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AutoRecon 1.3.0— Semi–automatic reconstruction processing

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Contents

1 CT reconstruction overview **3**
- 1.1 Attenuation conversion 3
- 1.2 Sinogram conversion 4
- 1.3 Slice reconstruction 5

2 AutoRecon overview **6**
- 2.1 Sequences 7
- 2.2 Regions 7
- 2.3 Attenuation filters 7
- 2.4 Sinogram filters 8
- 2.5 Reconstruction filters 8
- 2.6 Processing summary 8
- 2.7 Templates 9
- 2.8 User preferences file 10

3 GUI application (`autorecon.tcl`) **10**
- 3.1 File menu 10
- 3.2 Process menu 10
- 3.3 View menu 11
- 3.4 Attenuation settings 11
- 3.5 Beam hardening files 12
- 3.6 Ring removal 12
- 3.7 User centers 13

4 Console application (`autorecon`) **13**
- 4.1 Console processing steps 15
- 4.2 Sequences 16
- 4.3 Regions 16
- 4.4 Outlier SNR parameter 17
- 4.5 Ring removal 17
- 4.6 Beam hardening correction 17
- 4.7 User slice centers 18
- 4.8 Template files 19

5 Miscellaneous 19
5.1 Byte order of image data 19
5.2 Todo list 20

6 List of ".sct" file tags 20

7 List of .autoreconrc parameters 22

1 CT reconstruction overview

Reconstruction of raw shadow radiograps into cross–sectional slice images of object attenuation involves three main steps: Attenuation conversion, Sinogram creation, and Slice reconstruction. Each step involves some filtering operations that attempt to improve the final reconstructed slice quality.

1.1 Attenuation conversion

The raw data that is collected by the scanner is a measurement of the amount of X–ray photons that arrive at the detector along a line from the detector pixel position to the X–ray source. The resulting two–dimensional image of X–ray intensities is called a shadow radiograph. These shadow radiographs are taken at many different orientations around the object scanned, typically a 180° or 360° rotation. The relationship between X–ray intensity and attenuation coefficient is given by

$$a = -\ln \frac{I}{I_o} = \ln I_o - \ln I, \tag{1}$$

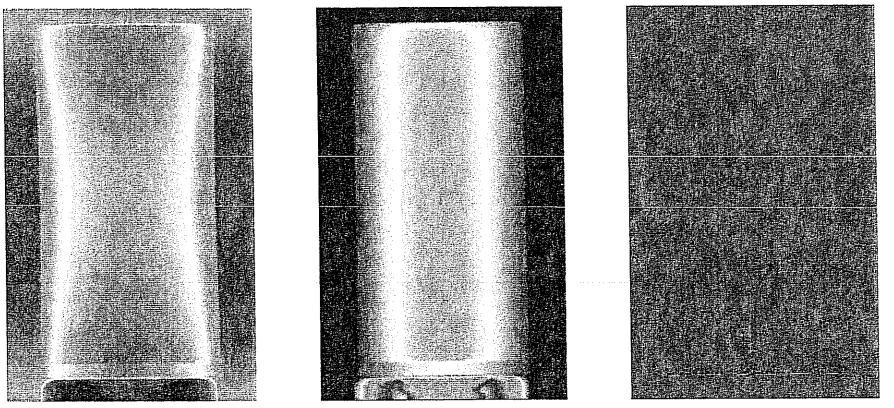
where I_o is the unobstructed X–ray intensity (bright field image). In reality a dark field image (I_D) is also taken and subtracted from both I and I_o. The full attenuation correction equation then takes the form

$$a = \left\lfloor \ln\left(I_o - I_D\right)\right\rfloor_{0.01}^{0.01} - \left\lfloor \ln\left(\beta \left\lfloor I - I_D \right\rfloor_1^1\right)\right\rfloor_{0.01}^{0.01} - 0.01, \tag{2}$$

where the threshold operator $y = \lfloor x \rfloor_b^a$ is defined as:

$$y = \begin{cases} b & : \quad x < a \\ x & : \quad x \geq a \end{cases}.$$

The image resulting from (2) is then median filtered (usually) to remove any outlying data points, this process is called outlier removal. The median filter used is 3x3 pixels and a threshold can be set to regulate the effect of the filter. If the median filter value corresponding to an original value of x is x^* and the threshold value (outlier signal–to–noise parameter) is δ, then the median filter threshold operation can be written as $y = \lfloor |x - x^*| \rfloor_{x^*}^{\delta}$. Higher values of δ lessen the effect of the outlier removal filter, a value of zero provides regular 3x3 median filtering (strongest filtering).



(a) (b) (c)

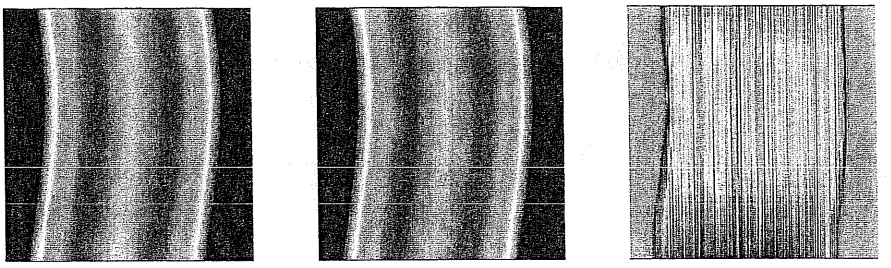
Figure 1: Attenuation conversion: (a) shadow radiograph, (b) outlier filtered attenuation radiograph, (c) filtered–unfiltered difference image

Figure 1 shows the effect of the attenuation conversion and outlier removal. To determine if over filtering is occuring, the difference between the image before and after outlier removal can be used to see if object edges are being blurred significantly.

1.2 Sinogram conversion

A sinogram is the same data as the attenuation images viewed in another way. A scan produces three-dimensional data where the dimensions are x–direction along the detector (usually horizontal), y–direction along the detector (usually vertical), and a rotation (Θ–direction). If the attenuation data is viewed in the $x\Theta$–plane rather than the xy–plane then the image is called a "sinogram." The image is called a sinogram because a point in the object will trace out a sine wave in the sinogram space. Sinograms are particularly useful for ring removal filtering which attempts to remove artifacts from the data that result from varying detector gains and/or bad detector pixels. These arifacts appear as vertical lines in the sinogram and rings in reconstructed slices.

Ring removal has been implemented as a horizontal box–car average filter spanning 3 pixels that can be applied multiple times. The region of the sinogram to which the filter is applied can be changed based on the intensity



(a) (b) (c)

Figure 2: Sinogram conversion: (a) filtered sinogram, (b) unfiltered sinogram, (c) filtered–unfiltered difference image

of the sinogram. Two versions of ring removal exist that either determine the filter region based on the entire sinogram (`ring2`) or only from portions of it (`ringo`).

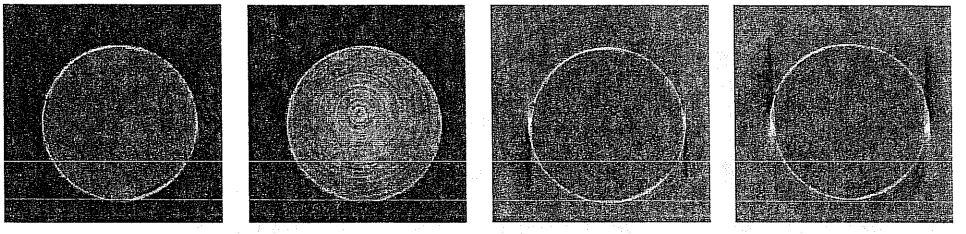
Figure 2 shows the effect of the sinogram conversion and ring removal. If excessive amounts of ring removal are applied, the edges of the sinogram will be blurred into vertical lines.

Beam hardening correction is also applied at this stage of the processing. Beam hardening correction attempts to compensate for the nonlinear relationship between attenuation and X–ray energy. It works by applying a polynomial correction to the sinogram data.

A normalization is also applied to the sinogram data that forces each row–wise sum of the sinogram to the same value. The normalization is applied after ring removal but before beam hardening correction.

1.3 Slice reconstruction

Each sinogram is reconstructed into a object slice using a convolution back-projection (CBP) algorithm. This algorithm needs to know the location of the center of rotation of the object along the x–axis in the sinogram. The CBP code can guess the location of the center using the shape of the sinogram but sometimes it is necessary to adjust this guess manually (Figure 3).



(a) (b) (c) (d)

Figure 3: Slice reconstruction: (a) correctly reconstructed slice, (b) poor ring removal, (c) reconstruction center too small, (d) reconstruction center too big

2 AutoRecon overview

The set of programs that comprise the AutoRecon system were created to make preprocessing and reconstruction job preparation easier and make it possible to submit these jobs in batch mode. This required the elimination of VIEW from the main processing computations since VIEW is by nature interactive. There are two interfaces that can be used to setup the parameters needed by AutoRecon: console based and GUI based. Both of these setup programs call helper programs to do each of the steps in the processing. Both interfaces modify the "`.sct`" file to include information regarding the different filters that are needed to do the preprocessing and recontruction.

The console based application is '`autorecon`' and it accepts user input from the command line. The console based interface is not as easy to use as the GUI and is probably only helpful if the user is connecting remotely and doesn't have an X–server (or a very slow connection). `autorecon` also performs the complete batch job processing and is called from the GUI when the complete job is run.

The GUI is written in Tcl/Tk and is called '`autorecon.tcl`.' It provides a much more intuitive and easy to use interface. It allows the user to set the preprocessing filters and view the results of those settings for a limited number of test cases before running the complete preprocessing/reconstruction job. Since the GUI is written in Tcl/Tk it runs on either Win32 machines or Xwindows machines.

2.1 Sequences

There are three sequences that are generated by AutoRecon: attenuation, sinogram, and reconstruction sequences. These sequences default to '`p0000`', '`s0000`', and '`r0000`' respectively. They can be changed to anything but the "_" and "." characters should be avoided. A relative path can be specified (e.g. "test/p0000") but the directories should already exist.

2.2 Regions

There are two regions that are used. The first defines the part of the shadow radiographs that will be used for background mean calculation. This region is read from the "`.sct`" file and is typically already specified by the scanner operator. If you change this region then the original region selected by the scanner operator is not overwritten, it will remain in the "`.sct`" file so it will be possible to revert to this default region. The background means are used to correct for any source or detector variations during the scan typically due to line voltage variations. The mean from the bright field is compared to the mean of the current projection and the projection data is scaled so the resulting corrected mean is the same in all projections. The background region must not contain any part of the object being scanned for any of the projection images. The background region can be outside the cropping region described next.

The cropping region defines a subregion of the shadow radiographs that is used in further calculations. This region is defined to be smaller than the original image in cases where their is excess blank space around the perimeter of the object in all the projections. This region defaults to the entire radiograph (no clipping).

2.3 Attenuation filters

AutoRecon will produce example attenuation images for selected projections. It can produce an example image for any projection number. These example images show the effect of outlier removal and the clipping region settings. Asking for an example attenuation radiograph will produce three VIEW files: '`testproj`', '`testproj_nc`' , and '`testproj_diff`.' The first file is the corrected attenuation radiograph, the second file is changed into attenuation but no outlier removal is done ('nc' == no correction), and the last file is

the difference image between filtered and unfiltered (see §1.1).

(Parameters : Background Region, Clipping Region, Outlier SNR)

2.4 Sinogram filters

AutoRecon will also produce example sinograms for a particular slice number. The slice number will correspond to the slice numbering after the clipping region is applied. The example sinogram file names are '`testsino`', '`testsino_nc`', and '`testsino_diff`.' AutoRecon keeps track of which slice number has been processed and uses that information during reconstruction so the user center slice number is correct (see §1.2).

(Parameters : Beam Hardening, Ring Removal)

2.5 Reconstruction filters

Finally, AutoRecon will also produce example slices through convolution backprojection of the example sinogram. The example reconstruction is saved in a VIEW file called '`testrec`.' If no user centers are specified then AutoRecon will let the reconstruction program estimate the rotation center and add the resulting center to the list of user centers after processing. If user centers exist, then the user will be prompted as to whether the user center should be used or not.

The user centers are used to generate a centers file (.ctr) for `newrecon`. At least two slice centers must be specified for the centers file to be generated. The location of the center for a particular slice is determined by trial and error with the reconstructed slice as feedback. The centers file is created by doing linear interpolation (extrapolation) between each two pairs of centers. If multiple centers are defined then linear interpolation is done between each pair of centers as the slice number increases. If two different centers are defined for the same slice bad things will probably happen.

(Parameters : User Centers)

2.6 Processing summary

1. Run AutoRecon on the "`.sct`" file for the shadow radiograph sequence. (see specific console or GUI section for command line arguments)

2. At this point you will probably leave the background region and the clipping region at their default values.

3. Run an example attenuation correction for a projection. Look at the resulting images and adjust the Outlier SNR (signal-to-noise ratio), background region, and the clipping region to get satisfactory results.

4. Choose the beam hardening correction file and enter the parameters for ring removal. Note that at this point the beam hardening correction file must be in the `~/autorecon` directory. (In the future we should put all beam hardening files in one directory as a master copy).

5. Run an example sinogram on a slice near the upper part of the data set.

6. Run an example reconstruction (it will process the test sinogram that you just made). After reconstruction is completed, respond 'yes' when asked to use the computed center. Adjust ring removal and the user center if necessary. If the ring removal is changed then you must regenerate the example sinogram (step 5) as well as the example reconstruction.

7. Repeat steps 5 and 6 on a slice near the bottom of the dataset and adjust its center until good results are obtained.

8. At this point you should have two centers defined, one near the top and one near the bottom of the data set. If at least two centers are defined then you may submit the job for processing in batch.

2.7 Templates

Template files can be created that contain some of the settings used for the current AutoRecon job so they can be easily applied to another job. Templates by default contain the sequence names, outlier SNR, ring removal parameters, and the beam hardening correction file name. Optionally the background region, clipping region, and user centers can also be saved by changing the preferences (in `autorecon.tcl` only). The template files are saved in '`~/autorecon`'. This is also the place where beam hardening correction files are kept. Template files are useful for saving settings that will

be used for several AutoRecon jobs. When a template file is loaded into an "`.sct`" file, all the settings in the template are applied.

2.8 User preferences file

In the Unix environment a preferences file can be created in the user's home directory to change the default behavior of AutoRecon. If the file "`.autoreconrc`" exists then it is read and the settings in the file are used. The different options that are available in the settings file are described in §7. On Win32 platforms the preferences file is in the AutoRecon install directory and is named "`autorecon.ini`" and is effective for all users.

3 GUI application (`autorecon.tcl`)

The GUI Tcl/Tk script is called "`autorecon.tcl`." It can be invoked without command line arguments or with the "`.sct`" file name as the only argument. The GUI shows all of the preprocessing and reconstruction parameters in one window (Figure 4). The main window is divided into regions that contain related parameters.

3.1 File menu

The [File] menu gives access to the commands for opening and saving "`.sct`" files as well as loading and saving template files. The current "`.sct`" file is automatically saved under certain conditions: Any processing action is performed, the program is exited, or [File⇒Save `.sct`] is selected. If you accidentally change something that you want to undo then use [File⇒Revert to Saved] before the "`.sct`" is saved (don't exit, that saves the changes).

3.2 Process menu

The [Process] menu gives access to the commands that create the example images (Attenuation, Sinogram, and Slice) to check the filter parameters. The [File⇒Submit Job...] menu item will prompt the user for a time/date to run the full AutoRecon job. The time specification is the same as that used by the UNIX '`at`' command and the man–page on `at` describes the time/date format and any aliases that can be used. The time defaults to "`now`" which

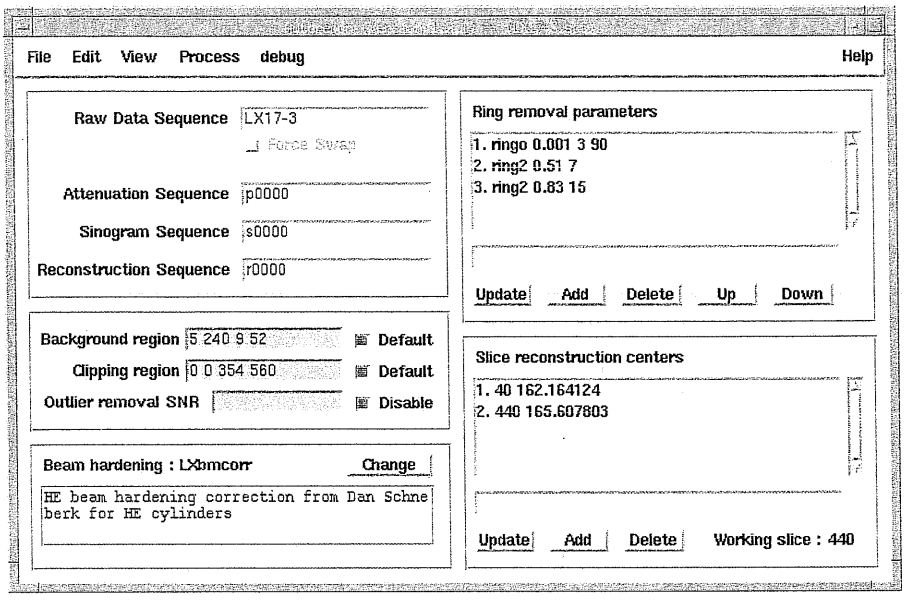


Figure 4: `autorecon.tcl` user interface

executes the job immediately. The output of the job is piped into the file `ar.out` and the process exit status is emailed to the user. In the Win32 version the time is not specified and the command runs immediately as a separate process.

3.3 View menu

The [View] menu will display the result of a Process command. It is possible to view either a single image or an entire sequence using the [View⇒Image / Sequence] menu selection. For the [View⇒Attenuation] and [View⇒Sinograms] cascade menu items the user has the choice of viewing the filtered image, the unfiltered image, or the difference image between filtered and unfiltered data.

3.4 Attenuation settings

The two regions are entered into the windows as a space separated list of four integers in the order (`x0 y0 nx ny`). If the default values are used then the default checkbox should be checked which will disable (gray-out) the

entry window. Outlier removal can be turned on by unchecking the disable checkbox and entering the outlier removal signal–to–noise ratio in the entry window.

3.5 Beam hardening files

The lower left section of the `autorecon.tcl` window shows the current beam hardening file that will be used and the title of the beam hardening file, or "`(none)`" if it is disabled. Pressing the Change button will open a dialog that shows the current beam hardening file parameters which includes the title of the beam hardening file, a long description, and the polynomial coefficients. If "Disable Beam Hardening" is checked, beam hardening will be turned off. The Open button will open a dialog that will allow the user to select a new beam hardening file to use. If no files appear then you should make sure that you have some beam hardening files (`.bhc` files) in the directory `~/autorecon`.

3.6 Ring removal

Ring removal commands are entered by typing the command in the single line entry box just above the command buttons. A ring removal command has one of the two forms:

```
ringo snr order window          ring2 snr order
```

where "`snr`" is the signal–to–noise ratio that determines what portion of the sinogram to operate on, "`order`" is the number of times 3 pixel smoothing is applied, and "`window`" specifies the number of rows to use in determining the region to filter (see §1.2). Once a command is entered into the entry box press the Add button and it will be added to the list of ring removal commands to apply to the data. As many ring removal commands as desired can be added. A command can be edited by selecting the command in the list window (upper window) and changing the command in the entry box the pressing the Update button. Similarly commands can be deleted, and shuffled up or down with the other buttons.

3.7 User centers

Interaction with the user centers is similar to the ring removal commands. However, the initial entries are usually inserted automatically as a result of running an example slice reconstruction. Adjustment is sometimes required and can be done by selecting the user center, editing the pxcenter value and clicking the Update button. The ordering is automatically sorted by increasing slice number. The lower right corner of the user center window shows the current sinogram/reconstruction working slice as a reference.

4 Console application (autorecon)

The command line interface program is called "autorecon." If you just type the command without any arguments then information about how to use the program is displayed:

```
nde-reine: dataset> autorecon

Usage :: autorecon sctfile [ options ]

   The options are :

      -flat    ===> Do the flat field correction (attenuation conversion).
                    This will also do outlier removal.
      -sino    ===> Create sinograms from attenuation sequence with ring
                    removal and beam hardening correction.
      -recon   ===> Run reconstruction from sinogram sequence.
      -fullrun ===> Run non-interactively to process the entire recon job
                    from raw radiographs through to the reconstructed
                    slices.
                    This is the same as specifying '-flat -sino -recon'.
      -m       ===> Make a template from the settings in the .sct file.
      -t       ===> Prompt for a template file to read from (*.tmpl).
```

To use the console interface, the program will have to be run several times. Each time only one task can be requested. Figure 5 shows a flow chart of autorecon's prompts and options.

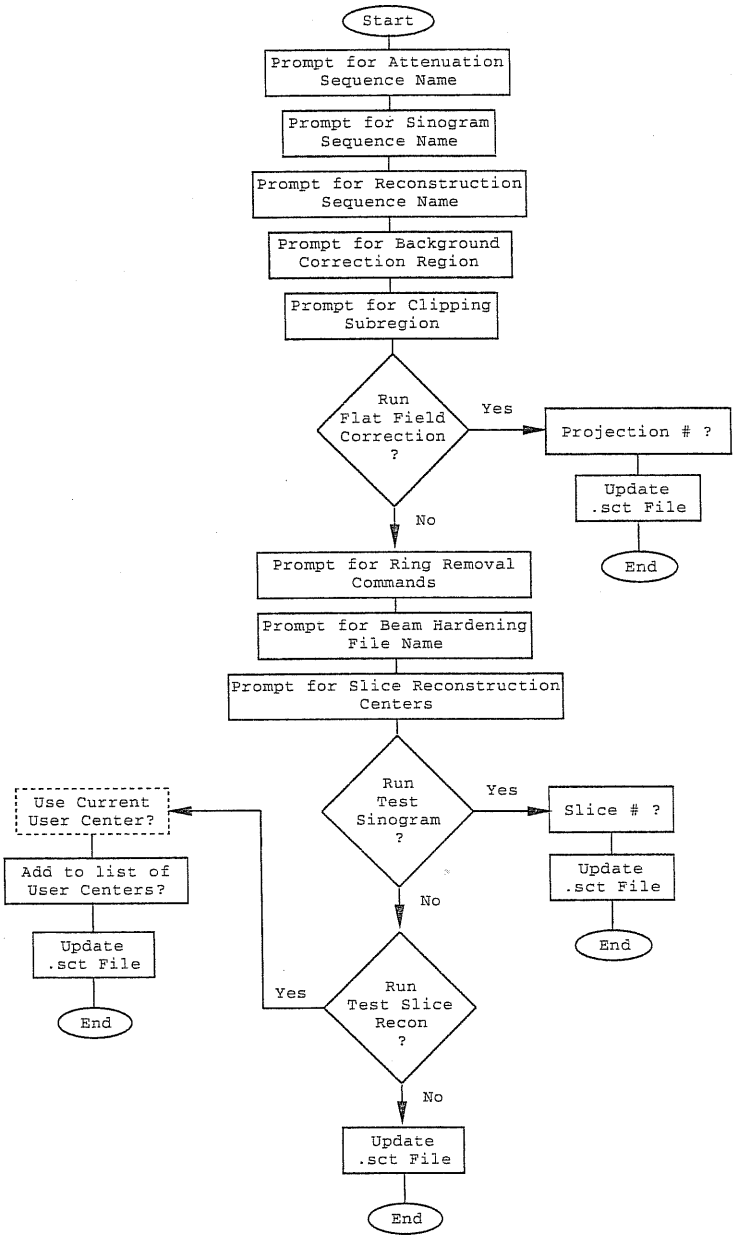


Figure 5: autorecon flowchart

4.1 Console processing steps

1. Run `autorecon` on the "`.sct`" file that is created during initial data collection by typing '`autorecon` *sequence_name*.' Without any options the program will prompt for all the information it wants.

2. Enter the necessary information. At this point you will probably leave the background postage stamp evaluation region (`-AR_eval`) and the projection clipping region (`-AR_rawsub`) alone.

3. Ask to run a test flat field correction for a projection. Look at the resulting images. Rerun `autorecon` and change the outlier SNR (signal-to-noise ratio), background region, and/or the clipping region and generate new test flat field images. (repeat if necessary).

4. Rerun `autorecon` and don't run a test flat field correction. Enter the parameters for ring removal and enter the file name for the beam hardening correction. Note that at this point the beam hardening correction file must be in the `~/autorecon/` directory. (In the future we should put all beam hardening files in one directory as a master copy). Run a test sinogram on a slice near the upper part of the data set.

5. Look at the test sinograms and adjust the ring removal as necessary.

6. Rerun `autorecon`. Don't enter any centers and ask for a test reconstruction. It will do a reconstruction of the test sinogram that you just made. Say yes to entering the computed center into the "`.sct`" file. Look at the slice. Adjust ring removal and the center if necessary. Rerun test sinograms and test reconstructions if needed. Use the same slice number as used in step 4.

7. Repeat sinogram–slice reconstruction process on another slice near the bottom of the dataset and adjust its center until good results are obtained. At this point you should have two centers defined, one near the top (approx. slice 30) and one near the bottom (approx. nslices-30). These two points will be used to create a centers file by linearly interpolating between them (and extrapolating out to the top and bottom).

8. Run `autorecon` with the '`-fullrun`' flag to run the entire job at once. A typical command line might look like:

`autorecon` *sequence_name* `-fullfun >` *output_file* `&`
where *sequence_name* is the raw radiograph sequence and *output_file* will be created and all program output will be piped into it. The ampersand (&) runs the command immediately and in the background.

4.2 Sequences

The first things that are prompted are these sequences (see also §2.1. Defaults are given for most parameters and pressing 'enter' will choose the default (in parentheses).

```
nde-reine: dataset>autorecon LX17-3
LX17-3.sct :: -AR_attenfile p0000
attenuation sequence set to p0000
Do you want to change the attenuation sequence (n) ?
attenuation sequence file name '-AR_attenfile' set to 'p0000'.

LX17-3.sct :: -AR_sinofile s0000
sinogram sequence set to s0000
Do you want to change the sinogram sequence (n) ?
sinogram sequence file name '-AR_sinofile' set to 's0000'.

LX17-3.sct :: -AR_reconfile r0000
reconstruction sequence set to r0000
Do you want to change the reconstruction sequence (n) ?
reconstruction sequence file name '-AR_reconfile' set to
'r0000'.
```

4.3 Regions

The background region is defined by the key word `-AR_eval(pts)` (where `(pts)` has four values, "`xstrt`", "`ystrt`", "`xsize`", "`ysize`") and the cropping region is defined by the key word `-AR_rawsub(pts)` (see §2.2). Both regions are entered as a space separated list of four numbers in the order above.

```
Region defined by : '-AR_eval' : 5, 240, 9, 52
```

```
Do you want to change this region (n) ?

Region defined by : '-AR_rawsub' : 2, 15, 350, 520
Do you want to change this region (n) ?
```

4.4 Outlier SNR parameter

The outlier signal–to–noise ratio is specified next (see §1.1). After this parameter you are asked if you want to run a test flat field projection.

```
Outlier signal-to-noise parameter = 0.007
Do you want to change this parameter (n) ?

Do you want to run a test flat field correction (n) ?
```

4.5 Ring removal

The next part prompts for the sinogram specific information (see §1.2). There can be any number of ring removal commands and they can be added to and/or modified. The format of the ring removal command is the same as the VIEW macros without the leading '@.'

```
Current ring removal commands :
ringo 0.001 3 90
ring2 0.51 7
ring2 0.83 15
Do you want to add/change the ring removal (n) ?
```

The ring removal commands have the format specified in §3.6. Ring removal is a data smoothing process that attempts to remove linear artifacts in the Θ direction in a sinogram due to differing detector pixel gain values.

4.6 Beam hardening correction

The beam hardening correction is another file that contains a text description of the application of the beam hardening and the order and coefficients of the polynomial used for the correction. These files will only be found if they are in the location '`~/autorecon/*.bhc`'.

```
Beam hardening correction file set to : HEbmcorr.bhc
Beam hardening information :
   Title : HE beam hardening correction from bmcor1.vm
   Description :
This second order polynomial given by y = 0.627699*x +
0.02187*x^2 was determined from tests done on TATB HE
on February ...
The data for this polynomial was taken from the view macro
bmcor1.vm in the /center1/CommonLocalDir/VIEW/macros
directory.

   polynomial order : 2
   Coeff[0] = 0
   Coeff[1] = 0.627699
   Coeff[2] = 0.02187
Do you want to change the file (n) ?
```

4.7 User slice centers

The slice centers are used to generate a centers file (.ctr) (see §2.5). On the first run of autorecon the center calculated by newrecon should be used and entered into the list of pxcenters. On the second run of autorecon that center can be changed and the results checked by running another reconstruction. This process is then repeated on another slice by running a test sinogram on a different slice and doing reconstructions.

```
Current slice pxcenters :
slice #50 with center = 162.172

Do you want to add/change the pxcenters (n) ?

Last run test sinogram : slice #450
Do you want to run a test sinogram (n) ?

Do you want to run a test slice reconstruction (n) ? n
```

4.8 Template files

The current sequence names, outlier parameter, ring removal commands, and the beam hardening correction file name can be saved for later use with another object (scan). This information is kept in template files (`*.tmpl`) in the directory '`~/autorecon`.' They are text files with the same format as an "`.sct`" file. The current objects settings are saved into a template by specifying the '`-m`' option to `autorecon`. The settings in a template file are loaded into the current objects "`.sct`" file by specifying the '`-t`' option in `autorecon`. Settings that are loaded from a template file overwrite the current settings for the object.

5 Miscellaneous

5.1 Byte order of image data

The native byte order of the image data is different on the IBM–PC's versus (nearly all) the rest of the computer world. The VIEW file libraries used in AutoRecon and its helper programs attempt to determine the byte order of the image data and swap the data if necessary. This is accomplished by looking in the "`.sct`" file for certain clues about where the data was generated. It is possible to force a certain byte order if the libraries do not guess the byte order correctly by putting the `-AR_byteorder` tag in the "`.sct`" file manually (see §6). All newly generated sequences are saved in the host machines native byte order and the correct `-AR_byteorder` tag is written into the "`.sct`" file.

The byte order is determined automatically in the following order: 1) Look for the `-AR_byteorder` tag; 2) Look for the first occurence of a `-program` tag, if found and it contains a forward slash "/" then assume the byte order is BigEndian otherwise the data is LittleEndian; 3) if neither the `-AR_byteorder` or the `-program` tag exist then look for the `-archdir` tag, if found and it contains a colon ":" then the data is LittleEndian otherwise the data is BigEndian; 4) Finally if none of the tags is found assume the byte order is the same as the current machine.

5.2 Todo list

1. Centralize beam hardening correction files into a single append–only (sticky–bit) directory.

2. Control memory usage in `flatfield` and `sinoring` and enable multi-threaded/distributed execution.

3. Port to Windows™ operating system.

6 List of ".sct" file tags

This is a list of the ".sct" file tags that are defined by AutoRecon. Many of the existing tags that `newrecon` uses are also used by AutoRecon in addition to the ones listed here. If more than one tag exists in a file then the first one encountered in the file will be used. Some tags can have multiple entries like the ring removal tags and the user center tags.

`-AR_rawfile` *string* The name of the raw radiograph data sequence to process. If omitted then the basename of the ".sct" file will be used.

`-AR_attenfile` *string* The name of the sequence to create (or overwrite) that will contain the attenuation radiographs after mean value correction and outlier removal.

`-AR_sinofile` *string* The name of the sinogram sequence to create (or overwrite) after ring removal and beam hardening correction.

`-AR_reconfile` *string* The name of the reconstruction sequence to create (or overwrite).

`-AR_evalxstrt` *integer* The upper–left corner x–coordinate of the "evaluation" region used for background mean variation corrections.

`-AR_evalystrt` *integer* The upper–left corner y–coordinate of the "evaluation" region.

`-AR_evalxsize` *integer* The x–size of the "evaluation" region.

`-AR_evalysize` *integer* The y–size of the "evaluation" region.

`-AR_rawsub`*(pts) integer* The four tags that describe the subregion of the raw radiographs to use for further processing. Used to exclude blank regions around the scanned object. The "evaluation" region can be outside this region.

`-AR_outlier` *float* The signal–to–noise parameter to use for outlier removal by `flatfield` during attenuation correction. A smaller value does stronger filtering and a value of zero uses straight 3x3 median filtering. Absence of this tag turns off outlier removal.

`-AR_ringrm` *float integer [integer]* A single ring removal specification where the parameters are the signal–to–noise ratio, the smoothing filter order, and optionally a window size. There can be more than one of these tags to specify multiple ring removal passes. Sinogram normalization is done after the ring removal and only if ring removal is performed. (NOTE: The `ringo` and `ring2` parts are not present.)

`-AR_beamhard` *string* The name of the file that describes the beam hardening correction. Can be specified with or without the "`.bhc`" extension. The file *must* be in the `~/autorecon/` directory.

`-AR_usercenter` *integer float* A user defined center specification. The first parameter is the slice number for the center and the second is the location of the x–center. There are usually two of these in each "`.sct`" file for slices near the top and bottom of the object. WARNING — If you change the `-AR_rawsub` parameters by hand such that the y–coordinates change then these centers will be wrong.

`-AR_sinoslice` *integer* The last slice number that was requested by `autorecon` test sinogram procedure. Don't modify by hand.

`-AR_byteorder` *string* The byte order of the sequence image data. This is specified as either "`BigEndian`" or "`LittleEndian`." IBM-PCs and VAXs are little endian and SGIs, Suns, and Macintoshes are big endian. This is usually set correctly by AutoRecon; however, if not then explicit setting of this tag will ensure correct byte ordering.

7 List of `.autoreconrc` parameters

This is a list of the parameters that can be set in the optional user preferences file "`.autoreconrc`" which is located in the users home directory. tags that are defined and use by `autorecon`. If more than one entry exists in the file then the last one encountered in the file will be used.

`BeamHardPath:` *dirpath* The path to use when looking for beam hardening files, without trailing slash (`~/autorecon`)

`TemplatePath:` *dirpath* The path to use when looking for template files, without trailing slash (`~/autorecon`)

`FlatFieldCommand:` *string* The name of the executable to use to do attenuation conversion (`flatfield`)

`SinoRingCommand:` *string* The name of the executable to use to do sinogram conversion (`sinoring`)

`ReconCommand:` *string* The name of the executable to use to do slice reconstruction (`newrecon`).

`ReconFlags:` *string* The options to pass on the command line to the `ReconCommand` executable (`-operation RECON -rmethod CBP`)

`TemplateAR_attenfile:` *0/1* Include the attenuation sequence base name in template files (`1`)

`TemplateAR_sinofile:` *0/1* Include the sinogram sequence base name in template files (`1`)

`TemplateAR_reconfile:` *0/1* Include the reconstruction sequence base name in template files (`1`)

`TemplateAR_evalROI:` *0/1* Include the background evaluation region in template files (`0`)

`TemplateAR_rawsubROI:` *0/1* Include the clipping region in template files (`0`)

`TemplateAR_outlier:` *0/1* Include the outlier SNR in template files (`1`)

`TemplateAR_beamhard:` *0/1* Include the beam hardeing file name in template files (`1`)

`TemplateAR_ringrm:` *0/1* Include the ring removal parameters in template files (`1`)

`TemplateAR_usercenter:` *0/1* Include the user centers in template files (`0`)

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