Stellenbosch University CT Scanner Facility: “after your scans”

A guideline on what to do with all your microCT data

Dear client, user, collaborator,

Congratulations on getting your CT scans done! The scanning process is shown in the video at this link: https://youtu.be/Yqui4OPVZu0

This document is meant to assist in getting you started with data analysis and reporting your X-ray tomography results. Please note that our facility is at heart a research facility and we are researchers, so we hope you will publish your work as much as possible and we are here to assist with that. You will note we do not distinguish between client, user or collaborator. This is because you are all of the above, and your work is important to us. We offer the best possible X-ray tomography facility, skills and expertise and this is made possible by people like you supporting us. This document outlines three important aspects:

(1) how to analyze 3D data and what are your options
(2) when to include us as co-authors in your paper and
(3) how to report your work in scientific publications, including possible references from similar work at our facility which you may cite

But before we start, please note that we do not keep your data in archive of any sort, your data is your responsibility, so please keep it safe and make a backup! We sell hard drives for this purpose.
(1) How to analyze your 3D data and what are the options

X-ray microCT generates high quality 3D volumetric data of an object, ie. your volume data set comprises of typically up to 2000 × 2000 × 2000 volumetric pixels (voxels), each having a grey value in the range 0 - 65535, depending on the material density and atomic composition. That means when a dense particle is inside your material, the associated voxels will be brighter (higher grey values) and surrounding material will be less bright. This data is typically analyzed in 3D data viewing and analysis software: in our facility we extensively use the market leading software for microCT data, Volume Graphics VGStudioMax 3.2. We also offer Avizo Fire and Simpleware for users familiar with these softwares. For analyzing 2D images, imageJ or Fiji is often used by researchers and this can also be applied to 3D data, but requires some effort. A simpler and more powerful solution for 2D images is MiPAR, also available at our facility. Custom image analysis procedures can also be written by users in matlab or python, for example. If you have an interest in making your own analysis, all you need to do is obtain the suitable format for your data set. We can generate any output type but our default output is a Volume Graphics format – VGI and VOL files, and when we have made analysis this is included in the VGL interface file and associated folder with project information. Please note the raw X-ray images with your scan are not part of the 3D data set, but included in your data (for the purposes of backup). For more information on your data, please see the youtube video here:

https://youtu.be/A0KZFeCOJHY

For more on the free 3D viewer (myVGL) and how to open your data, see here:

https://youtu.be/7xW5iHvl3sA

For now, you need to know that you have 3D image data and you need to analyze it. We offer analysis support, here below are some easy options

1. Make use of our analysis PCs, which can be booked via the online system in booking slots of 4 hrs. Month-bookings are available at a discounted price

2. Assisted analysis involves a trained analyst to directly assist you with routine analysis tasks, and sometimes assist in developing custom image analysis procedures. These bookings are also in 4 hr slots and can take the form of training when required, but is highly effective because it is done on your own data.

3. Provide us your requirements and data and we do all analysis for you, the cost depends on the complexity of the task. Typically accurate volume and dimensional measurements require 1 hr, porosity analysis 1 hr, making images and videos and data processing for easy viewing 1 hr. Routine analysis tasks are described in a later user guide, but the rule is – if its
possible (you have seen it in a publication), we can do it. If its not possible, its highly likely we can figure out how to do it

(2) When to include us as authors in your paper
We welcome the opportunity to take an active part in your research, as we are researchers ourselves. As researchers, we provide the best possible support to allow you make discoveries which would not have been possible without our inputs. When this is the case, we expect co-authorship, irrespective of the payments made. Ethically when a contribution is made by a staff member you are obliged to include them as an author in your work. This is not the case for routine work, such as basic generation of images. But, when an analysis involved custom analysis procedures, method development or insight by the person involved, this constitutes a scientific contribution and needs to be reported as such in the paper, by the person who did the work. We gladly assist in writing the paper and taking part in the work, which also simplifies the process for you. When you are unsure please discuss it with us directly.

When you have no interest in our possible scientific contributions, please still feel free to use the facility and make bookings for self-analysis. Everyone is welcome and we understand that your work is important to you. It is mandatory that our facility paper is cited:


This also indirectly acknowledges the National Research Foundation and Stellenbosch University for financial support of our facility through the initial equipment purchases.

(3) How to report your work in scientific publications
In order to report your results in the scientific literature (and in your thesis/dissertation), you need to provide enough details for others to be able to reproduce the work. Below you will find a typical paragraph from work done at our facility. All these details can be found in the “*.PCA” file of each scan.

MicroCT scans were performed at the Stellenbosch CT Facility [1], using a General Electric V|TomeX L240 system. Optimized parameters were selected according to the guidelines set out in [2]. X-ray settings included 220 kV and 200 $\mu$A and copper beam filtration of 1.5 mm was used, with a voxel
Size set to 80 µm. Image acquisition time was 500 ms per image and images were recorded in 2000 rotation steps during a full 360 degree rotation of the sample. At each step position, the first image was discarded and the subsequent 3 images averaged to provide high image quality. Detector shift was activated to minimize ring artefacts and automatic scan optimizer was activated to eliminate artefacts due to possible sample movement or X-ray spot drift. Reconstruction was performed in system-supplied Datos reconstruction software. Visualization and analysis was performed in Volume Graphics VGStudioMax 3.2.


Please do not cut and paste the above, as you need to report it in your own words. Sometimes less detail is required, other times more is required in terms of image processing steps. Sometimes it is easier to cite other similar work, especially when the analysis is performed in the same way. Below are some papers which can be cited for specific application types, but also check our website under “research” at this link for updated publications list:

http://blogs.sun.ac.za/ctscanner/research/

Or my google scholar profile here:

https://scholar.google.co.za/citations?hl=en&user=JlqadDkAAAAJ&view_op=list_works&sortby=pub
date

Below are some examples to get you started (last updated in 2017)

Many examples are shown in our facility paper:

Porosity / defect analysis, wall thickness analysis and CAD variance analysis in metal parts


Porosity analysis in metal, before-after processing


Porosity analysis of concrete


Analysis of additive manufactured / 3D printed parts


**Simulations of microCT data**


**Analysis of geological materials**


**Biological sciences**


**Food and agrisciences**


**Fossils / heritage**


**Energy materials**