CharBias

Read parameters from config file

Load **N** rawBias frames along stack axis of 3D masked array **nRawBias**

1

Compute Averages over **N** pixels along stack axis of **nRawBias**, results in array **charBiasMaA**

Compute Variances over **N** pixels along stack axis of **nRawBias**, results in array **charBiasMaV**

2

Using every pixel of **charBiasMaV** whose value is above **charBiasVarMin**, compute median **charBiasVar0ima**

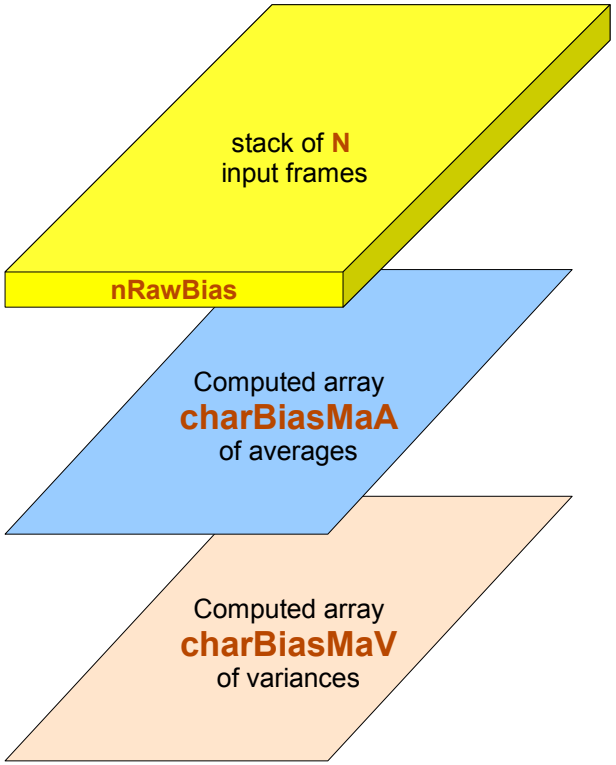
Compute tolerance level **charBiasCutoff** = **charBiasOut0** X sqrt(**charBiasVar0ima**)

Parameters (in green) computed variables (in red)

Read from config file
charBiasVarMin
charBiasOut0
charBiasOutM
charBiasOutCol

N files in input directory

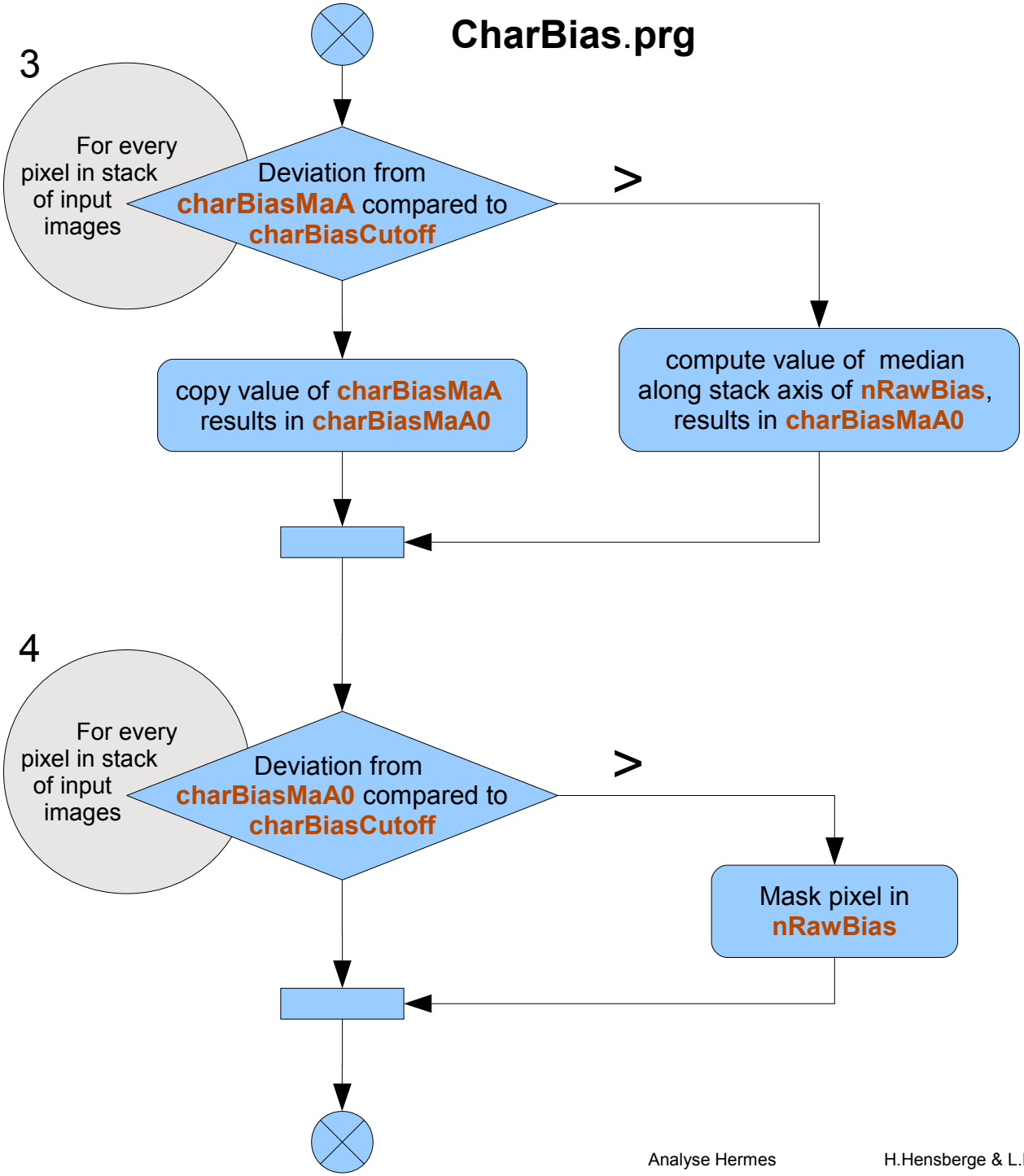
Internal masked arrays and other variables



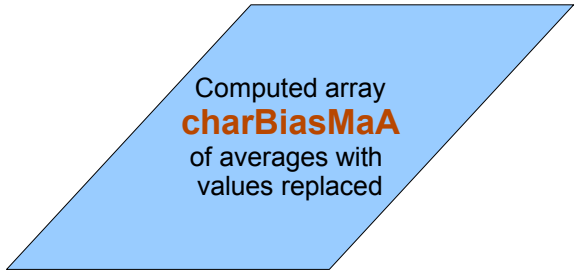
float **charBiasVar0ima** is median of variances where value is above **charBiasVarMin**

float **charBiasCutoff0** is first tolerance level

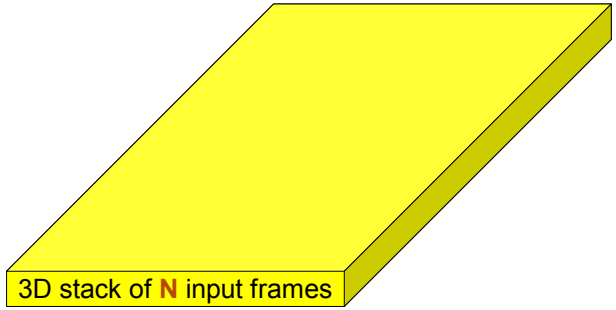
CharBias.prg



Internal masked arrays



charBiasMaA0



Pixels masked where deviation > cutoff0

5

Count masked pixels along stack axis
of **nRawBias**, results in **charBiasOutPixels**

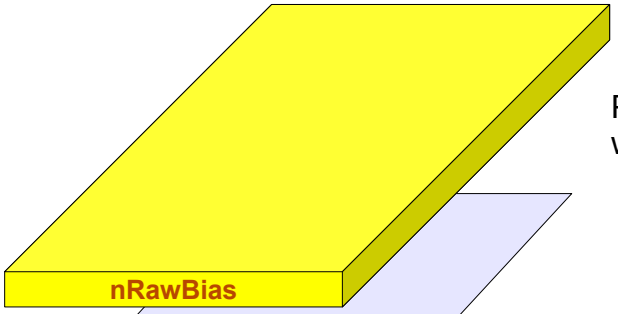
Count masked pixels along columns
of **charBiasOutPixels**, results in **charBiasOutCol**

Mask every pixel of **charBiasOutPixels**
having a non-zero value

7a

For every count of masked pixels in **charBiasOutCol**
exceeding (**charBiasOutCol** X **N**),
mask the whole column in **charBiasOutPixels**

For every masked pixel in **charBiasOutPixels**,
mask the whole stack axis in **nRawBias**

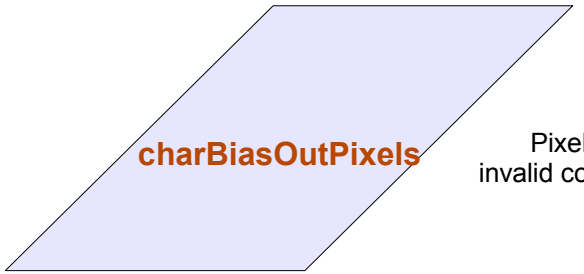


Pixels masked
where deviation > cutoff

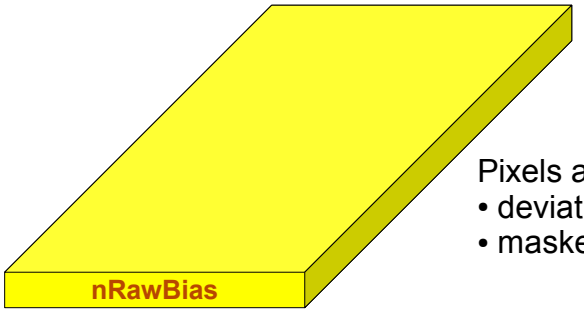
Count of masked pixels

charBiasOutCol

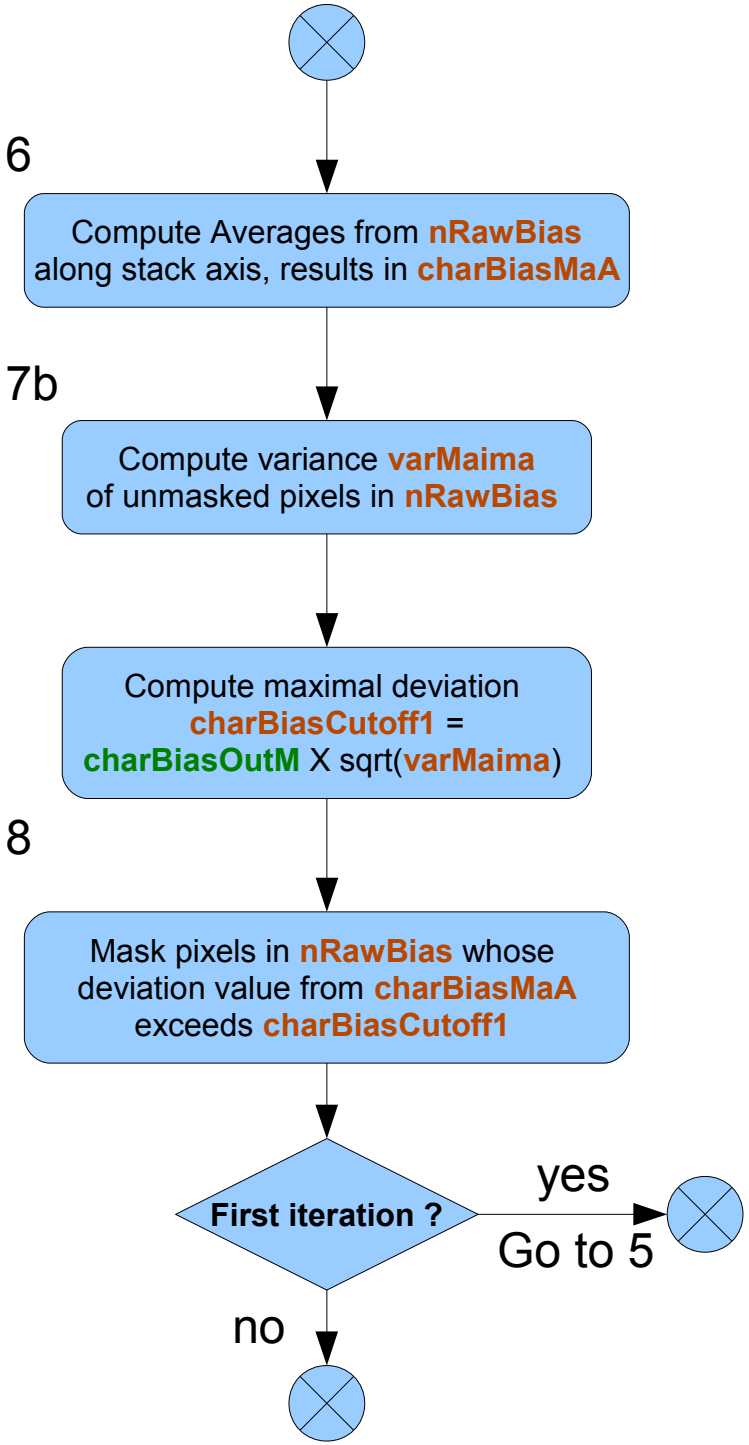
Count masked pixels by column

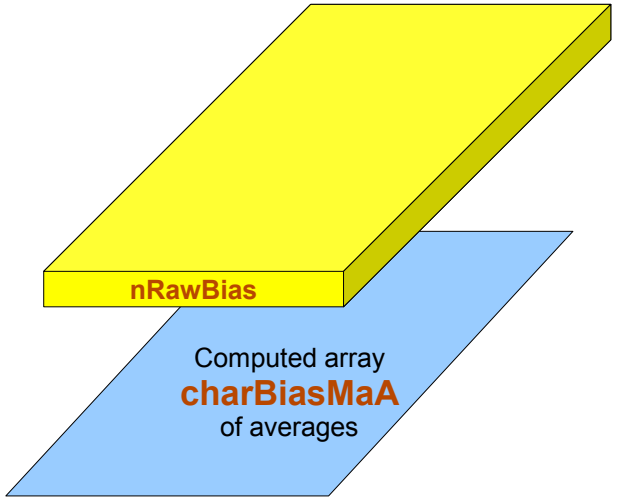


Pixels masked
invalid columns masked



Pixels are masked where
- deviation > cutoff
- masked in outPixels

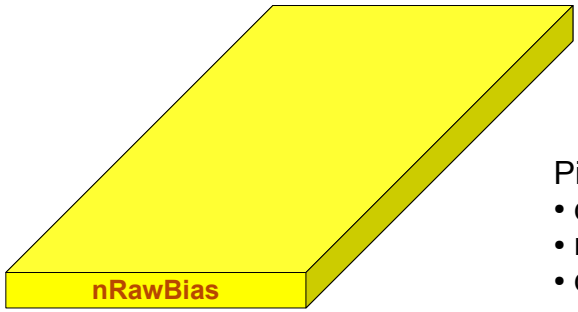




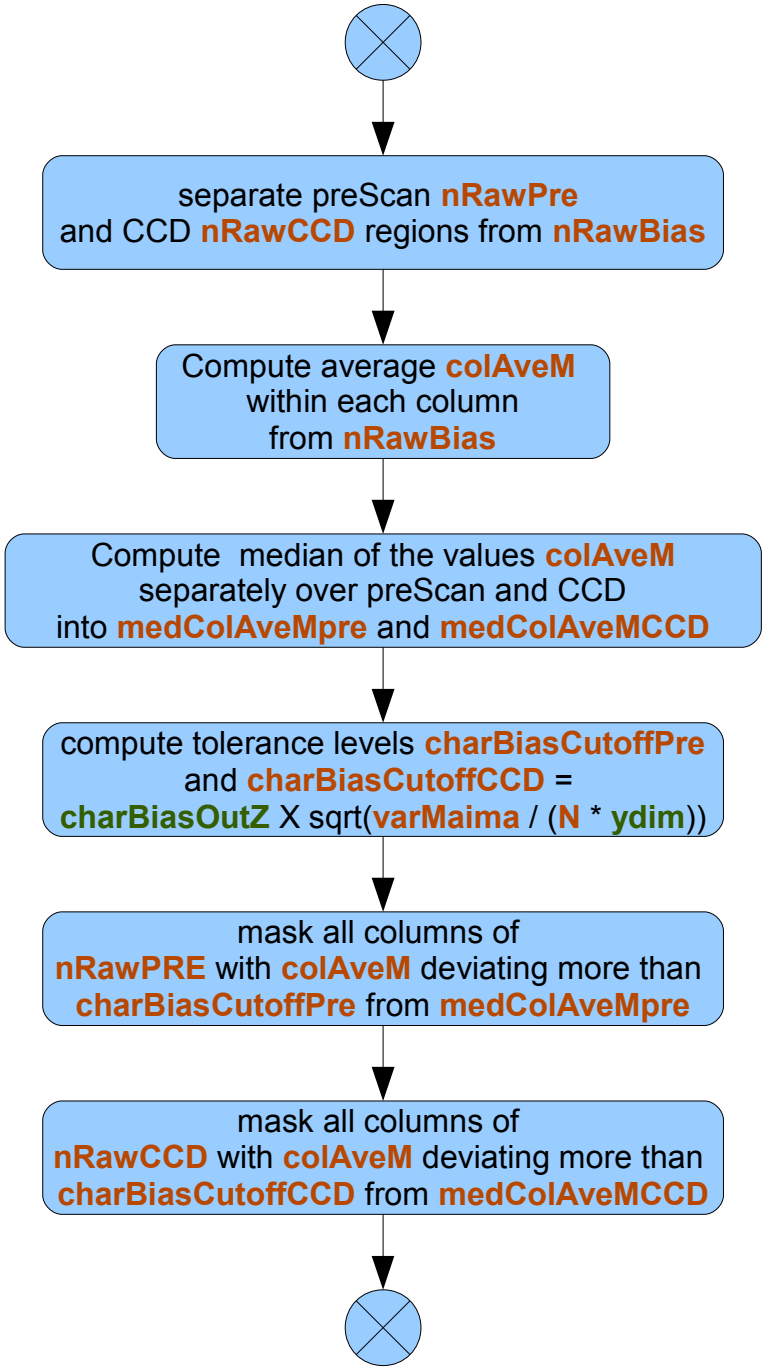
Pixels are masked where
- deviation > cutoff
- masked in outPixels

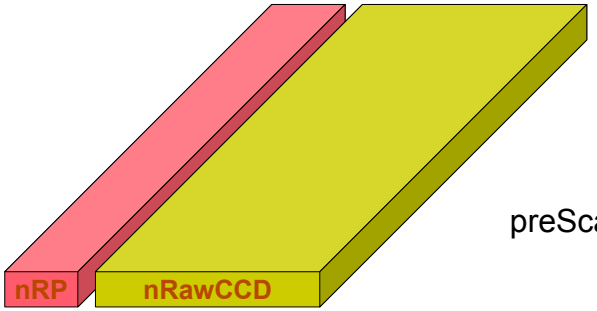
float **varMaima**
is variance
of all valid pixels
in **nRawBias**

float **charBiasCutoff1**
is second tolerance level



Pixels are masked where
- deviation > cutoff0
- masked in outPixels
- deviation > cutoff1

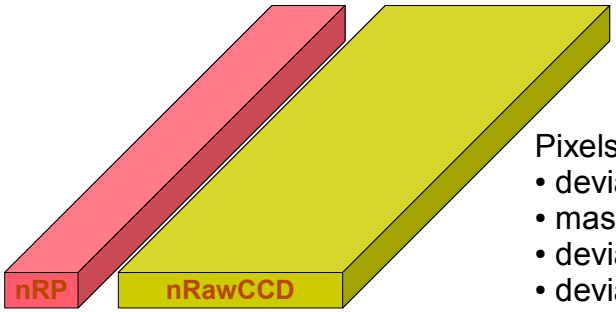




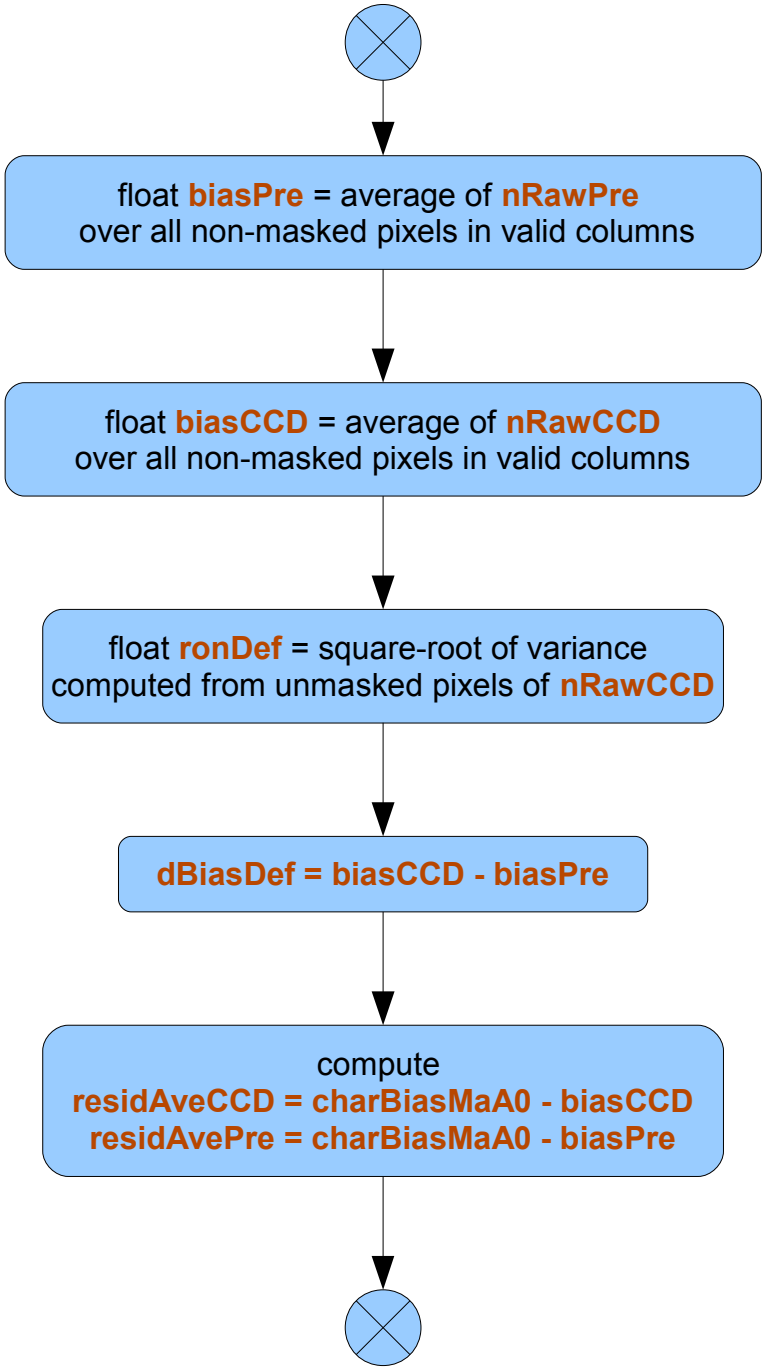
preScan is cutted from « raw »

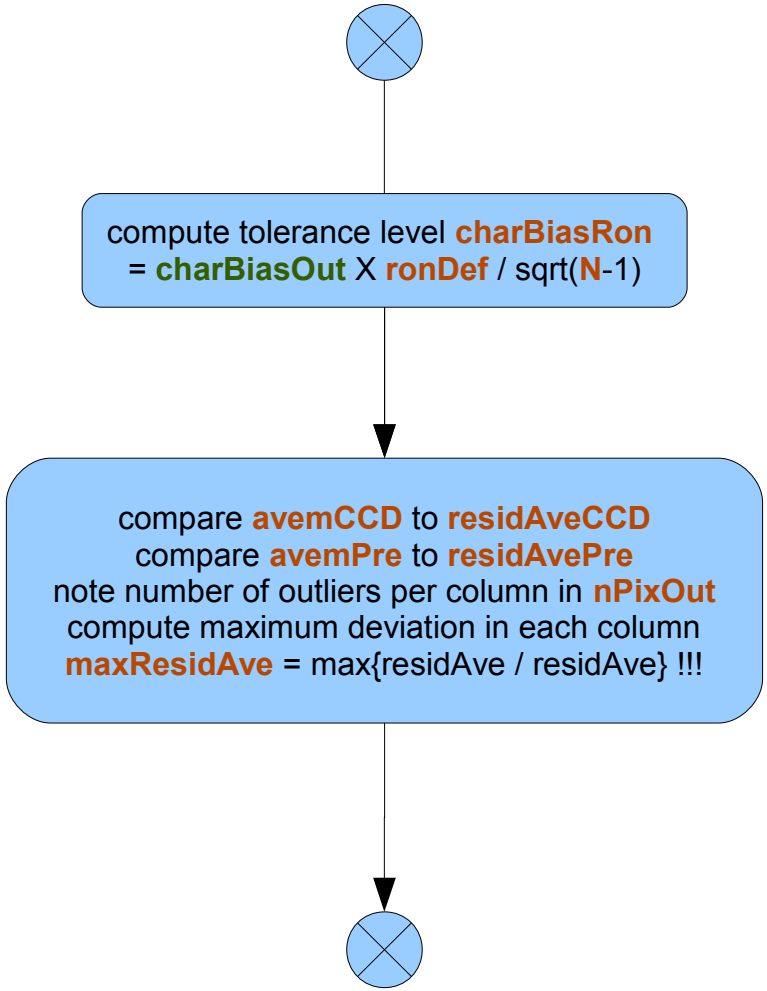
colAveM

medColAveMpre medColAveMCCD



Pixels are masked where
- deviation > cutoff
- masked in outPixels
- deviation too large
- deviation over z


float biasPre = average of nRawPre
over all non-masked pixels in valid columns
float biasCCD = average of nRawCCD
over all non-masked pixels in valid columns
float ronDef = square-root of variance
computed from unmasked pixels of nRawCCD
dBiasDef = biasCCD - biasPre
compute
residAveCCD = charBiasMaA0 - biasCCD
residAvePre = charBiasMaA0 - biasPre

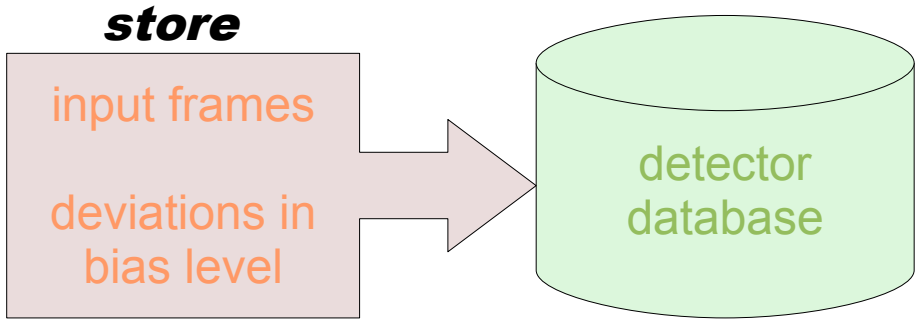


For instrument follow-up purposes and later extension of analysis to a larger number of frames, compute for each pixel variance over N input frames around **biasPre** or **biasCCD**, depending on which pixel is considered. Store those values.

Manual adjustment in the beginning.
could be largely automated later.

For columns with maxresidave(c) > 2.0 rondef
and npixout(c) > 0.01 ydim [ydim = ydimccd or ydimpre]
an interactive check of the distribution of rejected pixels is useful.
It may be necessary to reject the whole tail behind a very hot pixel.
This is easier done interactively than by complex programming.
[charbiashot = 2.0, charbiasbadc = 0.01]
Interactive final definition of mask mhot.

A frame residave”date”
with the deviations in the bias level
is saved to the detector data base;
also var”date” is saved with the data described;
and the number of input bias frames is recorded with them.
This permits consistency checks with later tests,
or combination with future results.



Useful analyses in optimizing the definition
of the mask **mhot**: (a) histogram of residave”date”
separately for: pre-scan and detector,
separately for columns with npixout(c) < 3
and columns with more hot pixels
or columns with bad stretches.
(b) distribution of residave”date”
values following behind strongly positive values.

Definitions of terms

CCD camera :	Photosensitive device.
rawBias frame :	image taken from the CCD camera when it sees nothing. it includes the CCD region and the prescan region.
CCD region :	the CCD sensitive area where images will come from.
prescan region :	reader region near the CCD region where no image will never come from.
CCD columns :	the columns of the **CCD region.**
prescan columns :	the columns of the **prescan region.**
Stack :	3D collection of same-sized images.
Stack axis :	refers to the same (x, y) coordinates for every image on the stack. It counts from 0 to the number of images – 1
Masked array :	special arrays where points can be « masked ». Masked points will no longer been used in calculations.

Names used for parameters

N :	Number of rawBias frames taken to determine the noise to be cut from real images.
charBiasVarMin :	float. Values above that level wil be used to compute median of variances .
charBiasOut0 :	float. Value used to compute tolerance level.
charBiasOutM :	float. Value used to compute maximal deviation .
charBiasOutCol :	integer. Used to find out bad columns.
charBiasOutZ :	float. Value used to compute tolerance level.
xdim, ydim :	integers. dimension of the ccd.

Variables in order of appearance

N :	Integer. Number of **rawBias frames** taken to determine the bias level and the read-out noise.
nRawBias :	a 3D masked array of floats containing N **rawBias frames**.
charBiasMaA :	a 2D masked array of floats containing averages along the stack axis.
charBiasMaV :	a 2D masked array of floats containing variances along the stack axis.
charBiasVar0ima :	Float. Median of variances in **charBiasMaV** using values above **charBiasVarMin.**
charBiasCutoff0 :	Float. Tolerance level computed with all pixels.
charBiasMa0 :	a 2D masked array of floats containing averages of frames or median.
charBiasCutoff1 :	Float. Tolerance level computed with all unmasked pixels.
outPixels :	a 2D masked array of integers counting masked pixels on stack axis of **nRawBias**.
outCol :	a 1D masked array of integers counting masked pixels in **outPixels** by column.
varMaima :	Float. Variance of unmasked pixels in **nRawBias.**
nRawPre :	a 3D masked array of floats containing prescan region of N **rawBias frames.**
nRawCCD :	a 3D masked array of floats containing CCD region on N **rawBias frames.**
colAveM :	a 1D masked array of floats containing column averages from **nRawBias.**
medColAveMpre :	a 1D masked array of floats containing median values of **colAveM** over **preScan columns**.
medColAveMCCD :	a 1D masked array of floats containing median values of **colAveM** over **CCD columns.**
charBiasCutoffPre :	float, computed tolerance level depending of number and size of images, for **preScan region**.
charBiasCutoffCCD :	float, computed tolerance level depending of number and size of images, for **CCD region.**
biasCCD :	average of **nRawCCD** over all non-masked pixels in valid columns.
biasPre :	average of **nRawPre** over all non-masked pixels in valid columns.
ronDef :	float. Square-root of variance computed from unmasked pixels of **nRawCCD.**
dBiasDef :	float, difference between **biasCCD** and **biasPre.**
residAveCCD :	**charBiasMaA0 - biasCCD.**
residAvePre :	**charBiasMaA0 - biasPre.**
charBiasRon :	float. Tolerance level.

Objects Model

proposed name	methods	what it Does
configHermes	configRead	read all values out of config file
inputFrames	LoadAverages&Variances	Load all frames, computes averages and variances, median and first tolerance level.
	maskOutPixels	search and mask « bad » pixels and columns.
	maskTolerance	compute new averages, variances and tolerance level, mask pixels with greater deviation.
	separatePrescanCCD	Separate the two regions and compute two medians and two tolerance levels
	maskSeparateTolerance	Mask all columns deviating more than second tolerance level from medians
outputValues	compute&Write	compute bias for prescan and CCD region, read-out noise and residuals, write them to disk.