

# New ways to use x-rays

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We develop new kinds of x-ray imaging that can reveal x-ray-transparent objects

Conventional

Phase contrast

Dark-field

X-rays can be:

Attenuated



Refracted



Scattered



X-ray beamlet:

Dims



Drifts



Diffuses



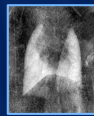
Revealing:



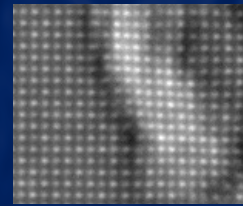
Dense objects  
Metal  
Bones



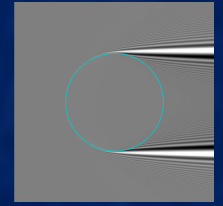
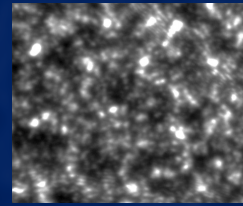
Low-density objects  
Airways  
Brain



Grains / Bubbles  
Fibres  
Air-sacs in the lungs



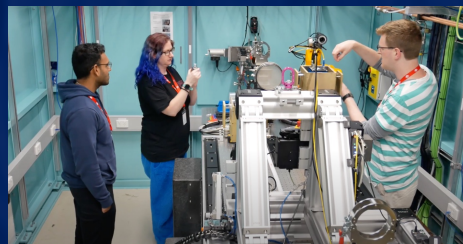
We developed the 'single-grid' and 'speckle-tracking' methods of x-ray imaging, and are examining how the x-rays self-interfere as they propagate.



Using Theory...

$$\frac{\partial I}{\partial z} = -\frac{1}{k} \frac{\partial}{\partial x} \left( I \frac{\partial \phi}{\partial x} \right) + \frac{\partial^2}{\partial x^2} (DI)$$

Experiments...



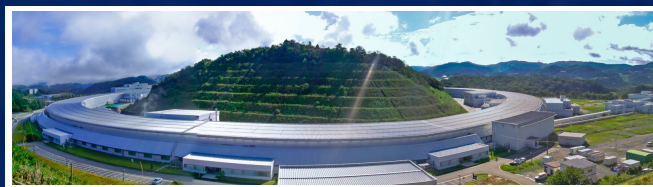
and/or Coding...

```
function [intensityDifference, intensityDifference2, intensityDifference3, intensityDifference4, intensityDifference5, intensityDifference6, intensityDifference7, intensityDifference8, intensityDifference9, intensityDifference10] = calculateIntensityDifference(image1, image2, image3, image4, image5, image6, image7, image8, image9, image10)
% Calculate the intensity difference between two images
% image1 and image2 are the two images to be compared
% image3 to image10 are the reference images
% Calculate the intensity difference between image1 and image2
intensityDifference = abs(image1 - image2);
% Calculate the intensity difference between image1 and image3
intensityDifference2 = abs(image1 - image3);
% Calculate the intensity difference between image1 and image4
intensityDifference3 = abs(image1 - image4);
% Calculate the intensity difference between image1 and image5
intensityDifference4 = abs(image1 - image5);
% Calculate the intensity difference between image1 and image6
intensityDifference5 = abs(image1 - image6);
% Calculate the intensity difference between image1 and image7
intensityDifference6 = abs(image1 - image7);
% Calculate the intensity difference between image1 and image8
intensityDifference7 = abs(image1 - image8);
% Calculate the intensity difference between image1 and image9
intensityDifference8 = abs(image1 - image9);
% Calculate the intensity difference between image1 and image10
intensityDifference9 = abs(image1 - image10);
% Calculate the intensity difference between image2 and image3
intensityDifference10 = abs(image2 - image3);
end
```

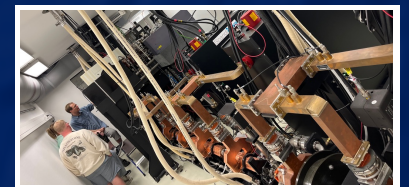
at a range of world-class facilities



The Australian Synchrotron



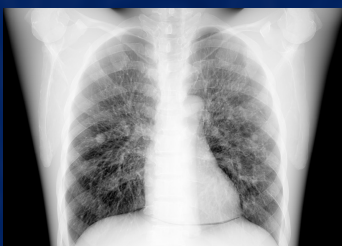
SPring-8 Synchrotron in Japan



The Munich Compact Light Source

We also apply these new x-ray imaging methods to solve real-world problems

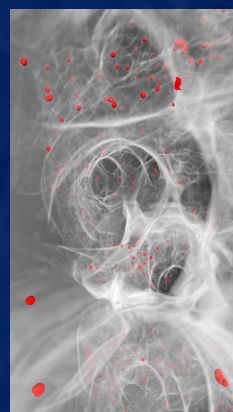
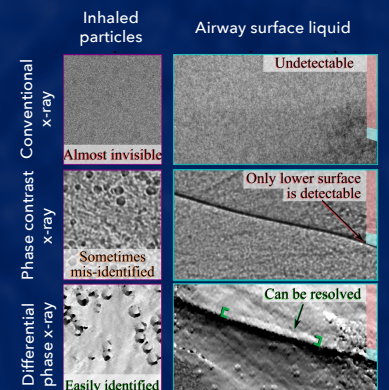
Lung cancer diagnostics



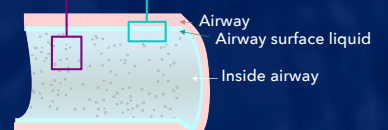
Understanding the anatomy of animals like the Honey Possum



Measuring treatment effects on the airway surface



Tracking treatment deposition in the lungs using phase contrast CT for 3D visualisation



Monitoring delivery of treatments attached to magnetic nanoparticles



Find out more at: [xrayimagingmonash.wordpress.com](http://xrayimagingmonash.wordpress.com)