
breastCrop Documentation

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Contents:

1	Overview	2
2	Installation	3
2.1	Operating System	3
2.2	Compilation	3
2.3	Finish	4
3	Running the Software	5
3.1	Command line options	5
3.2	Operating Modes	5
4	File Formats	7
4.1	Input Files	7
4.2	Output Files	7

Welcome to the VICTRE breastCrop software documentation!

This documentation provides information regarding how to download, install, and use the VICTRE breastCrop software which provides uniform cropping of physically compressed breast phantoms. It is designed to be used with anthropomorphic voxelized whole-breast phantoms generated by the VICTRE software packages breastPhantom and



breastCompress. This software was developed as part of the [Virtual Imaging Clinical Trials for Regulatory Evaluation \(VICTRE\)](#) project at the U. S. Food and Drug Administration.

The VICTRE tools provide a complete simulated imaging chain for mammography and digital breast tomosynthesis and are available as [open source software](#)

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For efficient use of limited GPU memory during x-ray particle transport with MC-GPU, an x-ray photon transport code which is also part of the VICTRE package, this code crops out parts of the phantom that are not directly in the path of the x-ray source between the compression surfaces. It also can uniformly crop repeated realizations of a phantom configuration file to remove slight variations in phantom size due to the effect of random internal tissue structures on the physical compression simulation.

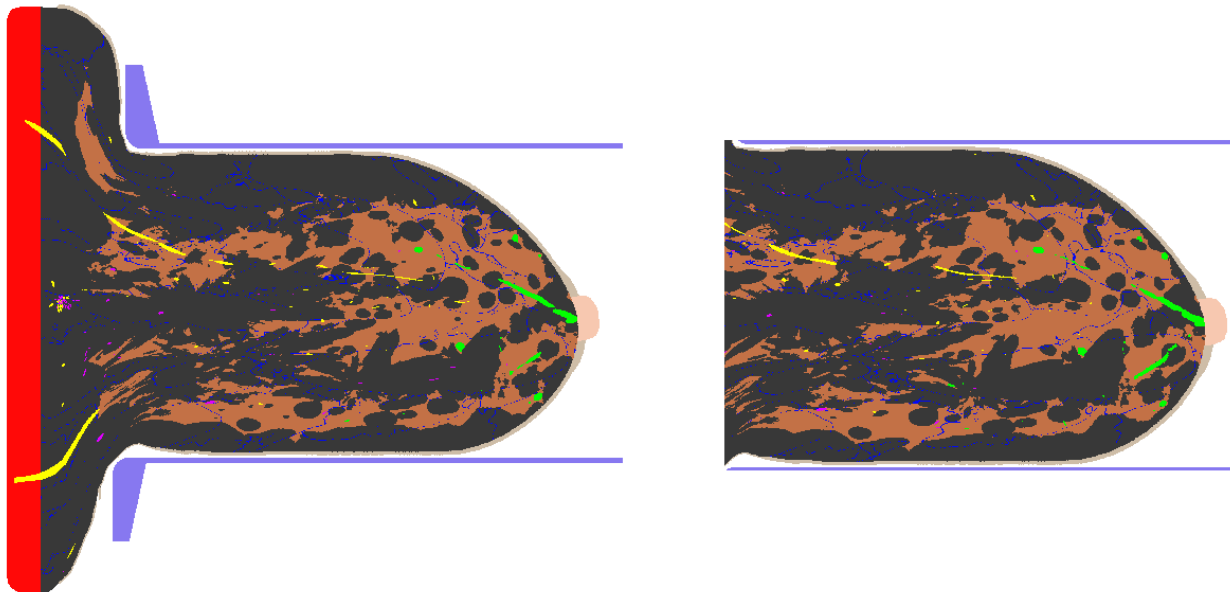


Fig. 1: Cross-sectional view of uncropped (left) and cropped (right) phantom.

The breastCrop source code is available [here](#). It is written in C++ and therefore must be compiled for your system before use.

2.1 Operating System

This software has been developed and tested on Debian and Red Hat based Linux distributions. Compilation is via cmake and should be possible on any UNIX-like operationg system (including MacOS) with minimal modification to the build configuration in the provided CMakeLists.txt file, however the following distributions are recommended:

- Ubuntu 16.04
- Centos 7.x

The following build instructions are based on Ubuntu 16.04.

2.2 Compilation

First, install the packages necessary to compile the software (reminder: instructions are specific to Ubuntu, consult your operating system documentation for analagous package names and installation procedures) From a terminal command prompt:

```
> sudo apt-get install cmake vtk6 libvtk6-dev \  
                        libblas-dev liblapack-dev \  
                        libboost-dev libboost-program-options-dev \  
                        libproj-dev zlib1g-dev
```

Next, clone the git repository:

```
> git clone https://github.com/DIDSR/breastCrop
```

From a suitable build directory generate a Makefile using cmake and run make:

```
> cmake <path to repository>
> make
```

where <path to repository> is the directory containing the cloned repository. Note, when running cmake you may receive an error message related to references to files “/usr/lib/x86_64-linux-gnu/libvtkRenderingPythonTkWidgets.so” and “/usr/bin/vtk”. This is a known Ubuntu VTK bug but since we are not linking to these files, the error can safely be ignored.

2.3 Finish

If the previous steps were successful, the executable breastCrop should be present in the build directory. This file can be copied to a convenient location in your path, or the build directory can be added to \$PATH. No additional installation steps are required. Consult the next section which describes how to run the executable.

Running the Software

3.1 Command line options

breastCrop is run from the command line and requires that several command line options be specified:

```
> breastCrop -s <SEED> -g <GAP> -x <XVOX> -y <YVOX> -z <ZVOX> -d [DIRECTORY] -h
```

required command line arguments are

-s SEED	the seed number of the compressed phantom you wish to crop
-g GAP	size of air gap to maintain around phantom (mm)
-x XVOX	crop size in x direction (number of voxels)
-y YVOX	crop size in y direction (number of voxels)
-z ZVOX	crop size in z direction (number of voxels)

optional command line arguments are

-d DIRECTORY	the directory containing the uncompressed breast phantom. The output compressed breast phantom will be placed in this directory as well. The default value is '.' representing the current working directory.
-h	print a help message

3.2 Operating Modes

breastCrop has two operating modes, automated determination of crop dimensions and proscribed crop dimensions. Automated crop dimensions are triggered by specifying 0 for the crop sizes, e.g. the command,:

```
> breastCrop -s 123456789 -g 1.0 -x 0 -y 0 -z 0
```

will crop the compressed phantom `pc_123456789.raw.gz` in the current working directory to the extent of the compression surfaces, with a 1 mm air gap around the edges of the phantom. The command:

```
> breastCrop -s 123456789 -g 1.0 -x 500 -y 600 -z 600
```

will crop the same phantom to a voxel size of 500x600x600 with the region cropped as close as possible to the region that would have been selected with automatically selected dimensions. The main purpose for this mode is to eliminate small variations in crop size across multiple phantom realizations to simplify batch processing with MC-GPU.

breastCrop requires as input a compressed breast phantom file and corresponding .mhd header. The output is a cropped phantom file and corresponding header. In the following filename descriptions *nnnnnnnn* represents the seed number specified as a command line option to breastCrop.

4.1 Input Files

The breastCrop input files are created using breastCompress. breastCrop expects the following files to be present in the input directory specified on the command line:

pc_nnnnnnnn.raw.gz The raw compressed phantom volume stored as 8-bit unsigned integers in a gzip archive. There is no file header.

pc_nnnnnnnn.mhd A metaImage header file containing information about the phantom data stored in the file pc_nnnnnnnn.raw.gz

4.2 Output Files

Final output file have formats indential to the input files with suffix *_crop* to designate they represent a cropped phantom

pc_nnnnnnnn_crop.raw.gz The raw cropped phantom volume stored as 8-bit unsigned integers in a gzip archive.

pc_nnnnnnnn_crop.mhd A metaImage header file containing information about the phantom data stored in the file pc_nnnnnnnn_crop.raw.gz

Note: The input phantom will likely have an associated TDLU location file pc_nnnnnnnn.loc. The locations provided are physical coordinates, not voxel indicies, therefore no translation of the .loc file is required for use with the cropped version of the phantom.
