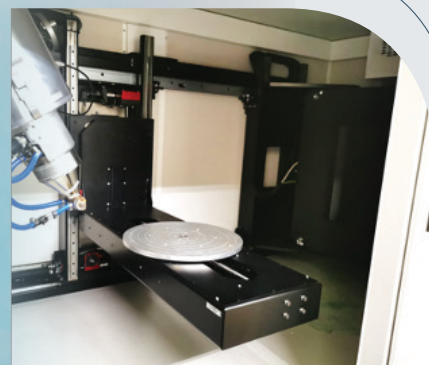


MIXRAD Facility

Micro-focus X-ray Computed Tomography for 3D Qualitative and Quantitative Non-destructive Investigations



The characteristics of the Micro-focus X-ray Radiography and Tomography laboratory, MIXRAD, enables selection of wide resolution range, X-ray tube, variable exposure time and sample stage carrying capacity that makes it attractive to a wide range of applications in science and engineering.

The instrument located at the South African Nuclear Energy Corporation (Necsa), is accessible to researchers from academia and industry.

Access to the facility is through scientific merit of submitted project proposals within the open access User Program where results are published in the open literature. Commercial (proprietary) access is also available. The calls for beam time booking proposals are communicated at the end of each beam time period.

Beam Time Booking Schedules		
Period 1	Period 2	Period 3
Jan - April	May - Aug	Sep - Dec

System Characteristics		Value
X-RAY SOURCE	Voltage [kV]	30 - 225
	Spot size [μm]	$\sim 1 - 3$
	Resolution [μm]	5 - 127
	Multi target selections	Mo; Cu; W; Ag
TRANSLATION TABLE	Sample position scannable [directions]	X, Y, Z, Rotation and Tilt
	Weight capacity [kg]	45
	Rotation accuracy [$^\circ$]	1×10^{-3}
	Tilt [$^\circ$]	45
	Sample dimensions: length, width [mm]	Minimum: > 10 Maximum: ~ 170
DETECTOR	Type	Perkin Elmer
	Dynamic Range	16 bit
	Physical Size [mm]	400 x 400
	Pixel Size [μm^2]	200 x 200

X-ray Computed Tomography Technique

Micro-focus X-ray computed tomography (μXCT) is a non-destructive technique that uses X-rays to investigate components for the qualitative and quantitative 3D visualisation of features. The μXCT system achieves high resolution ($5 \mu\text{m}$) for samples smaller than 10 mm, and lower resolution (up to $127 \mu\text{m}$) for samples larger than 170 mm. Large samples are sequentially scanned at different sections, or regions-of-interest, and stitched using advanced software to facilitate full component analysis. μXCT is thus an ideal technique irrespective of the sample sizes. A wide range of X-ray energies is available to provide different contrast and penetration options.

The Beam Line Centre at Necsa is also equipped with a Neutron CT facility to exploit the complementarity with μXCT .

useroffice@necsa.co.za to apply for beam time and general enquiries.

Case Studies

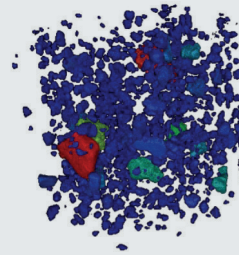
The non-destructive 3D visualisation capability contributes value addition to a wide range of scientific disciplines:

Geoscience

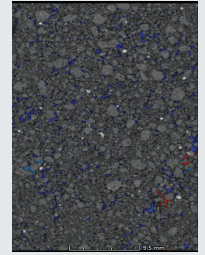
The selective attenuation of X-rays in their transmission through matter provides intensity contrast information of localised internal features such as: porosity; particle size, shape, volume, distribution; mineralogical and textural information. These parameters are important for minerals processing, mine planning and insights into the evolution of ore types.



Grey value/Density distribution



Mineralogy analysis

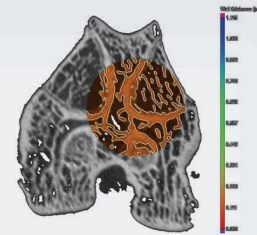


Porosity analysis

Anatomy / Zoology

μ XCT gives higher resolution than hospital based XCT, allowing amongst others identification of fine structures in anatomical sciences:

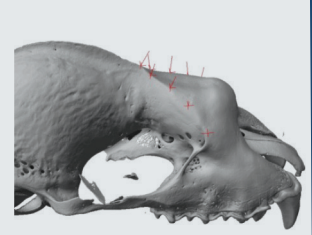
- Discrimination of internal morphometric structures such as trabecular spacing;
- Metrology such as length measurements;
- Land mark information for 3D structural spacing;
- Volumetric analysis to quantify volume structures;
- Trauma and forensic studies.



Bone structure analysis



Wall thickness analysis

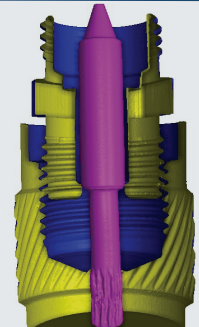
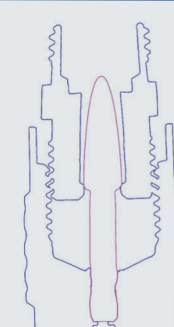
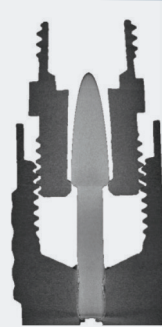


Land marks

Reverse Engineering

3D reconstructed volumes provide opportunities to:

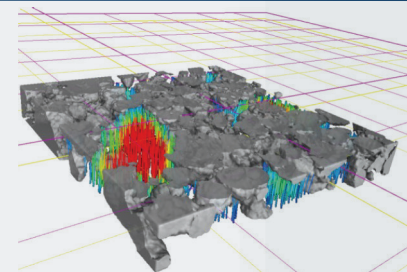
- Explore engineering design features;
- Optimisation of challenging areas;
- Generate stereolithographic (.stl) files that can be used to reproduce parts, or understand engineering design assemblies;
- Quality control of manufactured parts against original CAD drawings.



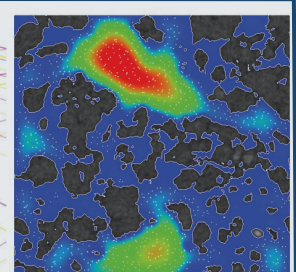
Conversion of 3D volume part (left) into a CAD drawing (right)

Agricultural Sciences

Porosity, pore structure and their connectivity are important parameters affecting water retention, binder efficiency, etc. in soil sciences. In addition insect infestations through-out the growth cycle of fruit and vegetables influence product quality. Quantitative information from laboratory based μ XC can benefit such farming practices.



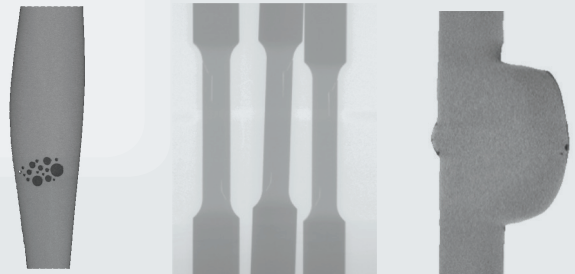
Water flow through soil pore structures



Simulation of flow rate

Non Destructive Inspections

The 3D capability enables inspection and study of internal phenomena in composite components manufactured by various methods. A rapidly expanding interest is the 3D inspection of additively manufactured components.



Visualisations of internal characteristics in additively manufactured components, and weld joining, i.e. pores, cracks, etc.



South African Nuclear Energy
Corporation SOC Limited

PO Box 582
Pretoria 0001
South Africa

T +27 12 305-5038
E useroffice@necsa.co.za
W www.necsa.co.za