ,3- ...jet events)
- alternative low-pass filter strategies
- data presentation with small or large number of data points
- projection methods (DCT) in one- and two-dimensions
- case of limited acceptance regions (e.g. low p_{T} – using constraints (Lagrange multiplier – RUN)) in one- and two-dimensions
- using general fit program (like aplcon) for unfolding? (flexible: e.g. fit may include uncertainty of $\boldsymbol{A}$ or background fit)
- uncertainties of response matrix elements
- algorithm for automatic variable bin definition (RUN)
- statistical comparison of information content for different number of degrees of freedom
- use of detailed estimates of the unfolding result (multiplicative, additive)