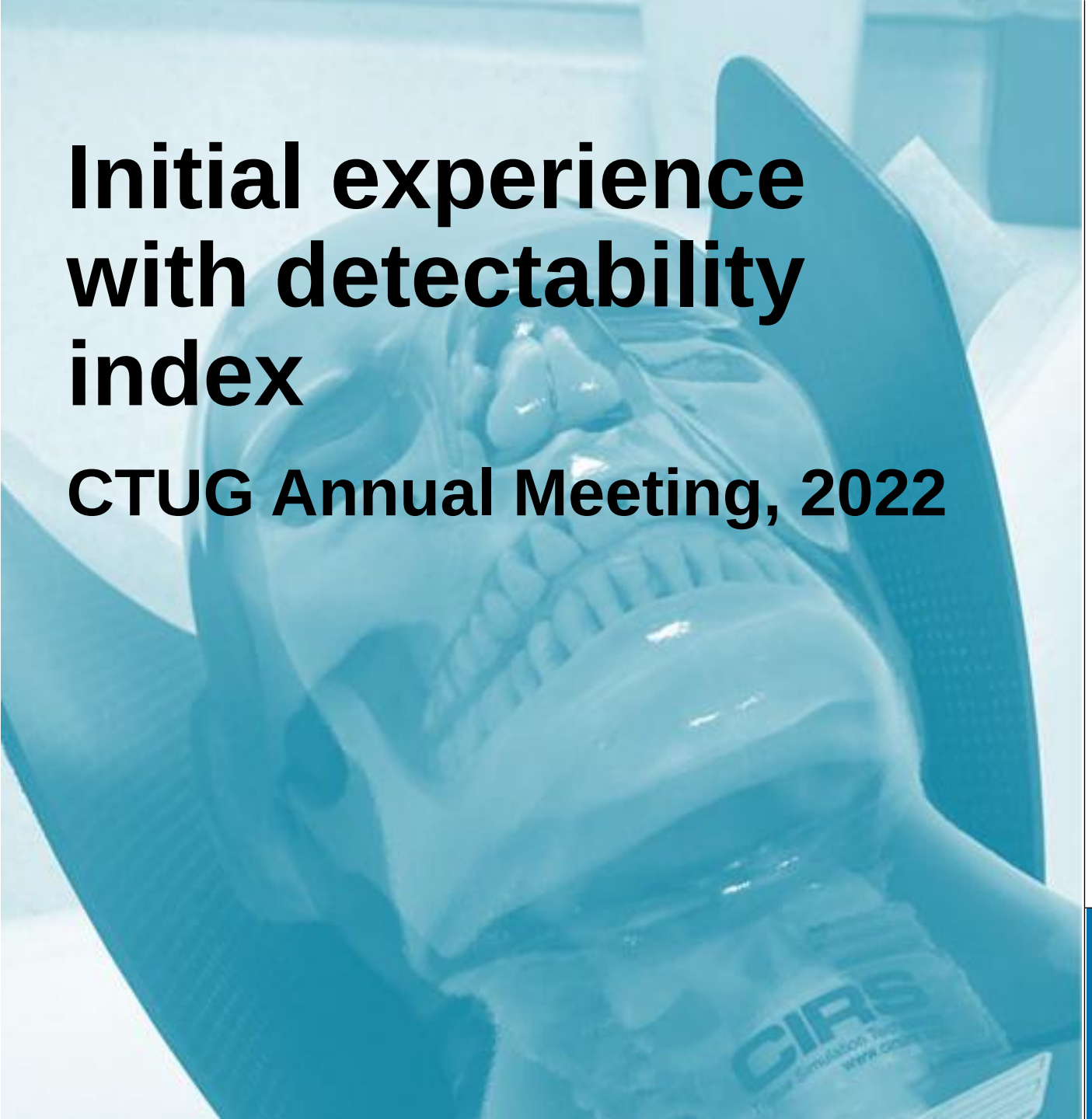


Initial experience with detectability index

CTUG Annual Meeting, 2022

NHS
CUH

Together
Safe
Kind
Excellent

Katie Howard
Lead Clinical Scientist for Diagnostic Radiology
East Anglian Regional Radiation Protection Service (EARRPS)

Objectives

To investigate the usefulness and usability of a detectability index (d') for optimisation of computed tomography examination protocols

- Detectability index
- Initial trials
- Validation

Detectability index, d’

This definition comes from Samei 2015

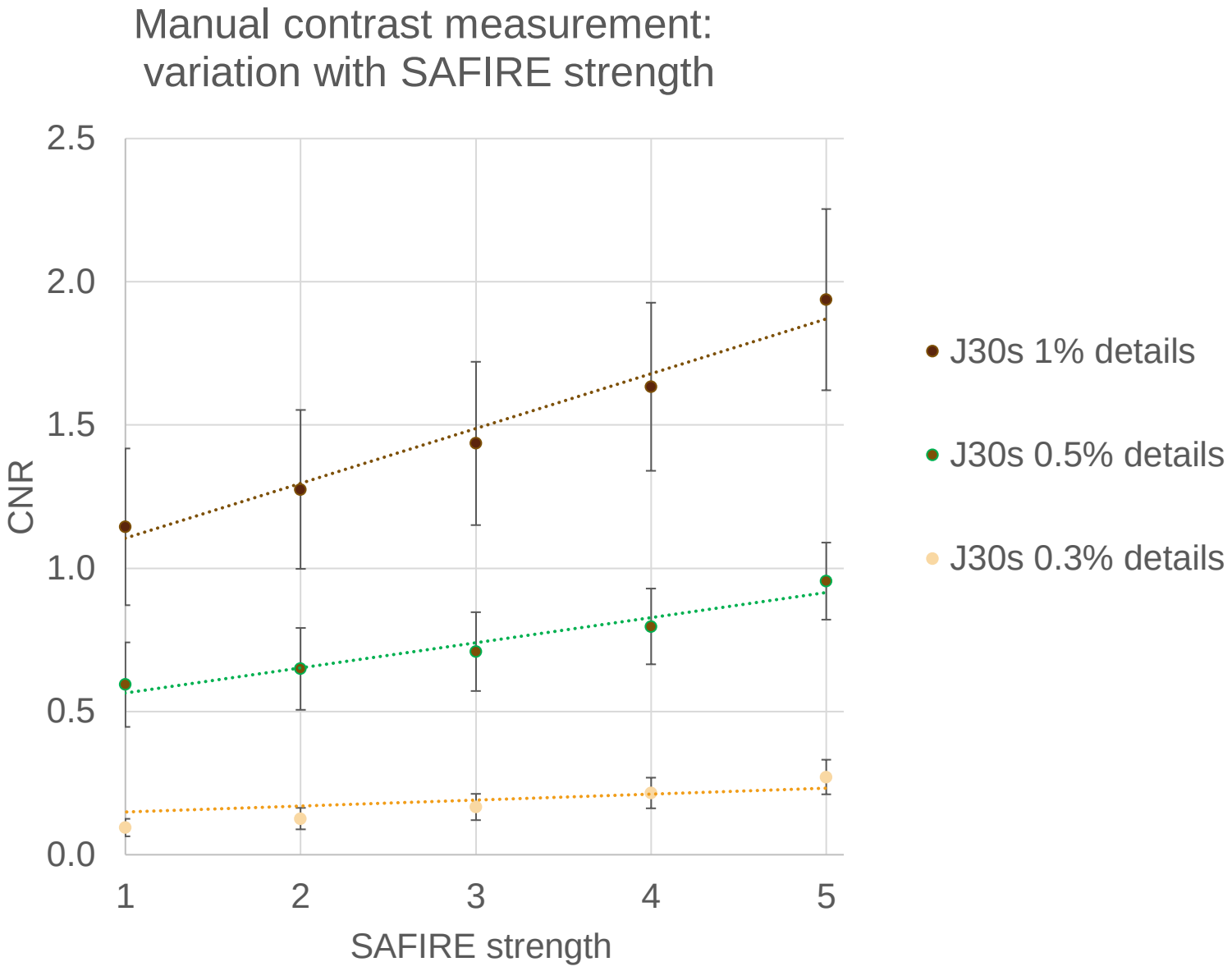
$$d'^2 = \frac{\left[\int\int |W(u,v)|^2 \cdot \mathrm{TTF}^2(u,v) \cdot E^2(u,v)\,du\,dv\right]^2}{\int\int |W(u,v)|^2 \cdot \mathrm{TTF}^2(u,v) \cdot \mathrm{NPS}(u,v) \cdot E^4(u,v)\,du\,dv}$$

W(u,v) = task function	Describes the target object (size and contrast) that we are trying to image Fourier transform of the idealised object with this size and contrast.
TTF(u,v) = Task transfer function	Spatial resolution, ability of system to reproduce object detail in image FT of LSF of the target object
NPS(u,v) = Noise power spectrum	Describes noise across image
E(u,v) = frequency response of eye	Describes human observer and viewing conditions (e.g. magnification)

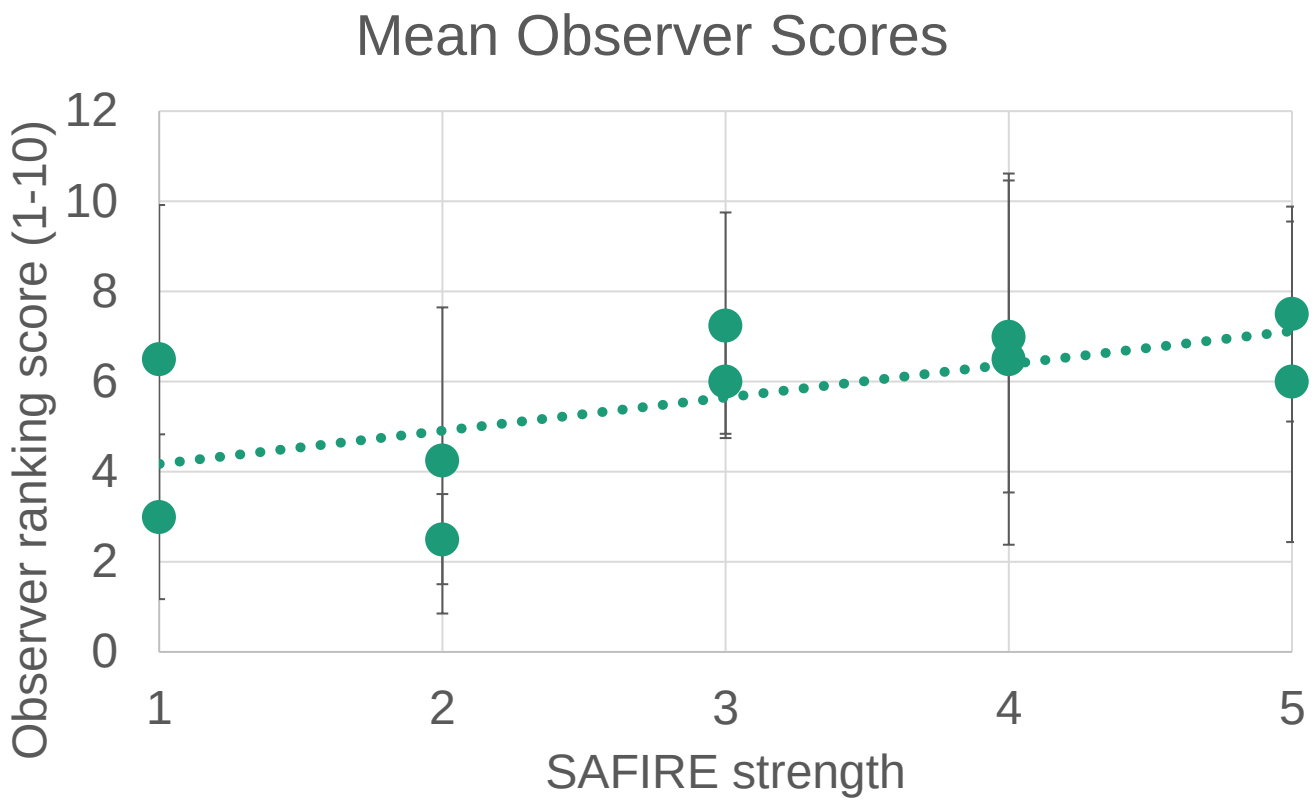
Characteristic image quality of a third generation dual-source MDCT scanner: Noise, resolution, and detectability

Med. Phys. 42 (8), August 2015 **Solomon, J., Wilson, J. and Samei, E**

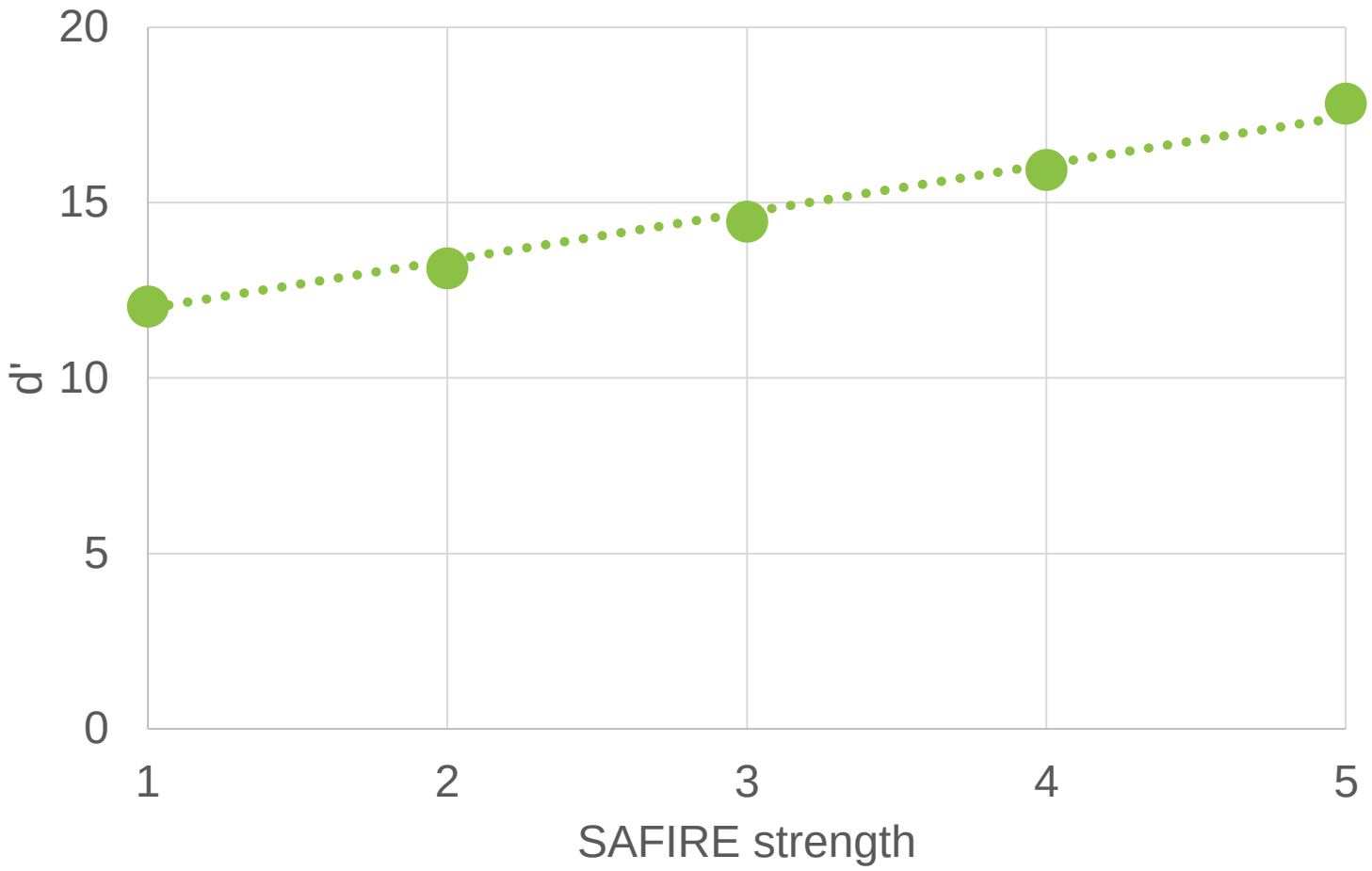
Manual measure of contrast



Observer ranking



Initial detectability index results



Validation

Observer study aiming to validate ability to detect objects with d’

Two alternative forced choice method

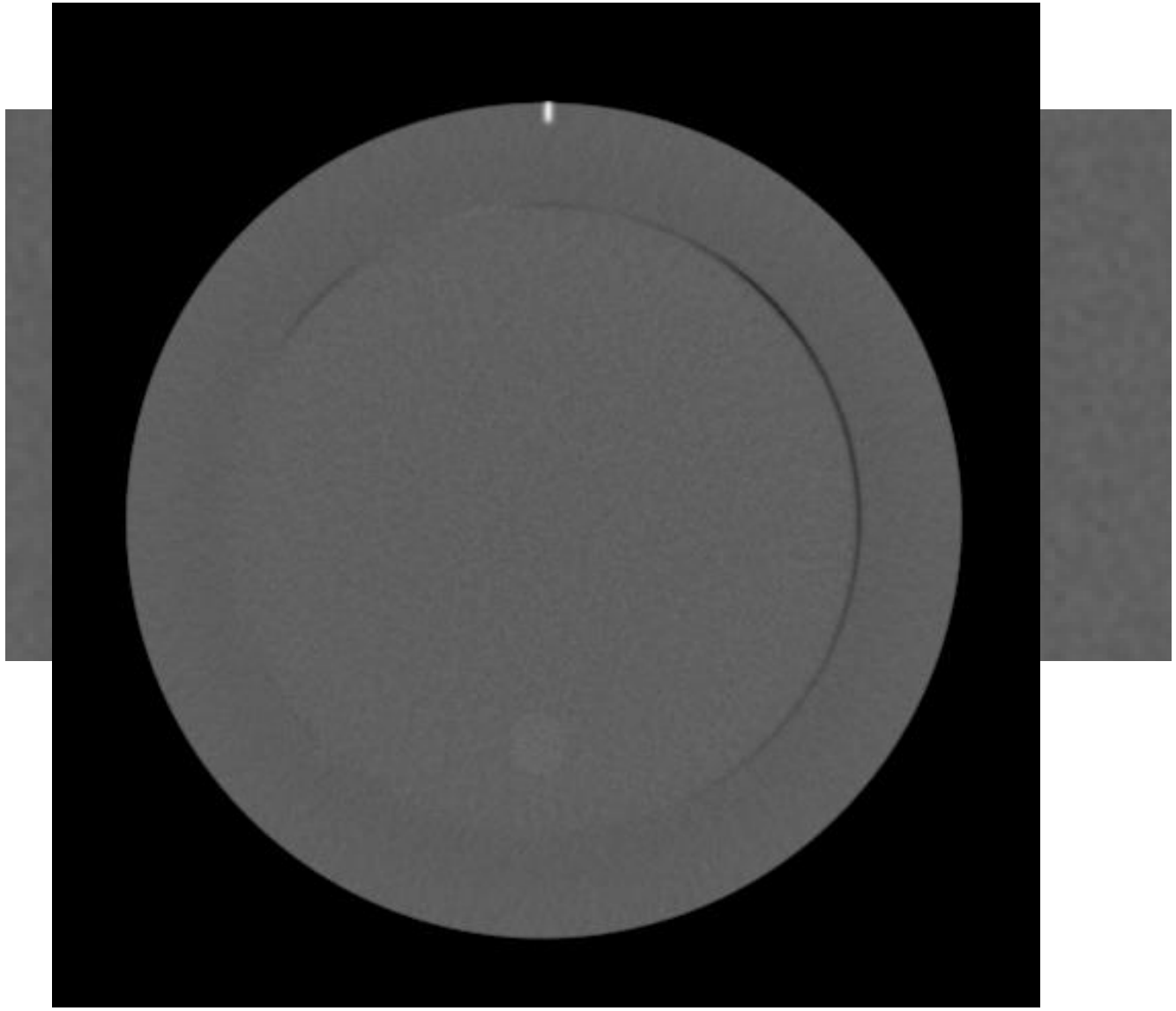
- is lesion in image A or B?

Are lesions of ‘task’ contrast and size detectable by real observers?

Add target object into images

Random positions

Contrast range above and below target value

Diameter above and below target value

Simply added lesions